Pilot Study on:
India's Reverse Brain Gain (RBG) In Liberalized Era

Study conducted by
Natural Resources India Foundation (NRIF)

Catalyzed and Sponsored by

Department of Science & Technology (DST),
Ministry of Science & Technology,
Govt. of India

2009

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(F. No.: DST/NSTMIS/05/87/2006-07 Dt. 15/02/07)

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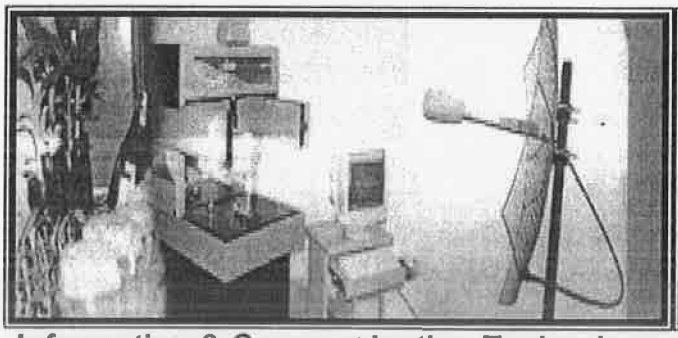

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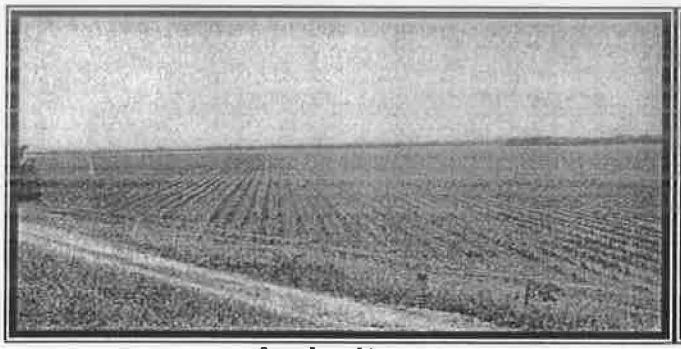

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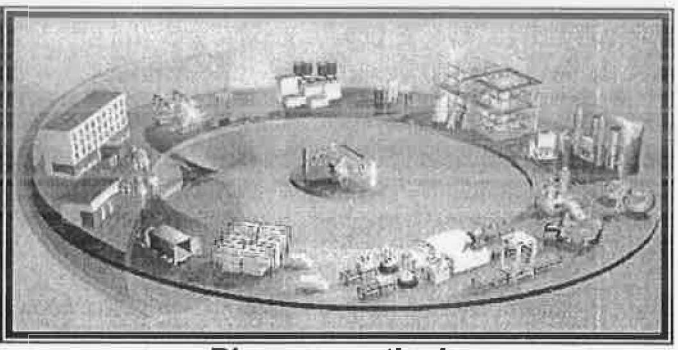

Pharmaceuticals

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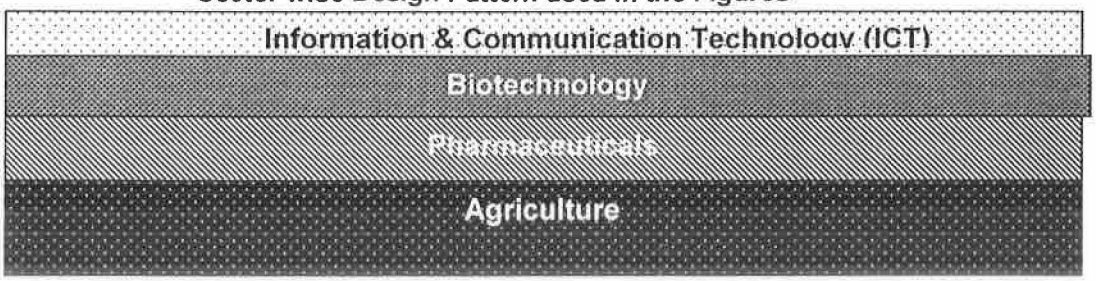


Preface

For more than four decades after independence, India has been suffering its knowledge-resource in terms of migration of its highly qualified persons to other countries a phenomenon commonly known as **'Brain Drain'**. The increasing dimension of *Brain Drain* has been a cause of concern for successive governments. Even World Bank reported that around 11 million India-born people were living abroad in 30 relatively rich countries in the year 2000.

However, globalization started introducing major changes in the economic, scientific, technological, medical and social scenario in the country. Coupled with these changes, development of IT sector, challenging career opportunities, opening of centres by multinational corporations, slow-down in US and European economies have created a scenario in India which is enticing the country's diaspora back to motherland. This home-coming of highly qualified and knowledgeable people is opposite to "Brain Drain" and hence has been termed as "**Reverse Brain Drain**" (RBD) or being knowledge-gain to India as "**Reverse Brain Gain**" (RBG). The "Reserve Brain Drain" which started.

The *Reverse Brain Drain* (RBD) or *Reverse Brain Grain* (RBG) which began as a trickle in late-1990s is now substantial enough to be reckoned as a real Brain Gain for India. However, no authentic data / information on the number and pattern of Reverse Brain Drain (RBD) were available. Neither consolidated information about fields of their specialization nor about their spread and engagement in India was available. Therefore, a project entitled "***India's Reverse Brain Gain in Liberalized Era***" was sponsored by the Department of Science & Technology (DST) [National Science and Technology Management Information System (NSTMIS) Division], Government of India to an NGO named Natural Resources India Foundation (NRIF), New Delhi.

The emphasis in this study has been on identifying those S&T disciplines in which Reverse Brain Gain has taken place. The various facets of the study are

connected to natural resources such as Agriculture; Forestry; Water Management; Oceanography; Space; Environment; General Health Care; Surgery; Endo-surgery; Gynecology; Ophthalmology; Urology; Rural livelihood; and other technological areas like Information & Communication Technology (ICT), Biotechnology, Pharmaceuticals, etc.

The study has been conducted by a team of experienced researchers of NRIF. The study has identified the persons which made young brains to leave the country and the factors which could bring them back to the motherland.

