NPTEL Course on

Mathematics in India: From Vedic period to Modern times

Lecture 40

Mathematics in Modern India 2

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Rediscovering the Tradition (1900-1950)

Several important texts of Indian mathematics and astronomy were published in the period 1900-1950.

Harilal Dhruva published the *Rekhāgaṇita*, translation of Euclid from Tusi's Persian version (Bombay 1901).

Vindhyesvari Prasad Dvivedi published some of the ancient *siddhāntas* in *Jyotiṣasiddhānta-saṅgraha* (Benares 1912).

Babuaji Misra edited the *Khaṇḍakhādyaka* of Brahmagupta with Āmarja's commentary (Calcutta 1925) and *Siddhāntaśekhara* of Śrīpati with Makkibhaṭṭa's commentary (Calcutta 1932, 47).

Padmakara Dvivedi, edited *Gaṇitakaumudī* of Nārāyaṇa Paṇḍita in two volumes (1936, 1942).

Gopinatha Kaviraja edited the *Siddhāntasārvabhauma* of Munīśvara, 2 Vols. (Benares 1933, 3); 3rd Vol. Ed. by Mithalal Ojha (Benres 1978)

Kapadia edited the *Gaṇitatilaka* of Śrīdhara with commentary (Gaekwad Oriental Series 1935)

Rediscovering the Tradition (1900-1950)

Several important works were published from the Ānandāśrama Pune: *Karaṇakaustubha* of Kṛṣṇa Daivajña (1927), *Līlāvatī* with commentaries of Gaṇeśa Daivajña and Mahīdhara (1937), *Bījaganita* with Kṛṣṇa Daivajña's commentary (1930), *Siddhāntaśiromaṇi Gaṇitādhyāya*, with commentary of Gaṇeśa (1939, 41), *Kuṭṭākāraśiromaṇi* of Devarāja (1944), *Mahābhāskarīya* with Parameśvara's commentary (1945), *Laghubhāskarīya* with Parameśvara's commentary (1946), *Laghumānasa* with Parameśvara's commentary (1952). *Siddhāntaśiromaṇi, Golādhyāya*, with Munīśvara's commentary (1943, 52).

Several important works of Kerala School were published from Tiruvanantapuram: *Goladīpikā* of Parameśvara, ed. by T. Ganapati Sastri (1916), Āryabhaṭīyabhāṣya of Nīlakaṇṭha in 3 Volumes, ed. by K. Sambasiva Sastry and S. Kunjan Pillai (1930, 31, 57), *Karaṇapaddhati* of Putumana Somayājī, ed. by K. Sambasiva Sastri (1937), *Tantrasaṅgraha* of Nīlakaṇṭha with *Laghuvivṛti* of Śaṅkara ed. by S. Kunjan Pillai (1957).

Rediscovering the Tradition (1900-1950)

Malur Rangacharya (1861-1916), a science graduate from Madras Christian College who later became Professor of Sanskrit at Presidency College, edited *Gaṇitasārasaṅgraha* of Mahāvīra along with English translation and notes (Madras 1912). This was the first detailed exposition of an Indian mathematical work after Colebrooke's translation of Brahmagupta and Bhāskara in 1817.

Prabodh Chandra Sengupta (1876-1962), a Professor of Mathematics at Bethune College, Calcutta, published several technical articles on Indian mathematics and astronomy highlighting the distinct nature of Indian methods as compared with the Greek methods. He published a translation of *Āryabhaṭīya* (1927) and a translation of *Khaṇḍakhādyaka* with detailed notes and examples (Calcutta 1934). Later, he also edited *Khaṇḍakhādyaka* with Pṛthūdaka's Commentary (Calcutta 1941). He also wrote on *Ancient Indian Chronology* (1947)

Rediscovering the Tradition (1900-1950)

Attippattu A. Krishnaswami Ayyangar (1892-1953) was educated at Pachaiyappa college, Madras, and later worked as a Professor of Mathematics at Maharaja's College, Mysore. He published several articles bringing out many of the technical aspects of Indian Mathematical tradition. In a series of articles (1929-1942), he showed that the $Cakravāla$ process always leads to a solution of the $Vargaprakṛti$ equation and also that $Cakravāla$ in fact corresponds to a semi-regular continued fraction expansion which is a contraction of the simple continued fraction associated with the Euler-Lagrange method of solution.

Bibhutibhusan Datta (1888-1958) passed MSc in Mixed Mathematics in 1914, and was awarded a research scholarship at Calcutta University. However, right form an young age, Datta had an inclination for $Sanyāsa$, the life of renunciation. He was initiated by Swami Vishnu Tirtha Maharaja in 1920. After receiving the DSC degree of Calcutta University for his thesis on hydrodynamics in 1921, Datta became interested in History of Mathematics under the influence of Prof. Ganesh Prasad.

Rediscovering the Tradition (1900-1950)

During the period 1926-35, Datta published over fifty papers on various aspects of Indian Mathematics. He also collected and studied a large number of manuscripts. All of this led to the preparation of the monumental *History of Hindu Mathematics.*

Datta resigned from Professorship of Calcutta University in 1929, “in aspiration of the life of a Vedantist residing in the Brahman, the Infinite Self”, as he mentioned in a letter to Prof. Karpinsky in 1934. In 1931, he briefly returned to the University and, in deference to the wishes of Prof. Ganesh Prasad, delivered a series of lectures which were published as *The Science of Sulba* (1932). In 1933, he retired from the University and in 1938 took up $Sanyāsa$ and became Swami Vidyaranya. He spent most of his later life at Pushkara in Rajasthan. In this period he wrote several scholarly volumes in Bengali on Indian Philosophy. It is said that, prior to leaving the University in 1929, Datta handed over the manuscript of the book *History of Hindu Mathematics: A Source Book,* to his junior colleague Avadhesh Narayan Singh. The latter saw through the publication of two volumes (Arithmetic and Algebra) in 1935 and 1938.

Rediscovering the Tradition (1900-1950)

Avadhesh Narayan Singh (1901-1954) went on to initiate the study of Indian mathematics at Lucknow University. He died in 1954 without completing the publication of the third volume of the Datta and Singh *magnum opus*, which was to cover the history of 'geometry, trigonometry, calculus and various other topics such as magic squares, theory of series and permutations and combinations' as noted in the preface of the first volume.

The third volume was not included even when the book was reprinted in 1961. It seems that, prior to his death in 1958, Swami Vidyaranya gave the manuscript of the third volume to Kripa Shankar Shukla. A copy was also obtained by R. C. Gupta in 1979 from S. N. Singh, the son of A. N. Singh. Shukla later published a revised version of the third volume in the form of a series of seven articles in the Indian Journal of History of Science during 1980-1994.

Ramavarma Maru Thampuran published, in collaboration with Akhileswarayyar, the Mathematics section of $Yuktibhāṣā$ (in Malayalam) of $\mathrm{Jyeṣṭhadeva}$, along with detailed mathematical notes in Malayalam (Trichur 1948). This formed the basis of all later work on $Yuktibhāṣā$.

Rediscovering the Tradition (1950-2010)

Indian National Commission for History of Science was constituted by the Indian National Science Academy in 1965. The Commission actively promotes research on History of Science in India.

In 1971, the Academy published *A Concise History of Science in India* (1971), a landmark publication in the field, edited by D. M. Bose, S. N. Sen and B. V. Subbarayappa. In 2009, Subbarayappa brought out a revised edition with substantial additions.

In 1966, the Academy started the *Indian Journal of History of Science,* which has been very successful and is counted amongst the premier Journals of India.

Cadambattur Tiruvenkatacharlu Rajagopal (1903-1978) taught in Madras Christian College, and later joined the Ramanujan Institute in 1951. He worked on series and summability. In series of seminal papers, published from around 1944 onwards, Rajagopal and his students, K. Mukunda Marar, A. Venkataraman, T. V. Vedamurthi Aiyar and M. S. Rangachari, brought to light, for the first time, the full technical details of the proofs contained in $Yuktibhāṣā$ and other seminal works of the Kerala School.

Rediscovering the Tradition (1950-2010)

Chickamagalur Narayana Iyengar Srinivasa Iyengar (1901-1972) obtained MSc at Calcutta and taught at Mysore, Bangalore and Dharwar. His research on differential equations earned him a DSc in 1932 from Calcutta University. Keenly interested in the history of mathematics, he published the $Gaṇitaśāstrada\text{-}caritre$ in Kannada (1958), and the *History of Ancient Indian Mathematics* in 1967. He supervised the thesis of Dhulipala Arka Somayaji on *A critical Study of Ancient Indian Astronomy* in 1971. Somayaji later published a translation of $Grahagaṇita$ portion of $Siddhāntaśiromaṇi$ along with mathematical notes.

Tekkath Amayankoth Kalam Saraswati Amma (1918-2000) worked with V. Raghavan in Madras University and then taught at Ranchi and Dhanbad. Her thesis work led to the publication of the first authentic and comprehensive study of *Geometry in Ancient and Medieval India* (1979). She supervised the thesis of R. C. Gupta on *Trigonometry in Ancient and Medieval India.*

Rediscovering the Tradition (1950-2010)

Samarendra Nath Sen (1918-1992) was a graduate in Physics and served as Registrar of Indian Association for Cultivation of Science. During 1947-49 he was with UNESCO and came under the influence of Joseph Needham. In 1950s He wrote a two volume $Vijñāner\ Itihāsa$ in Bengali. Sen was an active member of the INSA Commission on History of Science.

In 1966 Sen brought out *A Bibliography of Sanskrit Works in Astronomy and Mathematics* (with assistance from A. K. Bag and S. R. Sarma). Sen and Bag published a translation of the $Śulvasūtras$ in 1983. Sen also edited, with K. S. Shukla, a volume on the *History of Astronomy in India* (1985).

Rediscovering the Tradition (1950-2010)

Kripa Shankar Shukla (1918-2009) obtained his MSc from Allahabad University, and joined the Department of Mathematics Lucknow University. In 1955, he obtained his PhD degree under the supervision of A. N. Singh, for his thesis on *Bhāskara I and His Works.* This led to his landmark editions and translations of *Mahābhāskarīya* (1960) and *Laghubhāskarīya* (1963), and edition of *Āryabhaṭīyabhāṣya* (1976) of Bhāskara I.

Shukla has brought out editions (and translations) of several other seminal texts such as *Sūryasiddhānta* with Parameśvara's commentary (1957), *Pāṭīgaṇita* (1959), *Dhīkoṭidākaraṇa* (1969), *Bījagaṇitāvataṃsa* (1970), *Āryabhaṭīya* (with K. V. Sarma in 1976), *Karaṇaratna* (1979), *Vaṭeśvara-siddhānta* in two volumes (1985,86), and *Laghumānasa* (1990).

Shukla also edited the *History of Astronomy in India* with S. N. Sen (1985). During 1980-1994, he also edited and published, as a series of articles, the various chapters of the unpublished third volume of Datta and Singh's *History of Hindu Mathematics*.

Rediscovering the Tradition (1950-2010)

Krishna Venkatesvara Sarma (1919-2005) did his MA in Sanskrit in Trivandrum, and later joined the *New Catalogus Catalagorum* Project with V. Raghavan at Madras University. Soon he embarked on his life-long pre-occupation with Kerala Astronomy and edited the important works *Grahacāranibandhana* of Haridatta, *Siddhānta-darpaṇa* of Nīlakaṇṭha, *Veṇvāroha* of Mādhava and *Goladīpikā* of Parameśvara. During this period, Sarma worked with the renowned scholar T. S. Kuppanna Sastri, in the edition of *Vākyakaraṇa* (1962).

Sarma shifted to the Visvesvaranand Institute at Hoshirapur, where he served as director during 1975-80. During this period, he published more than 50 books, including several important works such as *Dṛggaṇita* of Parameśvara, *Golasāra* of Nīlakaṇṭha, *A History of the Kerala School of Hindu Astronomy,* *Līlāvatī* of Bhāskarācārya with *Kriyākramakarī* of Śaṅkara, *Tantrasaṅgraha* of Nīlakaṇṭha with *Yuktidīpikā* of Śaṅkara, *Jyotirmīmāṃsā* of Nīlakaṇṭha and *Gaṇita-yuktayaḥ*.

Rediscovering the Tradition (1950-2010)

In 1983 Sarma returned to Madras, and continued his work actively till his very death in 2005. His important publications during this period include: *Indian Astronomy: A Source Book* with B. V. Subbarayappa (1985); *Pañcasiddhāntikā* of Varāhamihira, based on his work with T. S. Kuppanna Sastri (1993); and his *magnum opus,* the edition and translation of *Yuktibhāṣā*, which appeared in 2008, along with notes by K. Ramasubramanian, M. S. Sriram and M. D. Srinivas.