The migrant young Indians have been achievers abroad. And in this connection, an important segment of the report is the **'Scenario after Home-coming'** of RBD / RBG persons. *It has covered their contributions, achievements, work responsibilities spread across the country, level of satisfaction and agglomeration centres in India.*

The NRIF Team is sure that the study *will be a guiding source to the government in identifying areas wherein new knowledge-resource is available and consequently higher emphasis and investment may be made.*

Based on the felt-needs of respondents, *the study has also reported the area in which there is need of policy changes. It has also included the steps that would encourage Reverse Brain Drain and consequent knowledge gain to the country.*

The NRIF-Team is confident that this *'Pilot Study' will meet the requirements of the Union Ministry of Science and Technology as well as of all those stakeholders who are connected with this phenomenon of RBD/RBG directly or indirectly.*

R P Mattoo
Principal Investigator

Acknowledgements

The NRIF is grateful to the National Science and Technology Management Information System (NSTMIS) of Department of Science and Technology, Ministry of Science & Technology, Government of India, New Delhi, for showing confidence in it by sponsoring this study on 'India's Reverse Brain Gain (RBG) in Liberalizer Era'. The NRIF feels privileged and is doubly thankful to NSTMIS for sponsoring this study after the NRIF's successful completion of the earlier study on "*Pilot Study on the Career Profile and Professional Achievement of the PhDs in Science from Selected Central Universities / Institutions of India*".

The NRIF-Team is highly grateful to Dr. Laxman Prasad, Adviser & Head (NSTMIS) for his able guidance and deep interest in this study.

We are indebted to Dr. Praveen Arora, Director (Scientist 'F'), in the NSTMIS, for his unstinted support and valuable suggestions which helped us in successfully completing the study within the stipulated time.

The NRIF gratefully acknowledges the technical support received from the Members of the Local Project Advisory Committee (LPAC), appointed by the DST, MoS&T, Govt. of India. Special thanks are also due to the Members of the Sub-Committee nominated by the LPAC, in its meeting held on 7th November, 2007, which helped in finalizing the requisite professional Questionnaires / Checklists within a short period of one month. Dr. Praveen Arora, Director, NSTMIS; Prof. Sujit Bhhatacharya, JNU; Dr. P Vigneswara Ilavarasan, IITD; and, Mr. Vijay Kumar Monga, Consultant, World Bank, deserve our special thanks.

The NRIF thanks all the members and experts from different disciplines for their technical input despite facing host of problems and limitations in completing the task within the stipulated time allotted to us by the Ministry. We also appreciate the timely technical input and editing of the report by Dr. B S Aggarwal, Scientist, CSIR, despite his busy schedule.

The NRIF Team thanks the Heads and Staff of various Institutes, Universities-Central, Deem, State and Institutes of National Importance, Technical-Institutes, CSIR-Institutes, ICMR Institutes, Industries, Top Pharmaceutical companies, CII-Overseas Indian Facilitation Centre (OIFC), FICCI; Assochem, State Industrial Development Corporations, IT Software NASSCOM, Indo- association; in providing the basic data about the returnees from abroad in their organizations.

Last but not the least, NRIF gratefully appreciates the candid technical inputs provided by the professionals, respondents, eminent scientists, academicians, researchers in government laboratories, opinion-makers, etc for their contribution in enabling us to compete the study within stipulated period.

R P Mattoo
Principal Investigator & President, NRIF

Local Project Advisory Committee (LPAC)

(Appointed by the DST, MoS&T, GoI)

Dr. Laxman Prasad, Chairman
Advisor & Head, NSTMIS,
DST, MoS&T, GoI; Technology Bhawan,
Mehroli Road, New Delhi-110016
Tel: 26567373:

Dr. Rajesh Luthra, Member
Head HRDG, Council of Scientific and Industrial Research, CSIR Complex,
Library Avenue,
Pusa, New Delhi;
Tel: 25748632, (D); 25721585;
R: 27651907, 27651996;

Dr. M. R. Prasad, Member
Chief, IAMR,
Plot No. 25, Sector-A, Institutional Area, Narela,
Delhi-110040...
Tel: 27787036; 27783467-8;
Fax: 27783467;

Dr. Suman Govil, Advisor , Member
DBT (HRD), GoI,
Block-2, CGO Complex, Lodhi Road,
New Delhi-110003;
Tel: 24369610

Prof. Sujit Bhattacharya, Member
Scientist, NISTADS & Visiting Professor,
Centre for Studies in Science Policy
School of Social Sciences,
Jawahar Lal University, New Delhi-110016,
Mobile: 9868285660;

Prof. Santanu Roy, Member
Professor (Operations),
Indian Institute of Technology
Kharagpur, India;
Mobile: +91-9810958486

Prof. P Vigneswara Allavarasan, Member
Dept. of Humanities & Social Sciences,
IIT, Haus Khas, New Delhi-110016;
Tel: 26591374 (0); 26591936 ®;

Mr. T S Vishwanath, Member
Senior Director & Head-International Division & Int'l Trade Policy
Confederation of Indian Industry
Core 4A, 4th Floor, India Habitat Centre
Lodi Road, New Delhi - 110 003
Tel: 91 11 2468 2228 (D), 2468 2230 - 35 (B):
Fax: 91 11 2468 2226 / 9 E-
mail: t.s.vishwanath@ciionline.org

Mr. Nirankar Saxena, Member
Additional Director, / **Ms Smriti Dwivedi, Sr. Asst.Director,** Federation of Indian Chambers of Commerce and Industry (FICCI), Federation House, Tansen Marg, New Delhi-110001
Fax: 91-11-23721504, 23320714, 23325158;

Mr. Rahul Kacker, Member
President, Gurgaon Chamber of Commerce& Industries(GCCI),
Khandsa Road, Gurgaon -122001
Tel : 0124 - 2370303,
Mobile: 9810134767,

Ms Akankaksha Kumar, Member
Head, Delhi State Council. CII
249 - F, Udyog Vihar Phase IV,
Sector 18, Gurgaon -122015;
Tel : 95124 – 4014073;