Radha Charan Gupta (b.1935) studied in Lucknow University and did his PhD with Saraswathi Amma at Ranchi. He served as Professor of Mathematics at the Birla Institute of Technology, Ranchi. With his extraordinary passion for history of mathematics, Gupta has investigated almost all aspects of Indian mathematics. He has published nearly 500 papers on history of mathematics. He founded the Journal *Gaṇita Bhāratī* in 1979, which has played a major role in promoting research on history of mathematics in India. Gupta was awarded the prestigious K. O. May Prize in the History of Mathematics in 2009.

Rediscovering the Tradition (1950-2010)

Amulya Kumar Bag (b.1937) worked with S. N. Sen from the time of inception of the INSA Commission. He has also been associated with the *Indian Journal of History of Science* all through and has contributed significantly to the Journal's success. Bag has published an overview of *Mathematics in Ancient and Medieval India* (Benares 1981) and has also translated $\acute{S}ulvas\bar{u}tras$ with S. N. Sen.

George Gheverghese Joseph was born in Kerala, but spent much of childhood in Africa and later shifted to England. He has been in the forefront of the debate against Euro-centricism in the history mathematics. His book *The Crest of the Peacock: Non-European Roots of Mathematics,* first published in 1991, drew wide acclaim and was translated to several languages. The third edition has appeared in 2011. Recently, Joseph has also written *A Passage to Infinity: Medieval Indian Mathematics from Kerala and its Impact* (2009).

Rediscovering the Tradition (1950-2010)

Among the prominent mathematicians associated with the Tata Institute of Fundamental Research, Kopparambil Balagangadharan (1922-2012), Ramiengar Sridharan (b.1935) and Shrikrishna Gopalrao Dani (b.1947) have done significant work also on Indian mathematical tradition.

Balagangadharan has analysed the work of Kerala School on infinite series; Sridharan has studied the Indian work on algebra and the combinatorial techniques developed in the Indian texts on prosody and music. Dani has investigated the geometrical and algebraic techniques in $\acute{S}ulvasūtra$-s.

P. P. Divakaran (b.1936) of the School of Physics TIFR has been working on various conceptual issues relating to development of calculus in the work of the Kerala mathematicians.

Rediscovering the Tradition (1950-2010)

Recently, there have been many important books published on Indian Mathematics and astronomy. They include:

- The translations of $Grahalāghava$ (2006) and $Karaṇakutūhalam$ (2008) with notes by S. Balachandra Rao and S. K. Uma
- C. K. Raju, *The Cultural Foundations of Mathematics* (2007)
- H. Selin and R. Narasimha (ed), *Encyclopaedia of Classical Indian Sciences* (2007)
- B. V. Subbarayappa, *The Tradition of Astronomy in India* (2008)
- S. R. Sarma, *The Archaic and the Exotic: Studies in the History of Indian Astronomical Instruments* (2008)
- J. V. Narlikar (ed), *Science in India* (2009)
- C. S. Seshadri (ed), *Studies in the History of Mathematics* (2010)
- $Tantrasaṅgraha$, Translated with Explanatory Notes by K. Ramasubramanian and M. S. Sriram (2011).
- T. K. Puttaswamy, *Mathematical Achievements of Pre-modern Indian Mathematicians* (2012)

Modern Scholarship on Indian Mathematics (1900-2010)

George Rusby Kaye (1866-1929) was the Principal of Government Training College, Allahabad and a member of Bureau of Education at Simla. He wrote monographs on Indian mathematics, tracing most of it to foreign influences. Some of his books are: *Indian Mathematics* (1915), *The Astronomical Observatories of Jaising* (1918), *Hindu Astronomy* (1924) and *The* $Bakhsh\bar{a}l\bar{\imath}$ *Manuscript* (1927).

A. Burk edited the $\bar{A}pastamba\ \acute{S}ulvas\bar{u}tra$ with a German translation (1901-2). Walter Eugene Clark, a Professor of Sanskrit at Harvard, translated the $\bar{A}ryabhaṭ\bar{\imath}ya$ (Chicago 1930). J. M. van Gelder edited and translated the $M\bar{a}nava\ \acute{S}ulvas\bar{u}tra$ (1961-3).

Otto Edward Neugebauer (1899-1990) was born in Austria, studied mathematics in Gottingen, and later shifted to the study of Egyptian, Babylonian and Greek exact sciences. In 1939 he moved to the US and founded the History of Mathematics Department at Brown University in 1947. During 1952-67 he published several papers on Indian Astronomy highlighting issues of transmission. He has translated the *Astronomical Tables of al Khwarizmi* (1962) and $Pañcasiddh\bar{a}ntik\bar{a}$ with Pingree (1970).

Modern Scholarship on Indian Mathematics (1900-2010)

"Tamil Astronomy": In 1952, Neugebauer wrote a paper on "Tamil Astronomy" where he suggested that the $vākya$ methods of computation outlined in Warren's $Kālasaṅkalita$ (1825) are indicative of an earlier "Tamil tradition" in astronomy. Van der Waerden also wrote a paper on "Tamil Astronomy" in 1956. Neugebauer's work was cited by S. Chandrasekhar in his Nehru Memorial Lecture on "Astronomy in Science and Human Culture" (1968). Now, it is well established that the $vākya$ method goes back to $\mathrm{Vararuci}$ and major improvements were made in it by the Kerala School. As, Pingree was to later write on the $vākya$ methods: "...misnamed 'Tamil', they generated some interest among non-Indian astronomers in 1950s and 60s".

David Edwin Pingree (1933-2005): After completing his PhD in Harvard in 1960 on "Transmission of Greek Astrology to India" under the guidance of D. H. H. Ingaals, Pingree worked in University of Chicago. He joined the Brown University Department of History of Mathematics in 1971. He became one of the leading experts on Exact Sciences in ancient and medieval world, with a focus on issues of transmission between cultures.

Modern Scholarship on Indian Mathematics (1900-2010)

Pingree has published around 20 books and over 60 articles on all aspects of $Jyotiḥśāstra$, which include editions of $Pañca$-$siddhāntikā$ (with Neugebauer) $Vṛddha$-$Yavanajātaka$ and $Yavanajātaka$, and a history of $Jyotiḥśāstra$, apart from the volumes of the seminal *Census of Exact Sciences in Sanskrit.* Many of his students have become leading scholars of Indian mathematics and astronomy.

During the period 1970-95, David Pingree brought out five volumes (running to over 1600 pages) of the *Census,* which lists the works of each author together with detailed references to the available manuscripts as listed in various catalogues. Detailed notices are also given about the publications of these works and secondary studies on them.

Modern Scholarship on Indian Mathematics (1900-2010)

French Scholars of Indian Mathematics: Leon Rodet, studied the Algebra of Al Khwarizimi in relation to Greek and Indian methods (1878). He also translated the $Gaṇitapāda$ of $Āryabhaṭīya$ (1879). Louis Renou (1896-1966) and Jean Filliozat (1906-1982) were major scholars of Sanskrit Grammar, Philosophy and Sciences.

Roger Billard (1922-2000) wrote *L'Astronomie Indiene* (1971) where he tried to use computational and statistical methods to date the Indian texts.

Recently, Karine Chemla (b.1957) has worked on the inter-relation between Chinese and Indian mathematical methods. Her student, Agathe Keller has published a translation of the $Gaṇitapāda$ of $Āryabhaṭīyabhāṣya$ of $\mathrm{Bhāskara}$ I with detailed notes (2006).

Francois Patte has worked on $\mathrm{Bhāskara}$'s $Līlāvatī$ and $Bījagaṇita$ and their commentaries.

Modern Scholarship on Indian Mathematics (1900-2010)

Japanese Scholars of Indian Mathematics: Kiyosi Yabuuti (1906-2000), the doyen of Japanese scholars on history of science, had written on the relation between the Chinese text *Chiu-Chih Li* and Indian astronomy in 1963. Micho Yano, Takao Hayashi (b.1949) and Takanori Kusuba (b. 1952) have written several papers on Indian mathematics and astronomy. They have published a book *Studies in Indian Mathematics, Series Pi and Trigonometry* in Japanese (1997) and, along with S. R. Sarma, they have translated $Gaṇitasārakaumudī$ of Ṭhakkura Pherū (2011).

Hayashi has edited and translated the $Bakhshālī$ Manscript (2005), which was his thesis work supervised by Pingree. He has also edited and translated the $Bījagaṇita$ of Bhāskara with $Vāsanā$ (2009) and $Kuttākāraśiromaṇi$ of Devarāja (2012). Takanori Kusuba and Setsuro Ikeyama were also Pingree's students and have worked on $Gaṇita$-$kaumudī$ and $Brāhmasphuṭa$-$siddhānta$. Yukio Ohashi has worked on Indian astronomical instruments under the guidance of K. S. Shukla.

Modern Scholarship on Indian Mathematics (1900-2010)

There have been several important works, which have been published recently, which include significant material on Indian mathematics and astronomy. These include:

- Helaine Selin (ed), *Encyclopedia of Science Technology and Medicine in Non-Western Cultures* (2008);
- van Brummelen, *The Mathematics of the Heavens and the Earth* (2009)
- Kim Plofker, *History of Mathematics in India* (2010);
- Clemency Montelle, *Chasing Shadows, Mathematics Astronomy and Early History of Eclipse Calculation* (2010).

Development of Higher Education in India (1900-1950)

	1901-2	1921-22	1936-37
Universities	5	10	15
Number of Students			9,697
Arts Colleges	145	165	271
Number of Students	17,651	45,418	86,273
Professional Colleges	46	64	75
Number of Students	5,358	13,682	20,645
Secondary Schools	5,493	7,530	13,056
Number of Students	6,22,768	11,06,803	22,87,872
Primary Schools	97,854	155,017	1,92,244
Number of Students	32,04,336	61,09,762	102,24,288
Special Schools	1,084	3,344	5,647
Number of Students	36,380	120,925	2,59,269
Total Recognised Institutions	1,04,627	1,66,130	2,11,308
Number of Students	38,86,493	73,96,560	128,88,044

Note: 1901-2 figures include Burma and some Indian States, while 1921-22 and 1936-37 figures are for British India only.

Development of Scientific Research in India (1900-1950)

The Indian Institute of Science was established in 1909 with munificent donations from the endowment created by Jamshedji Nusserwanji Tata (1839-1904) and the Government of Mysore.

The Indian Science Congress Association was initiated by two British Chemists, Profs. J. L. Simonsen and P. S. Macmohan. The first Science Congress was held in Calcutta in January 1914 with Sir Asutosh Mukherjee as the President.

Development of Scientific Research in India (1900-1950)

The Indian Academy of Sciences was founded by Chandrasekhara Venkata Raman (1888-1970) in Bangalore in 1934 with 65 Fellows, with the aim of promoting the progress and upholding the cause of science, in both pure and applied branches. It has currently about 1060 Fellows.

The Indian National Science Academy was started as the National Institute of Sciences in Calcutta in 1935 with 125 Fellows with the object of promoting science in India and harnessing scientific knowledge for the cause of humanity and national welfare. Sir Lewis Fermor was the founder president (1935-36); Meghnad Saha (1893-1956) became the first Indian President in 1937. The Academy shifted to Delhi in 1951.

“An Indian Academy of Science”

In an unsigned editorial entitled *“An Indian Academy of Science”* that he wrote in the *Current Science* in May 1933, C. V. Raman highlighted the importance of building a national scientific community and associated institutions such as academies, journals etc. for fostering scientific research in India.

Since many of these issues remain relevant even today, we present a few extracts from Raman’s editorial:

> “It is true that individual scientific workers in India have by their indefatigable industry achieved great distinction for themselves, but the prestige of both official and non-official research is still slow in attaining that status of international importance reached by most European countries. This unsatisfactory position is in our opinion partly due to the tendency of many scientific men to export their more important contributions for publications in foreign journals, with a proportionate impoverishment of Indian archives.”

“An Indian Academy of Science”

“Perhaps if the resources of an all-India journal such as we contemplate in connection with the Academy of Science, had been available for giving Indian scientific work suitable international publicity, the outflow of memoirs from this country would have been more restrained and less voluminous.”

“Continuance of this practice will retard the process of building up a scientific tradition for India and keep her in a position of semi-dependence in the world of science.”

“While the foundation of the scientific reputation of a country is established by the quality of work produced in its institutions, the superstructure is reared by national journals which proclaim their best achievements to the rest of the world.”

“An Indian Academy of Science”

“Manifestly the edifice of science in India is incomplete. If scientific contributions from countries which possess national journals are also sent abroad, let it be remembered that they represent a surplus, broadcasting the embellishments of their own national organizations.”

“It is true that the spirit of science and its service are international, but is it not also true that every nation has its own Academies, learned societies magazines and journals? ”

“India will have to organize and develop her national scientific institutions before she can enter into the comity of international scientists.”

“The achievements of Indian science are national assets, and an Academy which treasures and displays them collectively is assured of providing the necessary guidance and inspiration for the younger generation to put forth greater exertions in order to enrich and widen the usefulness of this great estate.”

Development of Modern Mathematics in India (1910-1950)

Syamdas Mukhopadhyaya (1866-1937) was A student of Presidency College, he proved the famous “four-vertex theorem” in global differential geometry in the Bulletin of the Calcutta Mathematical Society in 1909. He continued to be a major contributor to the Journal for several decades.

Ganesh Prasad (1876-1935) studied in Cambridge and Gottingen and taught at Allahabad, Benares (1905-1923), and Calcutta Universities. He worked on potential theory and summability. His two volume work *Some Great mathematicians of the Nineteenth Century* (1933) was a landmark publication in the history of mathematics.

K. Ananda Rau (1893-1966) was a student of Hardy at the time Ramanujan was in Cambridge and served as a Professor at Presidency College, Madras, from 1919. He was an outstanding analyst and teacher of many prominent Indian mathematicians.

Development of Modern Mathematics in India (1910-1950)

Prasanta Chandra Mahalonobis (1893-1972), was a contemporary of Ramanujan at Cambridge. He founded the Indian Statistical Institute in 1931, the first institute devoted to Mathematics research in modern India. The Journal $Sa\acute{n}khya$ was started in 1933. Mahalanobis was elected an FRS in 1945.

Ramaswamy S. Vaidyanathaswamy (1894-1960) was a student of E. T. Whittaker and H. F. Baker. He served as a Professor at Madras, from 1927. He worked on lattice theory and topology. He served as the editor of the *Journal of Indian Mathematical Society* during 1927-1950. He wrote a pioneering *Treatise on Point Set Topology* (1947).

Raj Chandra Bose (1901-1987) was also associated with the Indian Statistical Institute. He did important work on design theory and error correcting codes. He migrated to the United States in 1947.

Development of Modern Mathematics in India (1910-1950)

Subbayya Sivasankaranarayana Pillay (1901-1950) was a student of Ananda Rau and worked in the Annamalai University during 1929-41. He is well known for his work on the Waring problem in number theory. He also worked on Diophantine approximation.

Tirukkannapuram Vijayaraghavan (1902-1955) was a student of Hardy at Oxford during 1925-28 when he did notable work on summability. He later joined André Weil at Aligarh University during 1930-32 and moved on to Dhakka. He did important work on nonlinear differential equations and Diophantine approximation. He was the first Director (1950-55) of the Ramanujan Institute of Mathematics set up with the munificence of Alagappa Chettiar in Madras.

Subbaramaiah Minakshisundaram (1913-1968), a student of Ananda Rau at Madras, he later specialised in partial differential equations. He worked at Andhra University at Visakhapatnam. His work on the eigen-functions of Laplace operator in Riemannian Manifolds is highly acclaimed.

Development of Modern Mathematics in India (1950-2010)

Harish Chandra (1923-1983): One of the most distinguished mathematicians from India in modern times, Harish Chandra did his Masters in Physics at the University of Allahabad. During 1943-45 he worked with Bhabha at the Indian Institute of Science.

In 1945, he left for Cambridge University to work with the renowned theoretical physicist P. A. M. Dirac and was awarded PhD for his work on the Lorentz group in 1947.

During his stay at the Princeton Institute of Advanced Study in 1947-49, Harish Chandra shifted to mathematics. He taught at Columbia University during 1950-1963 and returned to the Institute of Advanced study in 1963, where he served as IBM von Neumann research Professor.

Development of Modern Mathematics in India (1950-2010)

Harish Chandra is considered to be a pioneer in the area of Harmonic analysis of Lie groups. Robert Langlands wrote in an article on Harish Chandra that

> "He was considered for the Fields Medal in 1958, but a forceful member of the selection committee in whose eyes Thom was a Bourbakist was determined not to have two. So Harish Chandra, whom he also placed on the Bourbaki camp, was set aside."

Harish Chandra was elected an FRS in 1973, the second Indian to be so honoured in the field of Mathematics after Ramanujan. Harish Chandra took up US citizenship in 1980. Soon thereafter, in 1981, he was elected a Fellow of the US National Academy of Sciences.

Development of Modern Mathematics in India (1950-2010)

The Indian Statistical Institute and the Tata Institute of Fundamental research have been the premier research institutions in India in Mathematics.

Indian Statistical Institute, which was founded in 1933 by P. C. Mahalanobis, produced many distinguished statisticians and mathematicians.

Calyampudi Radhakrishna Rao (b.1920), the renowned statistician, was a student of the Andhra and Calcutta Universities. Rao acquired his PhD degree working with R. A. Fisher at King's College, London, in 1948. He joined the ISI and later served as its Director. Rao is well known for many outstanding contributions such as Cramer-Rao bound and Rao-Blackwell theorem. There have been a number of well known mathematicians and statisticians who have been his students. He was made an FRS in 1967. Since 1978, Rao has been a distinguished professor at many US universities.

Development of Modern Mathematics in India (1950-2010)

Srinivasa Ranga Iyengar Varadhan (b.1940) was a student of Rao at ISI. After obtaining his PhD degree in 1963, Varadhan shifted to the Courant Institute in New York. Varadhan is known for his highly acclaimed work on diffusion processes and large deviations. Varadhan was elected a Fellow of the US Academy of Sciences in 1995 and he became FRS in 1998. He won the coveted Abel Prize, the first Indian to do so, in 2007.

Development of Modern Mathematics in India (1950-2010)

The Tata Institute of Fundamental Research was founded in 1945 at the initiative of Homi Bhabha (1909-1966) with the help of Sir Dorabji Jamshedji Tata Trust.

Komaravelu S. Chandrasekharan (b. 1920), a student of Ananda Rau at Madras, was with the Princeton Institute of Advanced Study when he was invited by Bhabha to organise the School of Mathematics at TIFR. Chandrasekharan is known for his work on the complex variables and multiple Fourier series. Chandrasekharan left TIFR in 1965 and is currently professor emeritus at ETH Zurich. TIFR School of mathematics produced many eminent mathematicians.

Development of Modern Mathematics in India (1950-2010)

Three members of the School of Mathematics at TIFR have distinguished themselves by the award of FRS.

Conjeevaram Srirangachari Seshadri (b.1932) was a student of Chandrsekharan at TIFR. He has done highly acclaimed work in algebraic geometry, especially on unitary vector bundles (in collaboration with Narasimhan) and Schubert varieties. He founded the Chennai Mathematical Institute in 1989. He was awarded FRS in 1992.

Mudumbai Seshachalu Narasimhan (b.1932) was a student of Chandrasekharan at TIFR. He has done highly acclaimed work in algebraic geometry. He worked as Head of the Mathematics group at the ICTP during 1992-1997. He was awarded FRS in 1996.

Madabusi Santanam Raghunathan (b.1941) was a student of Narasimhan in TIFR. He has done highly acclaimed work on discrete subgroups of Lie groups. He was awarded FRS in 2000.

Development of Education in India (1950-2010)

Number of Institutions

Year	Primary	Upper Primary	Sec./ Sr.Sec/	Colleges	Universities
1950-51	209,671	13,596	7,416	578	27
1960-61	330,399	49,663	17,329	1,819	45
1980-81	494,503	118,555	51,573	4,722	133
1990-91	560,935	151,456	79,796	5,748	184
2000-01	638,738	206,269	126,047	10152	254
2005-06	772,568	288,493	159,667	16982	350
2010-11	748,547	447,600	200,184	33,023	564

Development of Education in India (1950-2010)

Enrolment in Millions

Year	Primary (I –V)	Middle (VI-VIII)	Sec./Sr.S (IX-XII)	Colleges/Univ
1950-51	**19.2**	**3.1**	1.5	**.40**
1960-61	**35.0**	**6.7**	3.4	**1.05**
1980-81	**73.8**	**20.7**	11.0	**2.75**
1990-91	**97.4**	**34.0**	19.1	**4.93**
2000-01	**113.8**	**27.6**	27.6	**8.40**
2005-06	**132.1**	**52.2**	38.4	**11.03**
2010-11	**135.3**	**62.06**	**51.20**	**16.98**

Low Enrolment and High Dropout Rate at Schools (1950-2010)

Gross Enrolment Ratio

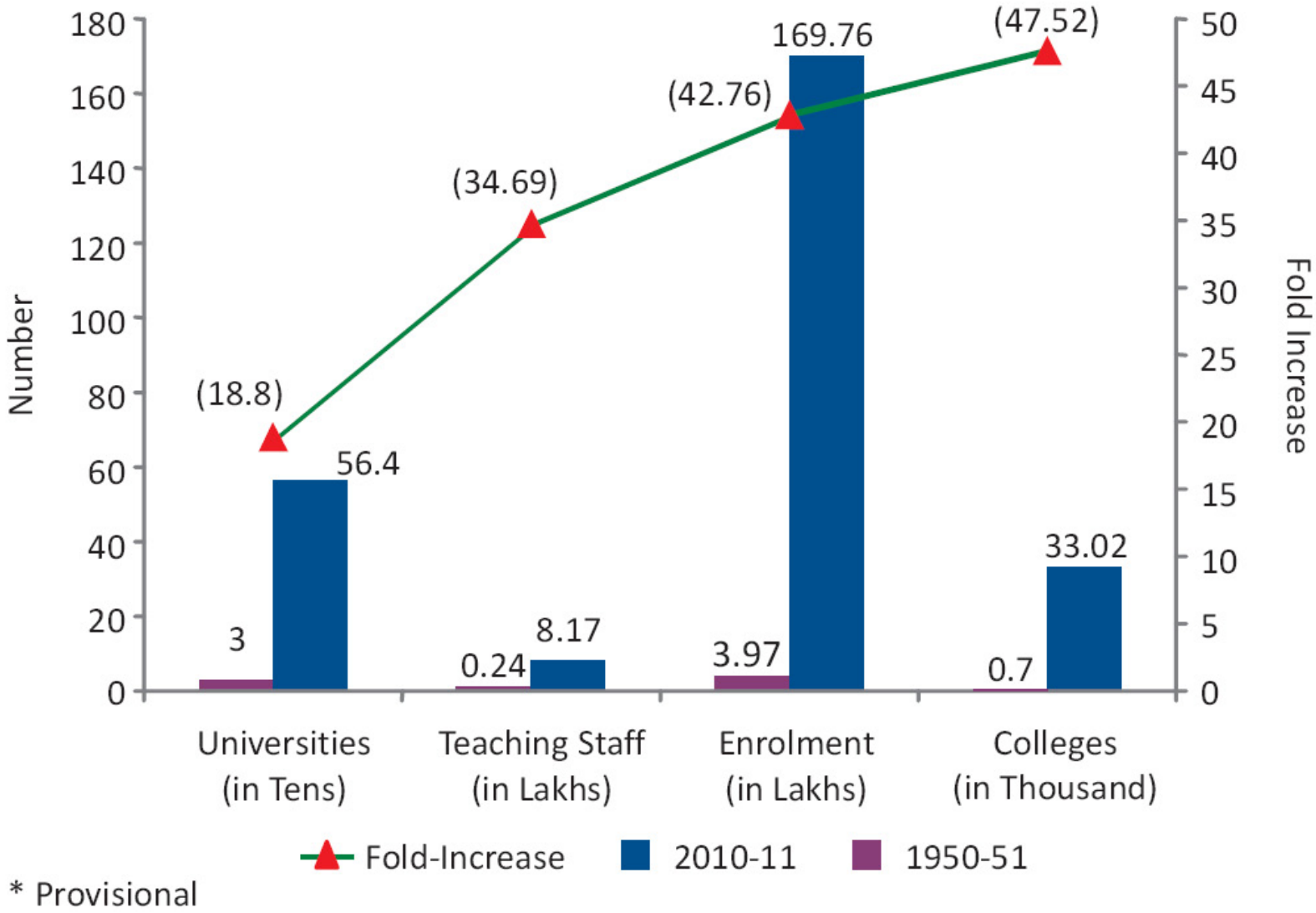
Year	Primary (I-V)			Upper Primary (VI-VIII)			Secondary (IX-XII)		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
1950-51	60.6	24.8	**42.6**	20.6	4.6	**12.7**			
1960-61	82.6	41.4	**62.4**	33.2	11.3	**22.5**			
1980-81	95.8	64.1	**80.5**	54.3	28.6	**41.9**			
2000-01	104.9	85.9	**95.7**	66.7	49.9	**58.6**			
2005-06	112.8	105.8	**109.4**	75.2	66.4	**71.0**			
2010-11	115.4	116.7	**116.0**	87.7	83.1	**85.5**	55.5	48.4	**52.1**