Dr. Praveen Arora, Director, Member
Director (Scientist-F), NSTMIS,
DST, MoS&T, GoI; Technology Bhawan, New Mehroli Road,
New Delhi-110016

Mr. Vijay Kumar Monga, Member
108, Chokhandi,
DDA Residential Scheme,
Meera Enclave, Outer Ring Road, (Near Keshopur Subzi Mandi/ Behind Park Hospital)
New Delhi-110018
LL: 28331529; Mob. : 9899685102

R P Mattoo, Convenor
President, NRIF
93, GH-9, Pocket, Sunder Vihar,
New Delhi-10087

Study Team / Professionals from India & Abroad

FULL TIME AT DELHI:

- Principal Investigator (PI) .....R P Mattoo
- Co- Principal Investigator: .....Dhanajay Kumar
- Consultant : (Research Specialist-S&T); .....Ms Geetha Natesh
- Systems Analyst & Web Designers:.....Ms .Sheetal Grag
- Computer Operator-cum-Accounts Asstt:.....Santosh Kumar Jha

CONSULTANTS / RESEARCH ASSOCIATES (PART-TIME)

AT DELHI:

- Consultant : (Research Specialist):.....Mr.Surendra Prasad
- Agricultural Expert:.....Dr. A K Jain
- Freelance Writer & Journalist :.....Ms Asha Dhar
- Technical Editing: .....Dr. B S Aggarwal
- Research Associates
    - B.K Shanti
    - Er. Savita Wakhlu
    - Dr. B.K. Pandey
    - Dr. Anima Sharma
    - Mukesh Kumar
    - Alakananda Das
    - Sandip Kumar

AT GURGAON

- Romesh Raina, MBA & HRD Expert
- Jatin Khanna
- Vineet Nijhon
- Hriday Gupta

AT FARIDABAD:

- Dr. B.L.Raina

AT NOIDA:

- Nawab Wahabul Haque

AT JAMMU:

- .Dr. R.L.Mattoo

AT BANGALORE:

- D V Jahagirdhar
- Shri Ananthraman DS

FROM BIHAR:

- Raju Kumar
- Manoj Kumar

AT HYDERABAD:

- Dr. G. Choodamani
- P. Sambasiva Rao

FROM KERELA:

- M.V. Mathew

FROM TAMIL NADU

- Ms F.Beatrice Vanaja

FROM USA:

- Dr. Vasuki Rethinam

FROM AUSTRALIA:

- Vivek Raina

Abbreviations & Acronyms

AMD= Advanced Micro Devices
APEDA= Agricultural and Processed Food Products Export Development Authority
APMC= Agricultural Produce Marketing Committee
ASSOCHEM= Associated Chambers of Commerce and Industry of India
BPO= Business Process Outsourcing
BT= Bio-technology
CII= Confederation of Indian Industry,
CSIR= Council of Science & Industrial Research & ICAR
FDI= Foreign Direct Investment
FICCI= Federation of Indian Chamber of Commerce & Industry
FII= Foreign Institutional Investors
DST= Department of Science and Technology,
EU= European Union
GDP= Gross Domestic Product
GoI= Government of India
GNP= Gross Net Product
Hp= Hewlett Packard
ICAR= Indian Council of Agricultural Research
ICMR= Indian Council of medical Research
ICT= Information and Communication Technology (and **I&CT** are synonymous and interchangeable)
IIT= Indian Institute of Technology
IISc: Indian Institute of Sciences
IT= Information Technology
JNU= Jawaharlal Nehru University
KPO= Knowledge Process Outsourcing
LPAC= Local Project Advisory Committee
MEA= Ministry of External Affairs () and, GoI
MIS= Management Information System
MOIA= Ministry of Overseas Indian Affairs
MoS&T= Ministry of Science & Technology
NDDB= National Dairy Development Board
MNCs= Multi National Companies
NABARD= National Bank for Agriculture and Rural Development
NASSCOM= National Association of Software and Service Companies
NSTMIS= National Science and Technology Management Information System
OECD= Organization for Economic Cooperation and Development
OIFC= Overseas Indian Facilitation Centre
PDS= Public Distribution System
Quick -sort technique (Q-methodology)
RDMS= Random Database Management System
REID= Radio Frequency Identification Device
R&D= Research and Development
RBD=Reverse Brain Drain
RBG= Reverse Brain Gain
UNESCO= United Nations Educational Scientific and Cultural Organization
UNDP= United Nations Development Programme
WTO: World Trade Organization;
Y2K: Year 2000

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Preamble

- Competiveness of an economy is largely dependent on skilled manpower. Since independence, India has been losing its knowledge resource in terms of migration of its highly qualified persons to other countries- a phenomenon known as '*Brain Drain*'. But the liberalization of economy and changing industrial, scientific, technological and social scenario in the country since early-1990s have created challenging opportunities for trained / highly skilled personnel to return to India. It is being catalyzed by employment entrepreneurship, opportunities in high-tech areas like information and communication technology, biotechnology, bio-informatics, pharmaceuticals, e-banking, etc. Consequently, several highly qualified / trained persons have started returning to the home country- a phenomenon known as '*Reverse Brain Drain*' or being knowledge gain to India, as '*Reverse Brain Gain*' *(RBG).*
- The RBG that has started in a limited way needs to be 'properly' institutionalised so that it does not remain a sporadic phenomenon. Empirical based policy formulations are required that can address the various issues that governs RBG. This study was commissioned by DST, Govt. of India to NRIF (Natural Resource Foundation) with the broad objective to capture in details various aspects of RBG through primary investigation of selected sample of persons who have returned to India and suggest policy recommendations.

- The **specific objectives** of this study were:

To identify major technological areas where reverse brain drain leading to brain gain appears to have occurred:

  - Biotechnology
  - Drugs & Pharmaceuticals
  - Agriculture
  - Information and Communication Technology (ICT)

- To find the extent to which Reverse Brain Gain (RBG) has spread across India, besides its impact on each of the identified areas.
- To underscore the factors that governs the RBG in various areas.
- To suggest related policy interventions and provide suggestions and recommendations based on above findings.
- The Study was: with a 16 year reference period from 1990-91 to 2006-07.

Key Findings of the Study

- The study has revealed that the process of 'Reverse Brain Drain' (RBD) / 'Reverse Brain Gain' (RBG) had although started during early-1990s, but got momentum only in the last few years. The maximum number of cases occurred during 2005-08.
- Across the four technological areas selected for the study, maximum number of RBD / RBG persons returned in ICT sector; followed by biotechnology, pharmaceutical and lastly agriculture areas. The growth rate of returnee has also been much faster in ICT than other technological areas.
- The number of countries from which RBD / RBG persons have returned is as large as 60. The maximum number of persons, as one would expect, have returned from USA, followed by UK, Singapore, Australia, Germany, UAE, Japan, and Canada.
- The analysis in terms of duration of stay has revealed that a majority (42.1%) of professionals returning to India had gone (received) on long-term (more than 2 years) assignments. The proportion of RBD / RBG persons who had gone on permanent assignment has also been found quite significant. The study has revealed that about one-fourth of RBD / RBG persons had permanent visa status and citizenship of that country. *This shows their strong urge to return to India.*
- The age-group-wise analysis of RBD / RBG persons has indicated that age group of 31-40 years is biggest, followed by 41-50 years group and up to 30 years group. It also shows that maximum returnees are in their youth with maximum capacity to work.
- The Reverse Brain Drain scenario has been found to enjoy male dominance.
- Qualifications and area of specialization of RBD / RBG persons being an important parameter, both pre-migration and post-migration status has been investigated. A significant proportion of RBD / RBG persons have acquired higher qualifications in terms of post-graduate and PhD degrees or more research experience in their specialized areas. The post-migration scenario has revealed that the percentage of graduates has gone down and of post-graduates has increased. *Thus, RBD / RBG persons are more qualified and have more experience in their specialized fields, which depicts high knowledge-gain to the country.*
- 'Scenario after home-coming' of returnees is an important segment of the study through which, it has concluded that the returnees share higher positions of responsibility in India than they had in foreign countries. Some of them have even launched or planning to

launch their own enterprises. It is believed that a significant number of these RBD / RBG persons have established small and medium-scale enterprises.

- A notable feature emerged from the study is the high level of satisfaction expressed by the returnees after coming back to India. Such a high level of satisfaction will provide strength to the RBD / RBG persons to work with more vigor which ultimately will be gain to India.
- The study has observed a decline in the proportion of RBD / RBG persons associated with R&D sector in India than that was in foreign countries. It is the consequence of lower investment to R&D sector by India than in several foreign countries.
- The spread of RBD / RBG persons in India was in 14 states / union territories of the country. The biggest congregation of RBD persons has been reported in Andhra Pradesh.
- The study revealed major achievements of RBD / RBG persons in the following areas: -
  - Development of *novel projects, novel process, or new designs*
  - *Exploring new clients* for their companies
  - Creation of new brands for their clients
  - *Introduction of organizational changes* for better performance
  - Imparting *tacit knowledge* to fellow colleagues
  - Evolution of *quality assurance mechanism*
  - Development of *just-in-time delivery system*
  - Introduction of *innovative accounting system* in the organization
  - Evolution of *management information system* (MIS)
- The study has outlined some 'Success Stories of RBD / RBG Persons'. These covered the areas of communication technologies (M/s Sanskean Ltd.), production of Hepatitis B vaccine in India (M/s Shanta Biotech), innovative combination of genetics and grain technologies (M/s Avesthagen), synthesis of vaccine for dysentery, pediatric, cardiology, tele-radiology, etc.

Key Policy Suggestions / Recommendations

- India needs to understand the pattern of RBG thoroughly and various waves of RBD / RBG from time to time.
- The sector-specific infrastructural requirements need to be identified and created so that RBD / RBG professionals feel comfortable back home.

- There is a need for developing common infrastructural facilities under public-private partnership (PPP), which will provide prompt and quality services.
- The study suggests 'Replication of Tamil Nadu Model' in other states. In this Model, Tamil Nadu has developed infrastructure facilities at the district level and has not restricted itself to capital or one / two cities. It has provided more choices / locations to RBB/ RBG persons.
- On the basis of feedback received from the respondents, the study has concluded that a number of changes will have to be made in policies related to sectors of education, research and industry to attract more professional people from abroad to India. Among the key issues that emerged were: Universities should have curriculum that evolves and involve experts in the designing process. Herein the persons who have returned and are involved in cutting edge research, can play a significant role. Separate funds can be earmarked for RBG persons who are interested to undertake research after coming back. Industry needs to be motivated to provide incentives to RBG, create own facilitation channels and not dependent solely on government intervention.
- It was felt that many issues that were raised require more in depth investigation. The scope needs to be widened so that more technological areas can be covered. The study needs to cover issues of entrepreneurship, effect on different industry segments and research more intensively. This primary survey can provide the background to undertake a further case based study. This can help in articulating specific policy inputs that can catalyze the RBG process.

CHAPTER 1

INTRODUCTION

Chapter 1

Introduction

1.1. Background

Migration of people, animals, birds and fisheries from one place to another, one country to the other, one continent to the other or one ocean to the other is a common phenomenon occurring since time immemorial. The forcing reasons behind these migrations are food, fodder, shelter and progeny. These migrations could be for a short duration, long duration or permanent settlement. Some of these migrations are seasonal, like those of migratory birds, whale, etc.

In the case of human beings, an individual is tempted to settle in a habitation based on the following five assets in one's possession: -

- *Human Capital*: Physical and mental assets such as health, education, skills, intelligence, and personality;
- *Natural Resources*: Land, movable and immovable properties, water, forest and environment;
- *Financial Resources*: Income, savings, and accessibility to money market;
- *Physical Resources*: Equipments and accessories;
- *Social Capital*: Social recognition and net-working.