Drop out Ratio

Year	Primary (I-V)			Elementary (I-VIII)			Secondary (I-X)		
	Boys	Girls	Total	Boys	Girls	total	Boys	Girls	Total
1960-61	61.7	70.9	**64.9**	75.0	85.0	**78.3**	N.A	N.A	**N.A**
1980-81	56.2	62.5	**58.7**	68.0	79.4	**72.7**	79.8	86.6	**82.5**
2000-01	39.7	41.9	**40.7**	50.3	57.7	**53.7**	66.4	71.5	**68.6**
2005-06	28.7	21.8	**25.7**	48.7	49.0	**48.8**	60.1	63.6	**61.6**
2010-11	28.7	25.1	**27.0**	40.3	41.0	**40.6**	50.4	47.9	**49.3**

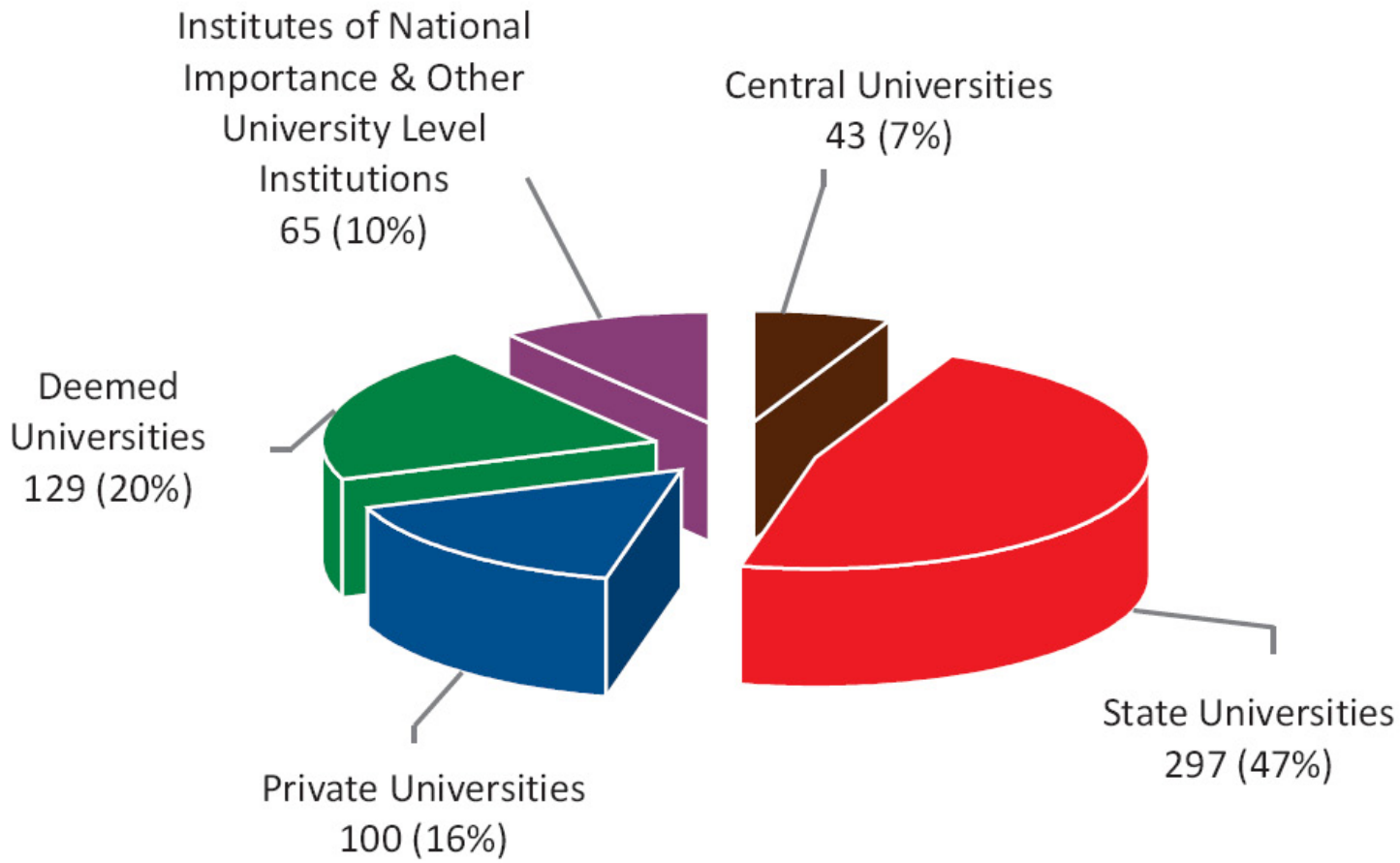
Development of Higher Education in India (1950-2010)

Growth of Higher Education : Universities/Colleges/Students enrolment/Teaching Staff : 1950-51 – 2010-11*

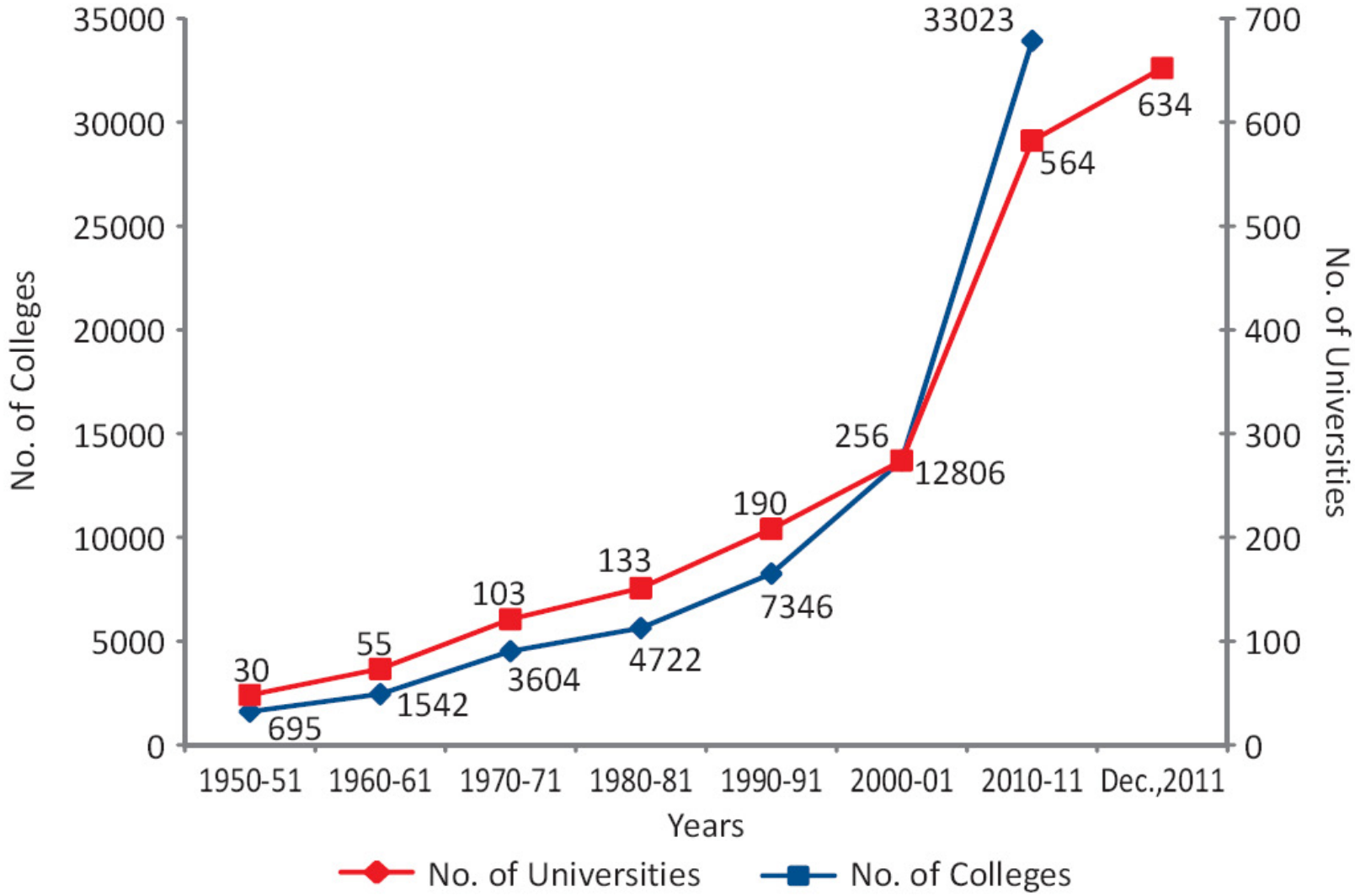


* Provisional

Type-wise Distribution of Degree awarding Universities / University Level Institutions : December, 2011