Source: Robert Chamber.and Conway G (1992) .

Possession or deprivation of these assets guides a person's performance and type of life-style s/he chooses. These selections determine his / her place of work and nature of job.

On a macro-level, the causes of migration could be:

- Economic: Job security, value for money, progressive investment opportunities, established and steady markets, safe financial portfolios, etc.;
- *Security*: Security for food and nutrition, health and hygiene and, physical, political, occupational and social securities.

Migration brings about changes in population distribution and mixing of different cultures. With the growth of civilization, industrialization and development of communication and transportation systems, the human migration has started increasing. But, if the human migration is centered around a specific group of people, then their country of origin gets deprived of that resource. When this group was comprised of highly educated and professionally qualified people, and then the migration was termed as "**Brain Drain**".

1.2. The International Scenario

Historically, one of the earliest brain drains was experienced by the Europe towards the final stages of Second World War when, due to the political turmoil and fear of persecution, many scientists, intellectuals, engineers, doctors and other professionals moved to the United States (*Kaukab, 2005*). However, according to Prof. *Emeagwali* (*2006*), brain drain actually began much earlier, in the 19th century, which was the Agricultural Age. At that time, the U.S. economy needed strong hands to pluck cotton, and the young and sturdy from the Africa were forced into slavery. Today, one in every five of African descents lives in US. Therefore, measured in numbers, the largest brain drain resulted from the trans-Atlantic slave trade (*Emeagwali, 2006*). The exodus of Bihari labourers from India to Mauritius some two hundred years ago is also well-known.

Despite obvious economic losses, empirically there is a reasonable amount of evidence suggesting that brain drain is still going on. The relative cumulative loss of brains by the region in 1990 has been estimated at 15% for the Central America, 6% for Africa, 3% for South America, and 5% for Asia (*Carrington and Etragiache, 1998*). The US 1990 Census had revealed that there were more than two and a half million highly educated immigrants from the developing countries residing in the United States (*Beine et al. 2003*). Since in the US Immigration Act of 1990 – followed by the American Competitiveness and Work Force Improvement Act of 1998-- emphasis has been laid on the selection of highly skilled workers through a system of quotas, favouring candidates with academic degrees and/or specific professional skills, there has an increase in the annual number of visas issued to highly skilled professionals (H-1B visas) from 48,000 in 1989 to 116,000 in 1999 (*Lowell, 2000*). More the brains are drained

from the developing nations the greater is the impact on various economies. The international exchange of knowledge and international mobility of researchers and scholars have always been of great importance in higher education and research. For decades, internationalization policy has concentrated on encouraging exchanges among students, researchers and academicians, and on capacity development. This approach, which is characterized by international cooperation, has taken several forms: the European Community Exchange Programmes for Students and Staff, the American Programme for Fulbright Scholars, National Exchange programmes and various development-cooperation schemes.

However, under the influence of globalization, international activities related to higher education and research and development (R&D) are no longer just a matter of cooperation. Competition has entered the picture. In the first place, scientists, engineers and other scholars need international experience for carrying out extraordinary research. It provides them a competitive edge. International competence is essential nowadays for anyone who wants to excel in economics, science, engineering or medical sciences. Secondly, analysts in all the major economic regions are realizing that competition for graduates is becoming inevitable. If economies are to remain strong and standards of living are to remain high, employers must be able to recruit the professionals and academicians they need—from other countries and regions, if necessary. It is particularly true for graduates in the R&D sector. In the rich countries of Europe, it seems that fewer and fewer young people are interested in the fields of science, engineering, medical sciences, biotechnology, information technology, etc.

The European Commission has estimated that by 2010, the EU will need 700,000 additional researchers in different fields. A part of these researchers will have to come from abroad, inducing brain drain from those countries. These figures are based on the target, set by the EU heads of state at the Spring Summit in Barcelona in 2002. On the other hand, the Europe is exporting more and more jobs in certain fields. Multinational Corporations (MNCs) are increasingly outsourcing even the most high-tech work to countries with lower labour costs. As a result, the developing economies with strong emerging infrastructure and

Box 1.1

What Led to Brain Drain from India?

- What sucked away many talented Indians was the fear of unemployment in India. They were lured by financial incentives and material benefits abroad. The other reasons were better working conditions, modern facilities more avenues for capacity development. Some could not bear excessive bureaucratic procedures in the country.
- For the most part of the 20th century and earlier still, Indian economy was inward-looking, under-performing, over-regulated and obstructionist. There was a sort of stagnation in the economy.
- The domestic market was unhealthily protected. Imports were controlled to a large extent and exports were discouraged to a certain extent. There was a surfeit of licenses and custom duties were very high-sometimes up to 200 per cent. Industrial licensing restricted the activities of entrepreneurs. The banking system–controlled by the government's Reserve Bank of India-- was stifling.
- Foreign exchange (Forex) was under strict control, but *Hawala* trade was flourishing. Foreign travel got curtailed because of a pittance of foreign exchange was allowed to travellers. The government policies were frequently changing and that upset the economic system. Employment opportunities for the highly educated were limited. So the best brains left the Indian shores to seek better fortune and opportunities abroad.
- The basic science research in Indian universities was stagnating, due to lack of incentive for initiatives. The declining standards freezed fresh appointments in university faculties. Abnormally low investment on infrastructure, poor incentives to science researchers and, bureaucratic inference at every step for innovation stymied the scientific activities. From 1980 to 2005, published research papers hovered between 15000 to 19500. In 1970, India was the 8th largest scientific paper publishing nation in the world, but in 2005, it had slid to the 15th position.
- Before India opened up in 1991 in a protected environment, the Indian industry had no motivation to innovate. Under the garb of import substitution Indians copied more and more. And, there appeared no exiting challenge for a young mind to create something new. So several talented individuals with scientific and technological creativity were lured to the world of opportunities in the western countries. The **Brain Drain** continued from 1960s to the end of the 20th century.
- Besides, 'physical income', the search for 'psychic income' i.e. the joy of creation, and contentment of having taken part in something novel also attracted the young to the West.
- India can be branded 'as a land of ideas' and USA, 'a land of opportunities'. India's youth, with aspirations and ideas, tended to go to USA, where they could find 'opportunities' to reach their "own ideas" and potential.

employment opportunities are slowly gaining back the skilled human resources which had migrated earlier in search of opportunities abroad.

1.3. The Indian Scenario

With the advent of Indian Independence, foundations were laid for the development of scientific and technological endeavour in the country. Besides, policy frameworks, a number of specialised institutional structures like Indian Institutes of Technologies, Indian Institutes of Management, Postgraduate Institutes of Medical Sciences, Indian Institute of Sciences, etc. were created along with establishment of several institutes under Council of Scientific and Industrial Research, Indian Council of Medical Research etc. These multi-dimensional efforts resulted in the generation of sound S&T base, both in terms of manpower and capabilities, in the country. But, unfortunately no sincere efforts were made towards utilization of talent of such a vast human resource within the country by offering suitable employment opportunities and a congenial environment for scientific and technological advancements. Even the industrial sector failed to keep this mass of highly qualified people bound to the country. Under such a scenario, the talented youth of India was lured by several overseas countries by offering big financial incentives, advanced S&T infrastructure, better working conditions and above all, personal recognition. This resulted in the migration of Indian youths to countries like the USA, the UK, Canada, former USSR, France, Germany, Australia, etc. This migration of highly qualified people from India to other countries was termed as '**Brain Drain**'.

The 'Brain Drain' started occurring on such a vast scale that it became an extremely worrying issue for the Government of India. The highly educated and professionally qualified people, on whose education country was making huge investments, were leaving the country in search of greener pastures for a short period or permanently. The country was getting depleted of its knowledge assets but sufficient corrective measures were not taken to contain the loss of talent from the country. It became a regular feature for every dignitary visiting a foreign country to make a call to the Indian talent to come back to the motherland. Even

the call of the first Prime Minister of India, Pandit Jawaharlal Nehru, to the drained brain to come back had not much fruitful effect and the brain drain continued.

The introduction of newer subjects like 'Computer Science', 'Information Technology', 'Biotechnology', etc. gave a further fillip to brain drain. The dream of a job in the Silicon Valley, California, lured many bright young students to the field of computers in a big way. And according to an estimate, more than 11,000 professionally qualified youths left India annually for higher studies or work abroad. The impact of brain drain was so strong that several studies were conducted on this topic. These included the studies conducted at the Indian Institute of Technology, Mumbai (1987), JNTU College of Engineering, Kukatpally, Hyderabad (1999), Institute of Technology (BHU), etc. Even the World Bank made an exhaustive study on the subject and revealed that 11 million Indian-born people were living abroad in 30 relatively rich countries of OECD in the year 2000. More details on what led to Brain Drain from India have been provided in ***Box 1.1***. It is believed that India had lost one per cent of top talent and 90 per cent of her intellectual energy in the form of 'Brain Drain'.

It is believed that the driving factors that affect migration of professionally qualified people are: -

- Employment opportunities
- Economic gains
- Skill up-gradation opportunities
- Better facilities and infrastructure
- Social and professional recognition
- Political and social stability
- Offspring's' future.

There are some minor factors also that may induce migration; these include stay or settlement of close relatives abroad, choice for a specific job or affiliation to a multinational organization.

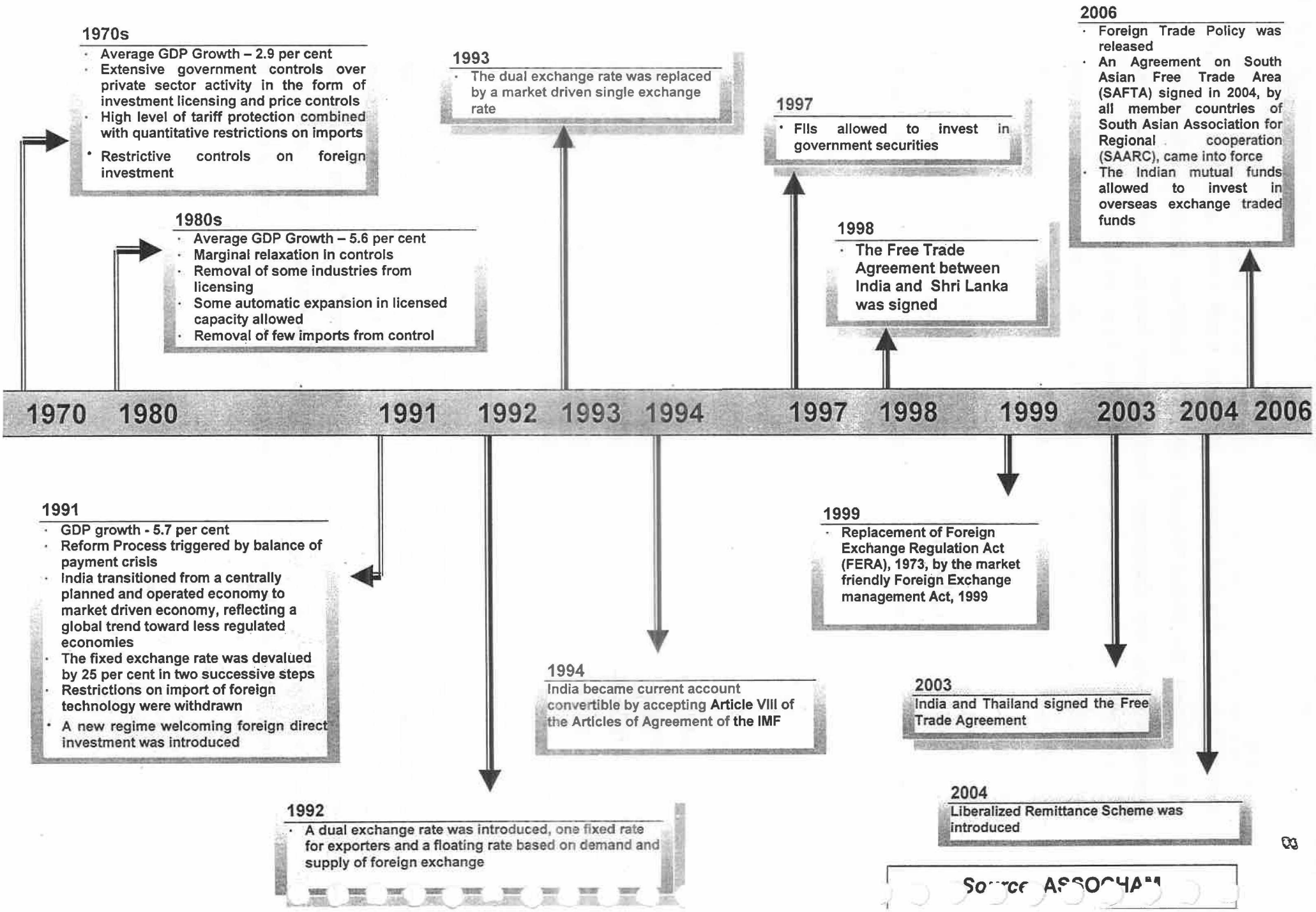
The migrated masses from India exhibit extremes, ranging from a large number of illiterate workers to a sizeable pool of highly educated scientists, technologists, engineers, doctors, etc. They represent a sizeable portion of the population in countries of their residence such as the Maldives, Afghanistan,