Growth of Higher Education Institutions



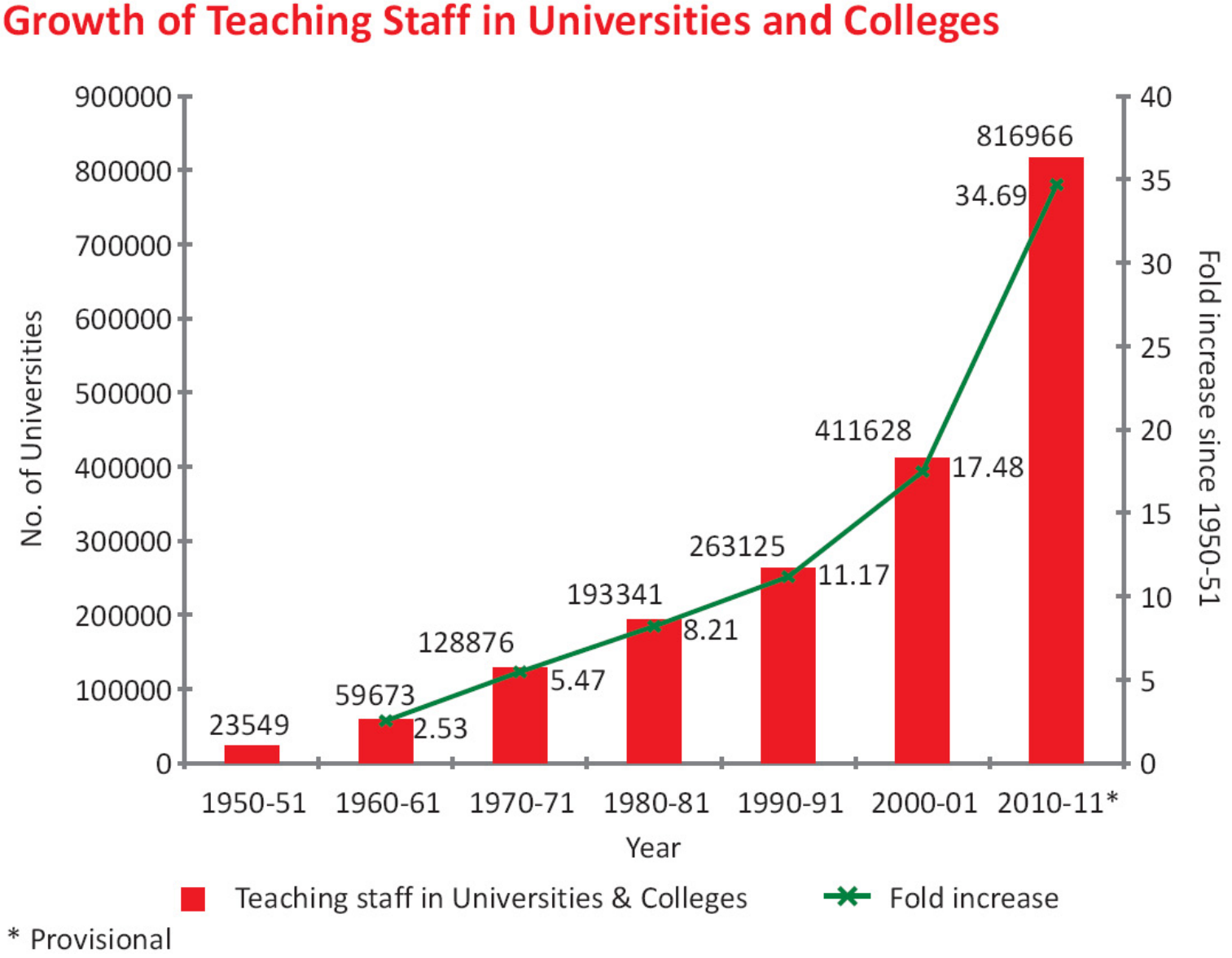
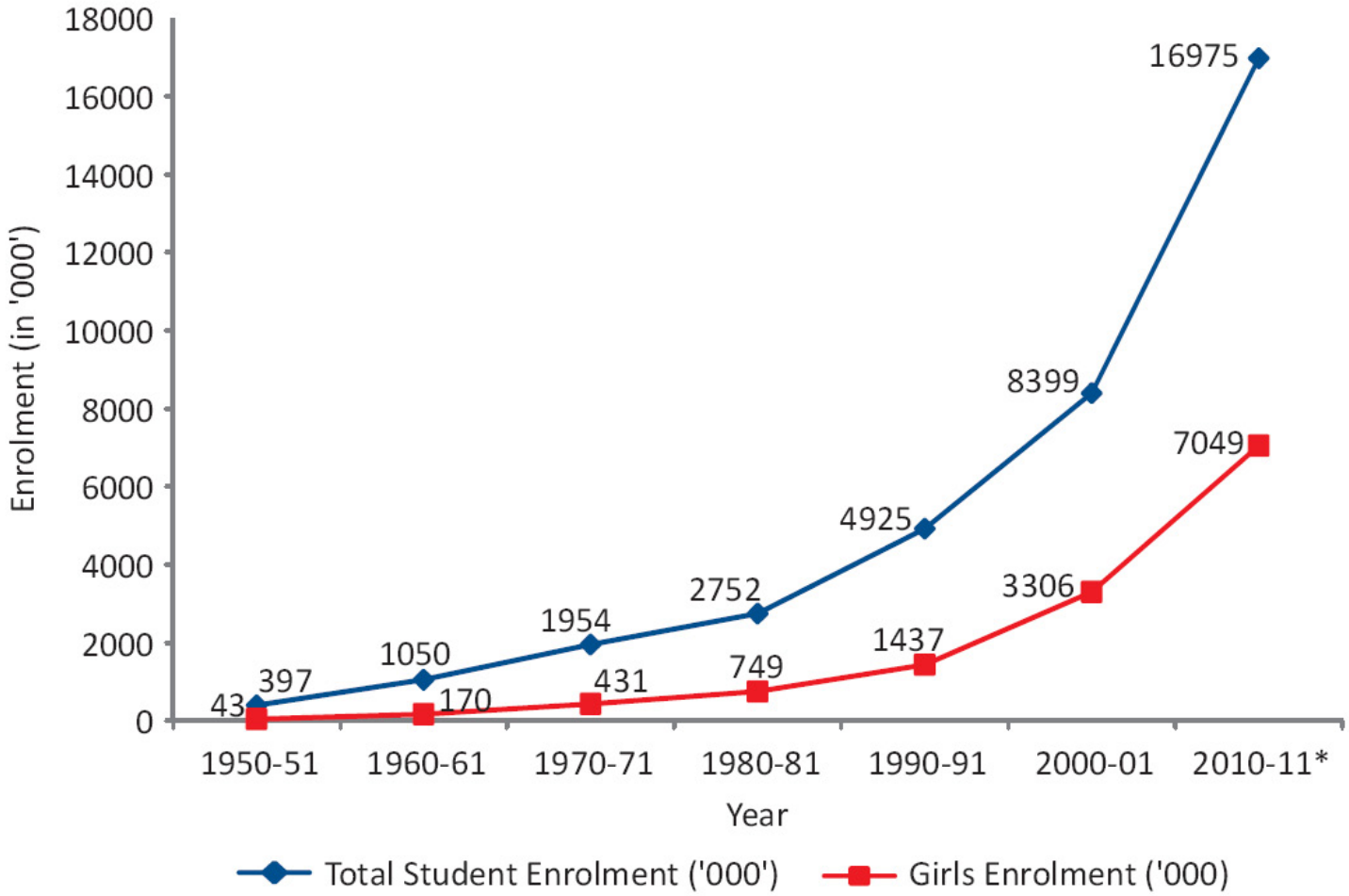


Figure: Source: MHRD for 1950-51 and 1960-61 and UGC for 1970-71 onwards

Growth of Students Enrolment ('000') in Higher Education



**Provisional*

Source : MHRD for 1950-51 & 1960-61 and UGC for 1970-71 onwards

***Coverage :** Figures of students enrolment & teaching staff (1970-71 onwards) pertain to regular courses in Universities & Colleges (excluding Polytechnics, other Diploma awarding Institutions & Non-formal System of Higher Education)*

Halting Growth of Higher Education in India (1980-2010)

The gross enrolment ratio (GER) in higher education (given as a percentage) is the ratio of the number of students studying in colleges and universities to the total population in the age group 18-24.

The GER in higher education in India

Year	1951	1961	1980	2001	2005	2009
GER (%)	0.7	1.4	5	8	11	15

Halting Growth of Higher Education in India (1980-2010)

GER FIGURES FOR 2010[1]

India: 18% (with enrolment of 20.75 million)

China: 26% (with enrolment of 31.05 million). China had a GER of 3% in 1992, which rose to 16% in 2002 and to 20% in 2005.

USA: 76% (with enrolment of 20.4 million)

Russian Federation: 76% (with enrolment of 9.33 million)

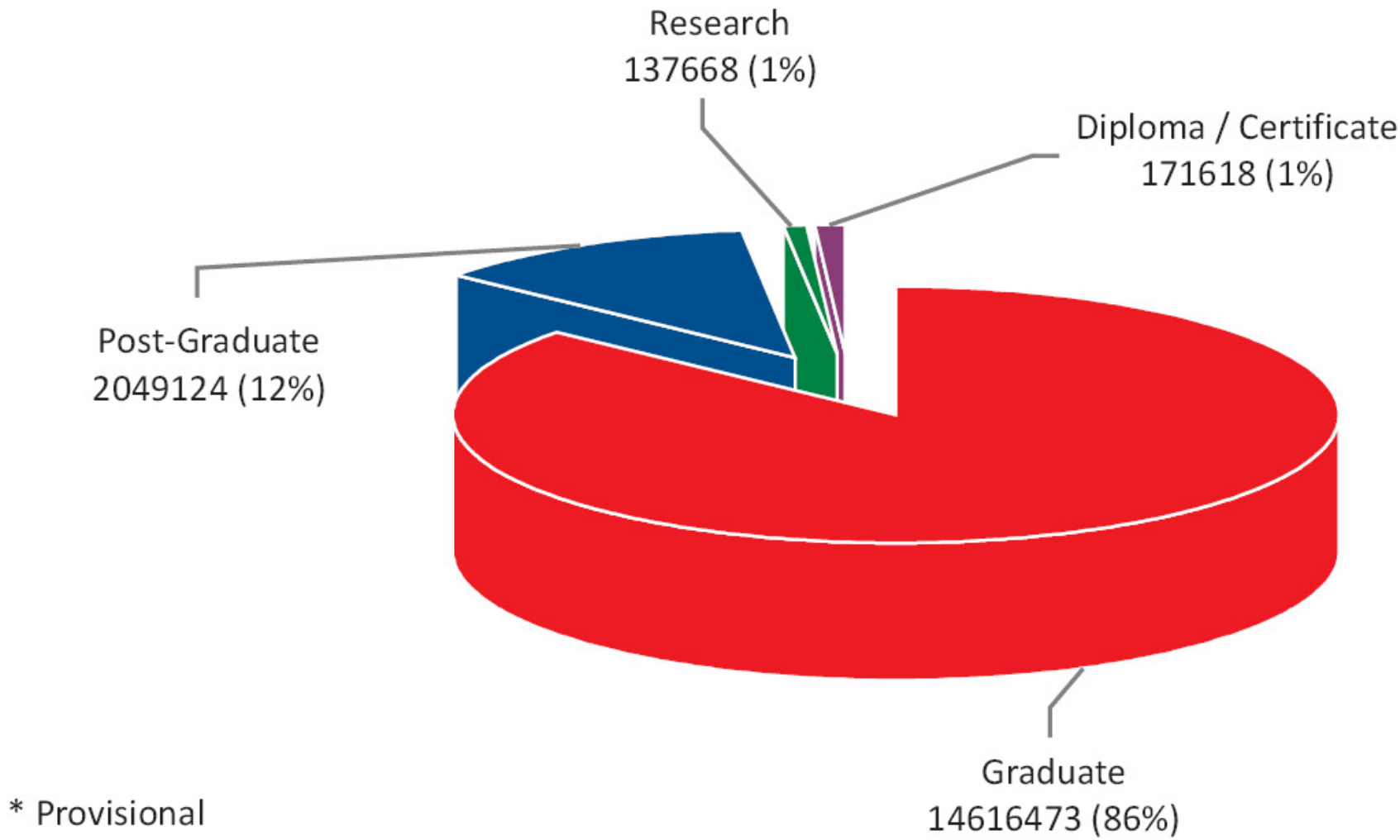
World average: 29% (with enrolment of 177.7 million)

North America and Western Europe: 76%, Latin America and Caribbean 41%

East Asia and Pacific: 29% [Korea 103%, Japan 60%, Thailand 48%, Malaysia 40%, Indonesia 23%, Vietnam 22%]

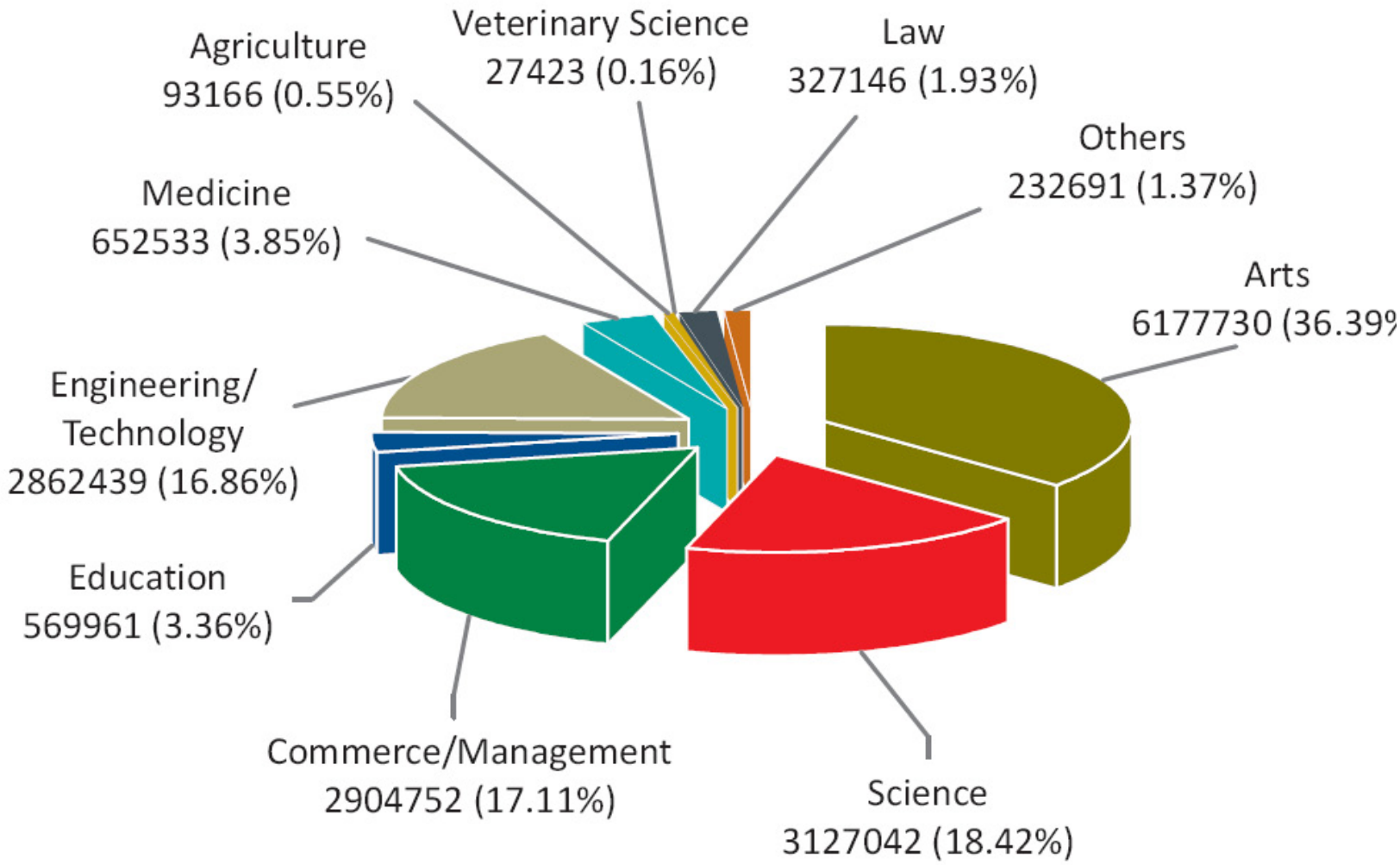
[1] Source: *UNESCO's Global Education Digest (2012)*