Central Asia, Iran, the Gulf countries, Mauritius, South Africa, and other African nations, Israel, the United Kingdom, and other European countries, the United States, Canada, the Caribbean, Trinidad, and Tobago, Guyana, Suriname, countries in South America, South East Asia, the Asia Pacific Region and the Fiji Archipelago. During the past two decades, the Indian diaspora worldwide has seen the transformation of its members from humble migrants in a foreign country to occupants of high posts in Universities, R&D institutions, politics and administration. They occupy reputed positions of professors, visiting professors, heads of research teams, CEOs, advisers, consultants, mayors, judges, and of late, owners of industrial houses. The Indian diaspora of about 20 thousand people gets added by about 1per cent every year and generates an annual income of about US $400 billion, which is equal to 35% of India's gross domestic product (GDP).

The advent of globalization in India brought a major change in the economic, political, industrial, scientific, medicinal and social areas of the country during the early-1990s. Universalization of these concepts had an explicit impact on the fiscal policies as well as movement of highly educated people. The new millennium experienced a revolution in 'Information and Communication Technology' and due to this technological feasibility, place of work has virtually lost its importance.

Secondly, the multinational corporate sector started realizing the need for mult-locational functioning to bring down operational cost and encourage a prompt delivery system. The monetary gains started matching the global standard prompting the work force to think in terms of returning to their home with similar level of earnings, life-style and socio-economic conditions. The concepts of diaspora and social belongingness have further accelerated the pace of returns to the motherland.

Figure 1.1: India's Journey towards Globalization



The concept of outsourcing cropped up and took an international shape. Again the comparative cost theory started playing its multipiler role and the developing nations like India have slowly become the feasible work stations due to their developed and developing infrastructure.

Several successful Indians in the high-tech industry in the US have started setting-up hardware and software companies in their home-country. The concept that had induced migration of qualified people from India has started becoming outdated.

The advanced knowledge brought home by the repatriated scholars in science & technology, medicine, agriculture and other fields has provided a big impetus to the level of scientific research and human resources in the country. These new knowledge-scholars have started strengthening ties by offering employment, training and consultation to the Indian students. No matter where they were based, an amazing communication network started evolving which provided a constant linkage with the scientific community at the global level.

Thus, the post-liberalization India has emerged as one of the fastest growing nations in the world. A brief review has been presented in **Figure 1.1.** The country is in the process of creating a strong infrastructure in diversified development sectors. The growing economy, true to international standard, has opened up excellent employment opportunities. As a result, not only the young talents are looking for domestic settlement but also the diasporas settled abroad are returning back to India. Several of them after achieving name, fame and money want to serve their motherland. The home-returning of such highly qualified and knowledgeable people is opposite to the process of **'Brain Drain'** and has been termed as **'Reverse Brain Drain'** or being a gain to the nation, as **'Brain Gain'**. More details on what led to **'Reverse Brian Drain'** or **'Reverse Brain Gain' (RBG)** have been provided in **Box 1.2.**

Box 1.2

What led to 'Reverse Brain Drain' or 'Reverse Brain Gain' (RBG) to India?"

- The post-liberalization India has emerged as one of the fastest growing nations in the world. The country is in the process of creating a strong infrastructural base covering diversified development sectors. A silent revolution, with a tremendous force, is taking place. India is becoming a global research, design and development hub, employing thousands of technically trained people. There are challenges and challenges for the young Indian innovators. This has induced the process of '**Reverse Brain Drain**'

- More than 100 companies around the world have set-up their R&D centres in India, employing thousands of people. For example, GE in Bangalore is the second largest R&D Centre of GE in the world, employing 400 PhDs, out of which 40 are young.

- India has established software services, back offices, etc. getting a sizeable amount of foreign currency. That money is being used to create new jobs. 'India will continue to gain', says Maryland-based technology Consultant, John Daly. Mr. Daly had worked for the U.S Agency for International Development, for 20 years. This trend has created an environment for luring Indian brains back home after having resided abroad, leading to "Brain Gain".

- Noticing India making good on its long-term economic vision, many Indian scientists and engineers are opting to come home,

- Prof. Kalyanaraman, Dean of the "Industrial Consultancy and Sponsored Research" at IIT, Chennai has emphasized, "There is an increase in "Brain Gain" and reduction in 'Brain Drain' by 40 per cent". Others IITs put up this figure at 50 per cent. Only 30 per cent of IIT graduates migrate abroad now, compared to 70 per cent 11 years ago. It is a pointer towards the process of "Brain Gain". Prof. Kalyanaraman outlines this trend due to:

-
    - Challenging career opportunities in India now;
    - Attractive remuneration in Indian corporate sector;
    - Decreasing opportunities in the Information Technology in the United States;
    - US government becoming highly security conscious after 9/11 episode. They have tightened visa regulations which most outsiders find irksome as well as embarrassing. This has also given a set back to the immigrant population generally.