Students Enrolment by stages in Higher Education 2010-11*



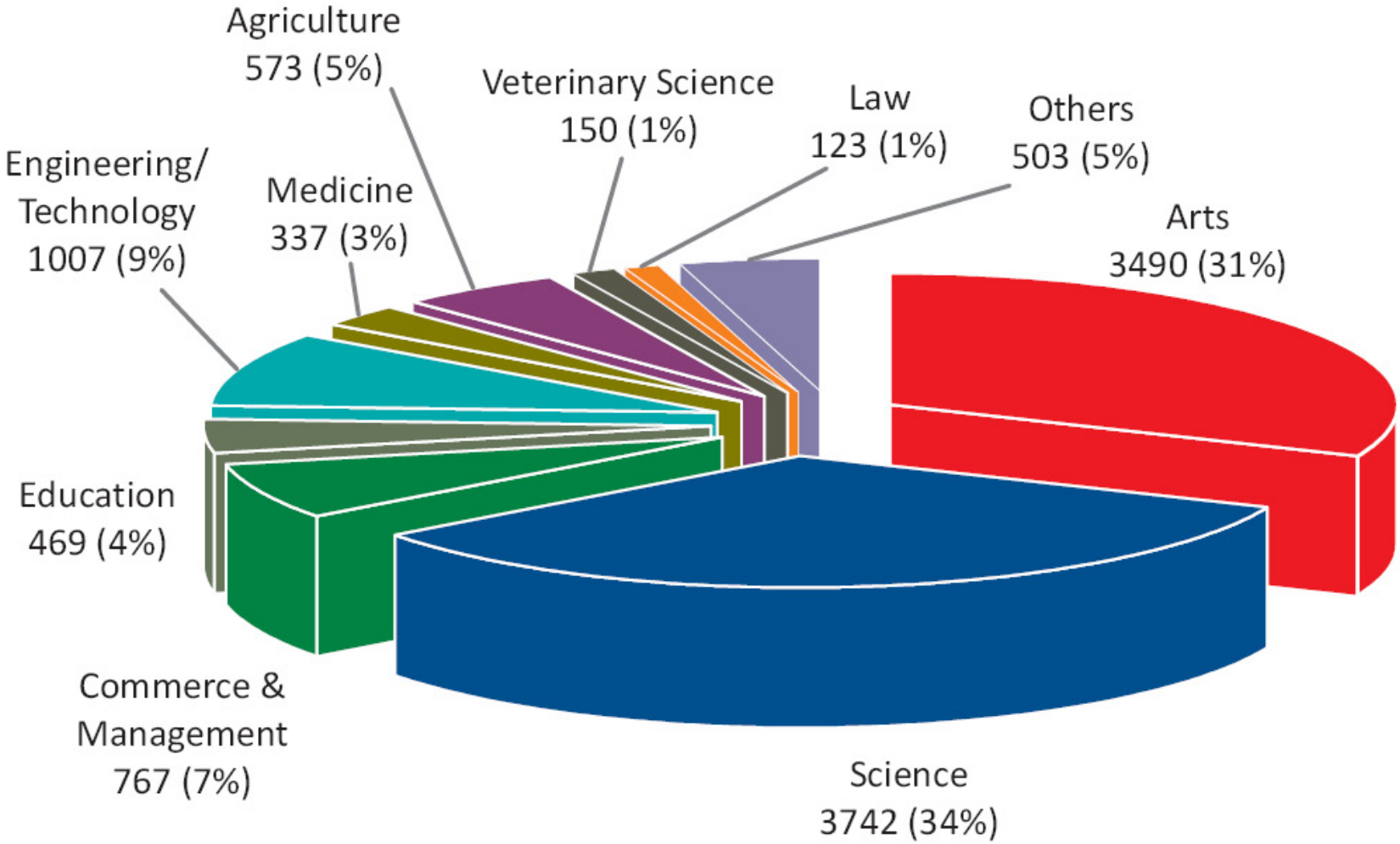
* Provisional

Faculty-wise Students Enrolment in Higher Education 2010-11



* Provisional

Faculty-wise Doctorate Degrees (Ph.D.) awarded during 2009-10*



* Provisional (Data pertains to 305 Universities / University level Institutions, out of 534)

India in the World of Science (1996-2010)

Country	Publications Output			Publications Share		
	1996-10	1996-98	2008-10	1996-10	1996-98	2008-10
USA	5322590	960747	1328564	22.83	27.78	21.21
China	1848727	94875	843949	7.93	2.74	13.48
UK	1533434	249366	393576	6.58	7.21	6.28
Japan	1464273	256624	330106	6.28	7.42	5.27
Germany	1396126	224877	355992	5.99	6.50	5.68
France	1021041	166997	267031	4.38	4.83	4.26
Canada	790397	140124	221833	3.39	4.05	3.54
Italy	762290	112521	211549	3.27	3.25	3.38
Spain	583554	74244	179875	2.50	2.15	2.87
India	533006	63153	185676	2.29	1.83	2.96

India in the World of Science (1996-2010)

Country	Publications Output			Publications Share		
	1996-10	1996-98	2008-10	1996-10	1996-98	2008-10
Australia	520045	68672	160286	2.23	1.99	2.56
Russia Fed	480665	92800	103677	2.06	2.68	1.66
Netherlands	435083	66747	120024	1.87	1.93	1.92
South Korea	430438	34961	152444	1.85	1.01	2.43
Brazil	328361	30163	122383	1.41	0.87	1.95
Switzerland	309549	46209	85268	1.33	1.34	1.36
Taiwan	308498	33210	104939	1.32	0.96	1.68
Sweden	304831	51144	75541	1.31	1.48	1.21
Poland	265139	34592	74501	1.14	1.00	1.19
Belgium	237081	34473	66832	1.02	1.00	1.07
World	23313577	3458215	6262939			

Data from SCOPUS in B. M. Gupta, Ind Jour Sc Tech. 2010, p.2900

India Hailed as a Research "Superpower" in the Third World in 1970's

Analysing the SCI (Science Citation Index) publication data of 1973, and the citation data for 1973-78, Eugine Garfield hailed India as a "Research 'super power' of the Third World":

> "About 353,000 articles are indexed in the SCI [in 1973]... and these articles received two million citations during 1973-78....'First World' countries account for 84% of 1973 articles and 90% of 1973-78 citations....
>
> [Among] the top 25 countries in terms of the number of articles written by their authors, only two Third World countries appear – India and Argentina.

India Hailed as a Research "Superpower" in 1970's

India's rank is significant. It is considered to rank third in the world in the number of researchers behind the US and USSR. But it ranks eighth when we consider the number of articles its researchers authored ...

In fact Indian researchers alone authored half of the 16,000 articles from the Third World. Out of the 93 Third World author countries in the 1973 SCI database, authors from 30 developing countries authored more than 50 papers. ...Clearly India is a research 'superpower' in the Third World. Argentina is a distant second, accounting for ... a fifth of India's output."[2]

[2]E. Garfield, Mapping Science in the Third World, Science and Public Policy, 10, 1983, pp 112-127

India Hailed as a Research "Superpower" in 1970's

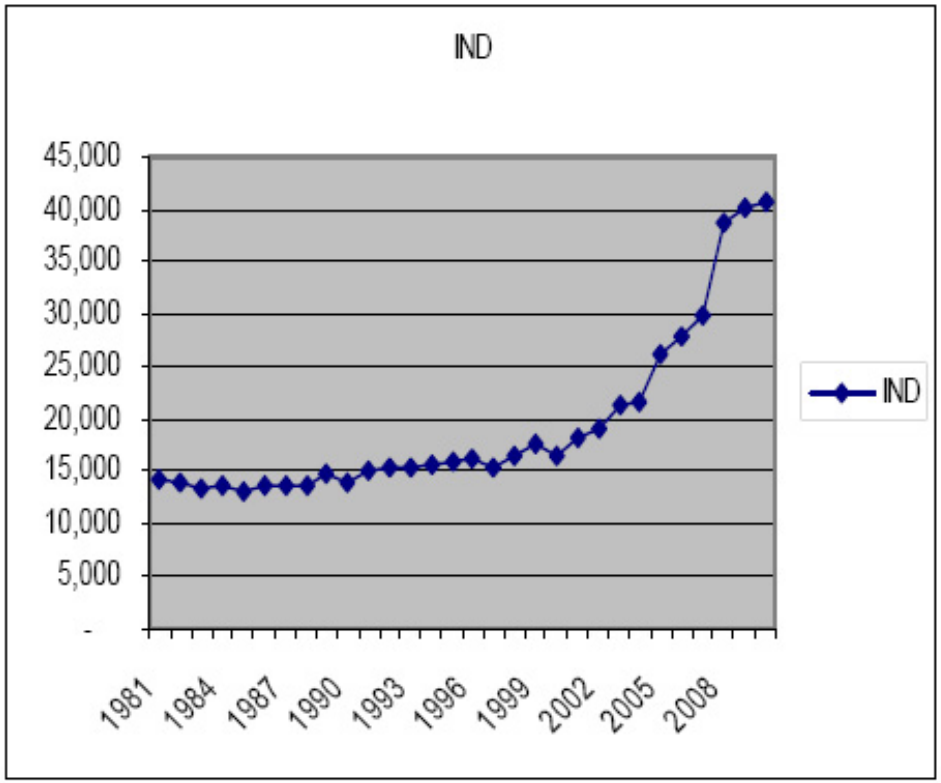
Articles Listed in SCI in 1973 and Citations During 1973-78

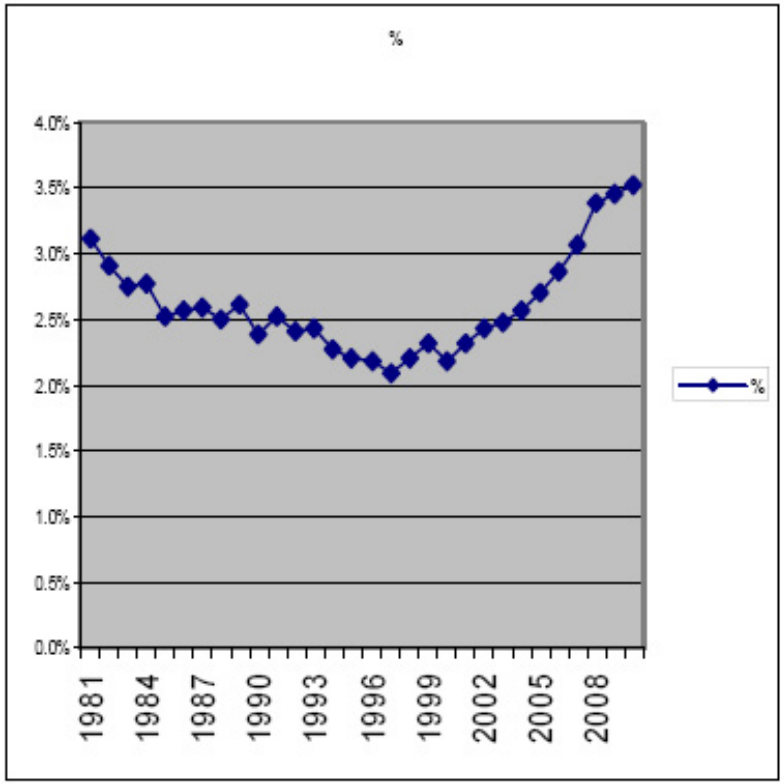
Country	Articles	Citations
US	151,939	1,047,854
UK	32,189	202,600
USSR	24,715	40,455
FRG	20,137	93,233
France	17,707	72,912
Japan	15,569	64,160
Canada	15,362	86,654
*India	7888	15,515
Australia	6985	38,342
Italy	6012	22,276
Sweden	4989	42,078
Switzerland	4483	29,078
Netherlands	4114	28,415
Czechoslovakia	3497	9859
Israel	3199	20,788
Poland	2918	7072
Belgium	2675	12,532
Denmark	2398	18,460
GDR	2344	6401
Hungary	2209	5025
Norway	1850	11,200
Austria	1753	5205
South Africa	1676	5182
Finland	1669	9467
*Argentina	1526	4110

Souce: E. Garfield, Mapping Science in the Third World, Science and Public Policy, 10, 1983, pp 112-127

Halting Growth of Science Research In India (1980-2010)

India: Changing Trends in the Number of Publications and Global share of Publications

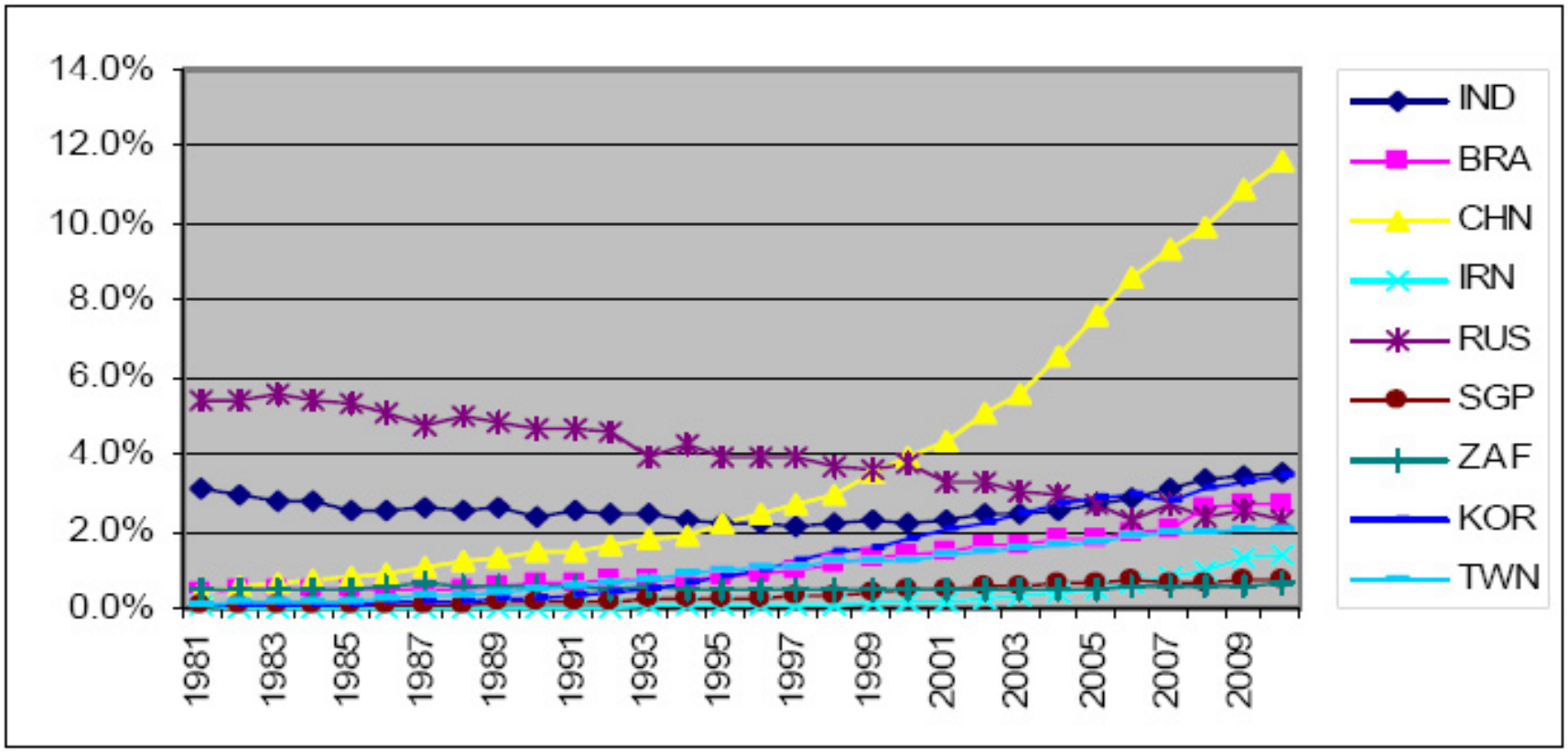




Data based on SCI Databases, cited in DST Bibliometric Study 2012

Halting Growth of Science Research in India (1980-2010)

Changes in global share for select countries 1981-2009



Data based on SCI Databases, cited in DST Bibliometric Study 2012

Halting Growth of Science Research in India

Number of Papers with High Citation: India, China, South Korea, Brazil and Israel 1998-2007

	India*		China*		South Korea*		Brazil*		Israel**	
Year	Papers	A	Papers	A	Papers	A	Papers	A	Papers	A
1998	17,629	101	20,621	165	11,822	96	10,277	92	10,025	339
1999	18,073	92	24,639	190	13,683	134	11,732	93	10,364	307
2000	18,137	109	31,028	255	15,116	165	12,978	83	10,688	294
2001	19,141	113	36,505	267	17,505	160	13,736	83	10,576	274
2002	20,656	90	41,354	336	19,371	156	15,888	92	11,336	231
2003	22,846	91	50,954	314	22,729	137	16,749	81	11,748	201
2004	24,783	67	61,432	264	27,025	118	18,362	65	12,229	143
2005	27,482	51	74,257	229	29,392	80	19,465	65	12,323	111
2006	30,979	34	90,737	81	32,342	45	21,911	34	12,640	69
2007	35,953	10	98,329	41	33,570	23	27,661	19	12,555	20
Total	235,679	758	529,856	2142	222,555	1114	168,759	707	114,484	1989

Column A gives the Number of Papers receiving at least 100 citations,
*Data collected on 22 November 2009
**Data collected on 25 January 2010

Data from Web of Science in M. Madan et al. Current Science, 2010, p.739.

Halting Growth of Science Research in India

Number of Researchers in India, China, US and EU

	Researchers '000s		% world Researchers		Researchers per million inhabitants		GERD per Researcher ('000s ppps)	
	2002	2007	2002	2007	2002	2007	2002	2007
India	115.9	154.8	2.3%	2.2%	111.2	136.9	102.6	126.7
China	810.5	1423.4	13.9%	19.7%	630.3	1070.9	48.4	72.0
USA	1342.5	1425.6	23.1%	20.0%	4566.0	4663.3	206.4	243.9
EU	1197.9	1448.3	20.6%	20.1%	2473.9	2936.4	172.1	182.9

Source: DST Bibliometric Study 2012

Halting Growth of Science Research In India

Table: Number of Ph.D Degrees Awarded in S&T in Select Countries, 1983-2003.

Year	Number of Ph.Ds Produced in S&T								
	India	China	S.Korea	Taiwan	Japan	France	Germany	UK	USA
1983	3886	NA	281	8	2676	NA	4978	2430	19274
1985	4007	125	548	20	3088	NA	5738	2410	19663
1987	4123	218	759	35	3248	NA	6576	2580	20694
1989	4209	1024	984	42	3561	4888	7568	2940	22706
1991	4294	1198	1135	62	3874	5384	10465	3150	25061
1993	4320	1895	1421	97	4438	6829	10200	3030	26640
1995	4000	3417	1920	115	5205	7027	10889	2580	27864
1997	4764	5328	2189	163	6157	8962	11728	3420	28653
1999	5317	6778	2607	150	7082	7054	11984	3670	27339
2000	5395	7304	2865	147	7089	NA	11895	4370	27557
2001	5394	8153	NA	144	7401	NA	11803	4380	27160
2002	5527	NA	3225	NA	7461	NA	11017	4380	26226
2003	6318	NA	NA	202	7581	NA	10796	3780	26891

Source: NSF. Science and Engineering Indicators 2006 Appendix Tables 2.42 and 2.43.

2008: 7982 28439 3716 2005 8017 7710 11314 9470 33369

India In World Mathematics Research (2001-11)

Rank	Ranking by papers		Ranking by citations	
1	USA	74,874	USA	366,539
2	PEOPLES R CHINA	36,146	PEOPLES R CHINA	111,986
3	FRANCE	26,377	FRANCE	106,239
4	GERMANY	21,078	GERMANY	84,647
5	ITALY	15,453	ENGLAND	64,474
6	JAPAN	14,412	ITALY	55,968
7	ENGLAND	13,871	CANADA	54,039
8	CANADA	13,673	SPAIN	44,712
9	RUSSIA	13,614	JAPAN	40,417
10	SPAIN	12,671	AUSTRALIA	28,928
11	POLAND	6,703	RUSSIA	22,986
12	SOUTH KOREA	6,406	ISRAEL	20,517
13	AUSTRALIA	6,259	THE NETHERLANDS	17,348
14	INDIA	5,766	POLAND	16,938
15	ISRAEL	5,427	SOUTH KOREA	16,794
16	BRAZIL	5,175	BELGIUM	16,248
17	TAIWAN	4,169	BRAZIL	16,075
18	THE NETHERLANDS	3,880	SWITZERLAND	14,970
19	BELGIUM	3,807	SWEDEN	14,107
20	TURKEY	3,379	AUSTRIA	13,725
21	SWITZERLAND	3,289	TAIWAN	12,763
22	ROMANIA	3,247	INDIA	11,794
23	SWEDEN	3,219	SCOTLAND	11,145
24	IRAN	3,134	CZECH REPUBLIC	9,395
25	AUSTRIA	3,073	ROMANIA	8,583

Source: Web of Knowledge Database cited in G. Prathap, Curr. Sc., 102, 2012, p. 1349

Halting Growth of Mathematics in India (1980-2000)

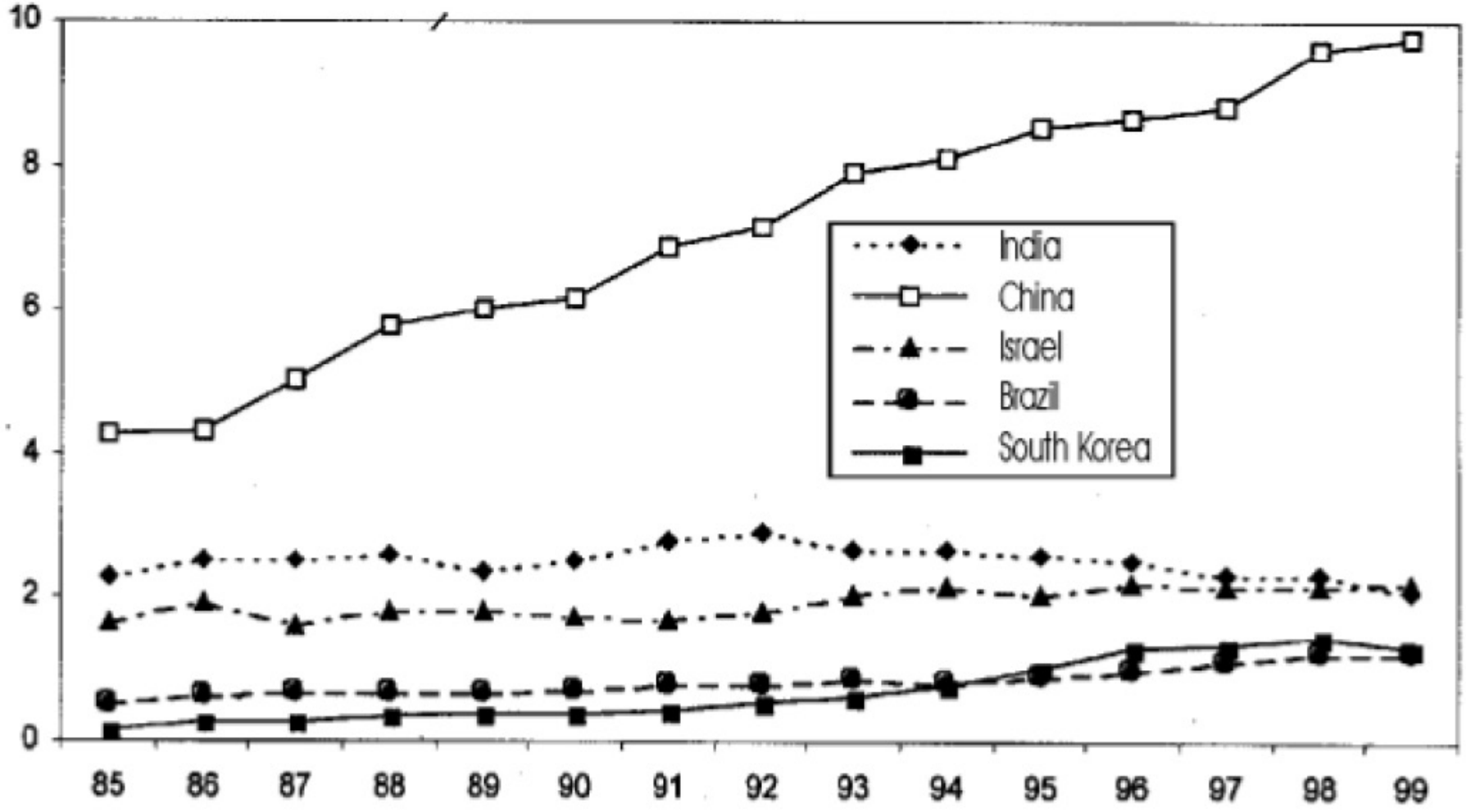
Numbers of Papers Indexed in Mathscinet

	India	China	Israel	Brazil	South Korea	World contribution
1983	826	966	402	158	34	43116
1984	1107	1628	623	235	56	47392
1985	1111	2081	606	258	71	48782
1986	1233	2110	676	303	140	48759
1987	1299	2587	609	341	139	51520
1988	1435	3150	762	362	184	54714
1989	1339	3379	756	373	228	56382
1990	1434	3472	742	406	211	56423
1991	1598	3943	703	449	245	57201
1992	1691	4157	799	466	329	58136
1993	1517	4460	899	480	358	56453
1994	1552	4664	1006	481	454	57421
1995	1589	5197	1024	554	630	60780
1996	1563	5363	1121	601	805	61837
1997	1519	5743	1174	729	862	65024
1998	1541	6357	1170	798	959	66057
1999	1407	6547	1242	827	878	67043
2000	1419	6552	1196	881	977	66885

S. Arunachalam, Curr. Sc.83, 2002, p.253

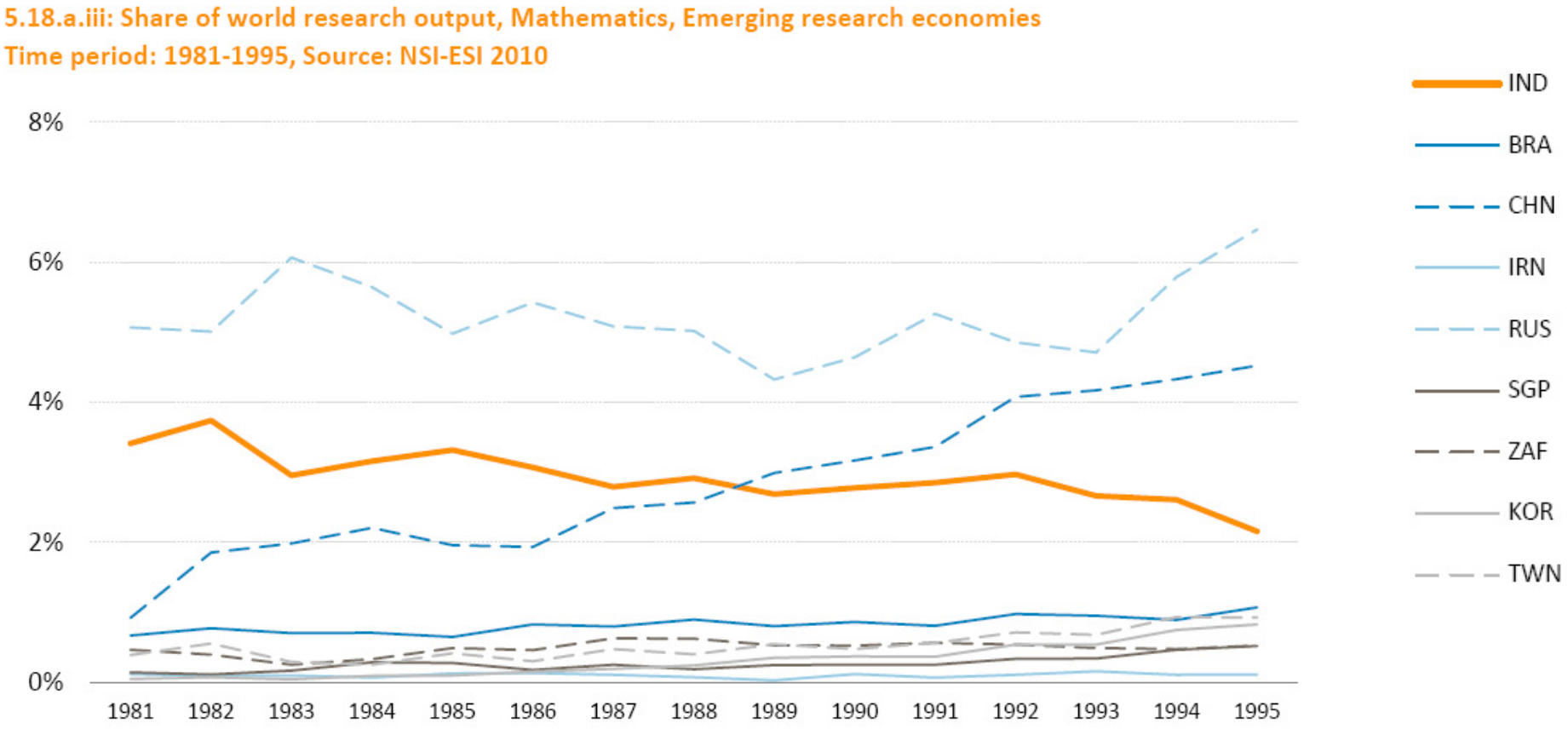
Halting Growth of Mathematics in India (1980-2000)

Share of World Publications in Mathematics 1985-1999



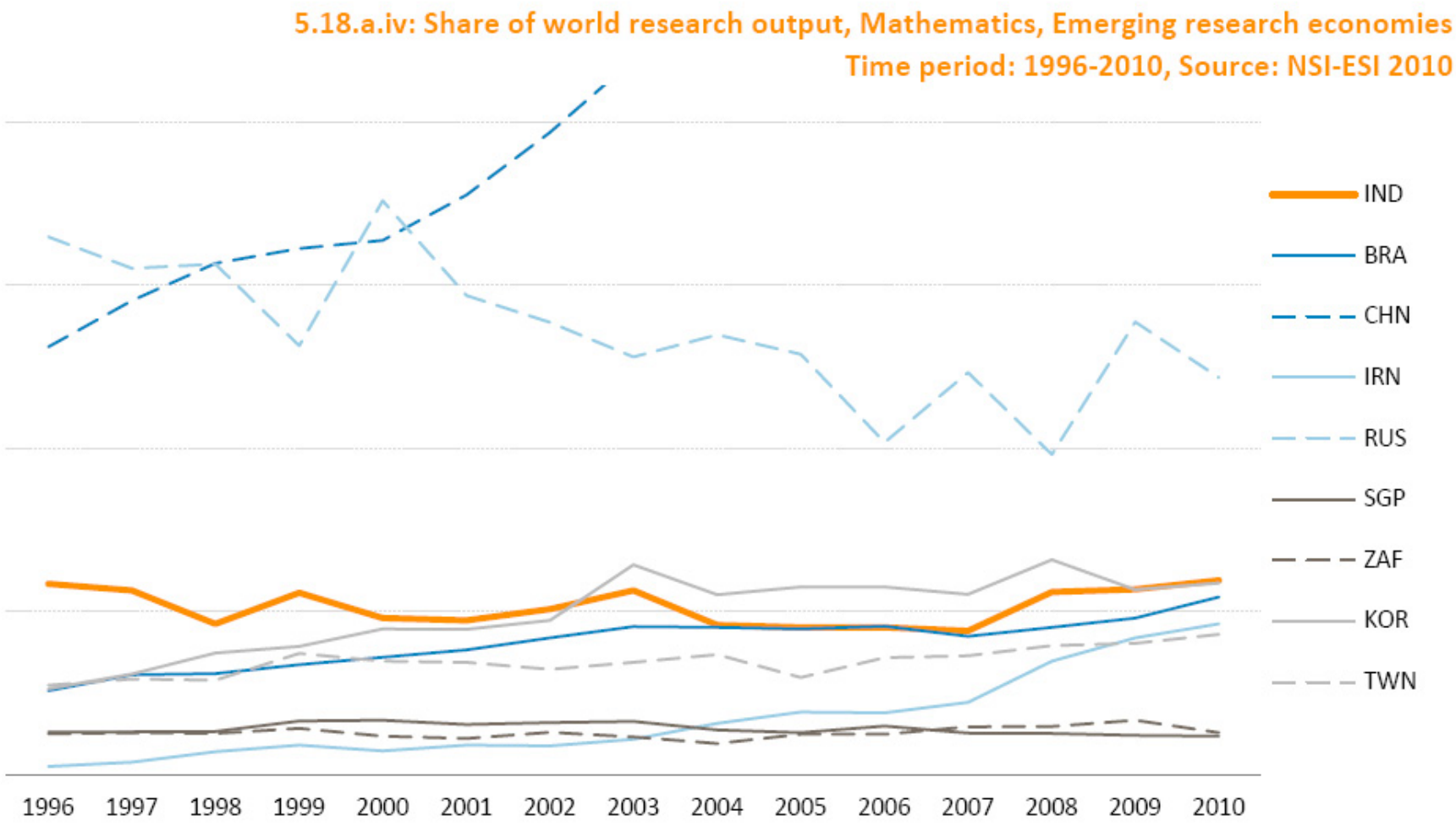
S. Arunachalam, Curr. Sc.83, 2002, p.253.

Halting Growth of Mathematics in India (1980-1996)



DST Bibliometric Study 2012

Halting Growth of Mathematics in India (1996-2010)



DST Bibliometric Study 2012

Halting Growth of Mathematics in India (1980-2010)

Trends during 1981-1995

"India's percentage share of world output fell from over 3% in the early part of this period to just over 2% by 1995.

In the earlier period, the USA ... clearly dominated in terms of its percentage world share of Mathematics research output, although this share declined substantially over the period (from 40.9% in 1981 to 34.4% in 1995). It was followed by Germany in the earlier part of this period, until Germany was overtaken by France from 1993 onwards. The UK's share fell (from 7.3% in 1981 to 6.3% in 1995) and Japan's share also fell. Italy's share increased from 1.5% in 1981 to 4.4% by 1995.

China's rise in Mathematics research began in this period, rising from 0.9% in 1981 to 4.5% by 1995, overtaking India in 1989 and displacing India as second in rank to Russia. Russia's share varied between from above 4% to just above 6% over this period."

DST Bibliometric Study 2012

Halting Growth of Mathematics in India (1980-2010)

Trends during 1996-2010

"India's share of world Mathematics research output was around 2% over this period, and was broadly maintained at these levels.

In this later period, the USA's share of world Mathematics research output... was further eroded from 32.9% in 1996 to 23.6%, ultimately a fall of 17.3% (nearly half) on its 1981 level. France reached a share of 10.8% in 2003, but this fell to 8.8% by 2010. Germany's share also fell from a height of 9.4% in 2000 to 6.6% by 2010. Italy's share continued to rise from its 1981 levels overtaking Japan in 2005.

China in effect trebled its percentage world share of Mathematics research output, from 5.2% in 1996 to 16.7% by 2010. Korea began to overtake India from around 2003 onwards, although by 2009/2010, their world share was equal (2.4% by 2010). Brazil, Taiwan and also notably Iran increased their world share over this period too."

DST Bibliometric Study 2012

State of Higher Education and Research in India 2010

- Low enrolment in High Schools & Secondary Schools (50% in 2011) with high dropout rates in I-X (about 50% in 2011)
- Halting growth (compared to many countries of Asia and Latin America) of GER in higher education from 5% to 15% during 1980-2009.
- Only 550 Universities which grant degrees (in 2011)
- Proliferation of colleges 33,000 with average enrolment around 500

State of Higher Education and Research in India 2010

- Only 12% of students in higher education (17 million) enrolled in PG (2 million), and less than 1% in Ph.D (1.4 lakhs)
- Halting growth of PhDs awarded annually in Science (3750 in 2010), engineering (1000) and Medicine (300).
- India, which was hailed as a research “superpower” in the third world in the 1970’s, has exhibited a rather halting growth in the global share publications in science, which has stayed around 2-3% during 1980-2010. while many countries of Asia and Latin America have shown high rates of growth.
- In Mathematics, India’s global share of publications has declined from over 3% to 2% during 1981-1995 and has stayed around 2% during 1996-2010, while many countries of Asia and Latin America have shown high rates of growth.

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Thanks!

Thank You