- There is a slowdown in the U.S economy and because of that 45 per cent of Indian high-tech workers aboard are coming back. Since 2001, the slump in the US economy has accelerated a trend of outsourcing jobs to developing countries like India.

- Indian's breakneck economic resurgence, considered 'miraculous" and the growth of technology industry is enticing the country's diaspora back to India.

The National Association of Software and Service Companies (NASSCOM) have revealed that around 30,000 Indian Research & Development professionals have returned to India during the past three years. Ninety per cent of them are IT professionals—a pointer towards "Brain Gain"!

The liberalization of economy and changing industrial climate has created opportunities for trained / skilled personnel to come back to India. These are also playing crucial roles in providing / generating employment opportunities in several high-tech areas and science-based industries in Bangalore, Hyderabad, Chennai, NCR of Delhi, etc. An indicative list of such areas has been provided in ***Box 1.3***. In these, the first four are major areas and have formed the basis for the present study.

Box 1.3
S&T Areas in which 'Reverse Brain Drain' or 'Brain Gain' is an on-going process: -

- **Information Communication Technology (ICT)**
- **Biotechnology (BT)**
- **Pharmaceuticals**
- **Agriculture**
- Nano-technology
- Petro-chemicals
- Catalysis
- Bio-informatics
- Medical Sciences: Cardiology, Surgery, Endo-Surgery, Urology, Ophthalmology, Gynecology, Transplantations
- Health & Tourism
- Space
- Oceanography
- Renewable Sources of Energy
- Population studies
- Social / Rural Development

- ***Definition of 'Reverse Brain Drain' or 'Brain Gain', for this study is given in Box 1.4. Below.***

Box 1.4.

- ***Definition of 'Reverse Brain Drain' or 'Reverse Brain Gain',***

- The present study defines, the 'Reverse Brain Drain' (RBD) or 'Reverse Brain Gain' (RBG) as the return of Highly Qualified Professionals and other trained and highly skilled persons to their native country.

- Categories / Types of RBD or RBG are the "professionals of Indian origin returning back to India
  - ✓ Permanently;
  - ✓ Long-term (2-5 or more years);
  - ✓ Medium-term (up to 2 years);
  - ✓ Short-term (one month to less than 6 months or so)
  - ✓ For:
    - ✓ Joint industrial visits;
    - ✓ Joint research programmes and / or pursue research with Indian scientists and trained young students in India;
    - ✓ Consultancy;

The 'Reverse Bain Gain' (RBG) though began as a trickle during the late 1990s, is now substantial enough to be reckoned as a 'Reverse Brain Drain'. The growing number of professional Indians, who once saw their hopes for good jobs and better lives in the West, has returned to India. Drawn by an economy, in which outsourcing is playing a crucial role, and the money to buy the lifestyle they had in the developed countries, Indians are returning to their motherland.

However, no authentic data / information on number and / or pattern of 'Brain Gain' is readily available. Neither is there any information in a consolidated form about their outer and inner spread; and impact of Brain Gain on changes in

wages (both labour-based and skill-based enterprises) and related policy issues (international and domestic). But, speaking at the NASSCOM-2006 Leadership Summit, held at Mumbai on 17th February 2006, the then-President Dr A.P.J Abdul Kalam, had remarked, "Data indicates that global off-shoring, including BPO, is of around $300 billion presently, whereas we are tapping only 10 % of this market. As estimated, the contribution of this segment can account for 17 % to India's GDP and 44 % to export growth". Recommending a growth-path that could lead India to $200 billion pole post, Dr Kalam had said, "We need to create awareness about India in another addressable market. BPO will have to move to second tier cities with a population around one million and later to towns with five lakh population."

The US President in his last visit to India had pointed out that India contributes the largest number of students to the US universities each year (about 85,000 per year). For many years, we have considered this as a '***Brain Drain***'. The 'retention rate' of Indian students in the US was considerable, particularly amongst the best and the brightest.

Considering all these factors, a need was felt to undertake a study on the number and pattern of professionals returning to India. Accordingly, a project entitled "India's Reverse Brain Gain (RBG) in Liberalized Era" was submitted by the NGO, Natural Resources India Foundation (NRIF), New Delhi, to National Science and Technology Management Information System (NSTMIS) Division of Department of Science & Technology, Ministry of Science & Technology, Government of India, New Delhi. The proposal was approved with the following objectives for the study.

1.4. Objectives of the Study

- To identify major technological areas where reverse brain drain leading to brain gain appears to have occurred: -
    - Biotechnology
    - Drugs & Pharmaceuticals
    - Agriculture
    - Information and Communication Technology (ICT)
- To find extent to which Reverse Brain Gain (RBG) has spread across India, besides its impact on each of the identified areas

- To underline the factors that govern the RBG in various areas, and
- To suggest related policy issues and provide suggestions and recommendations based on above findings.

- **Reference Period**

- The reference period for the study was about 16 years, from 1990-91 to 2006-07 with following intervals:
  - Pre-WTO: 1990-95
  - WTO & Post: 1996-2004
  - Beyond 2005.

1.5. Organization of Report

The report has been organized in six chapters. This Chapter on **Introduction** is followed by the Chapter on **Approach and Methodology**, used in the study. Chapter 3 describes the **Characteristics of RBD / RBG Persons** and chapter 4 provides **The RBD / RBG Scenario in India**. **Some Success Stories of RBD / RBG Persons and Development in Selected Four Technological Areas** have been described in Chapter 5. Finally, **Conclusions and Suggestions** have been outlined in Chapter 6. Besides, these main chapters, two appendices have been provided in the report. The ***Appendix I*** provides an overview of the four technological areas in which 'Reverse Brain Gain' is happening. ***Appendix II*** gives the 'Questionnaire' used by NRIF for the study.

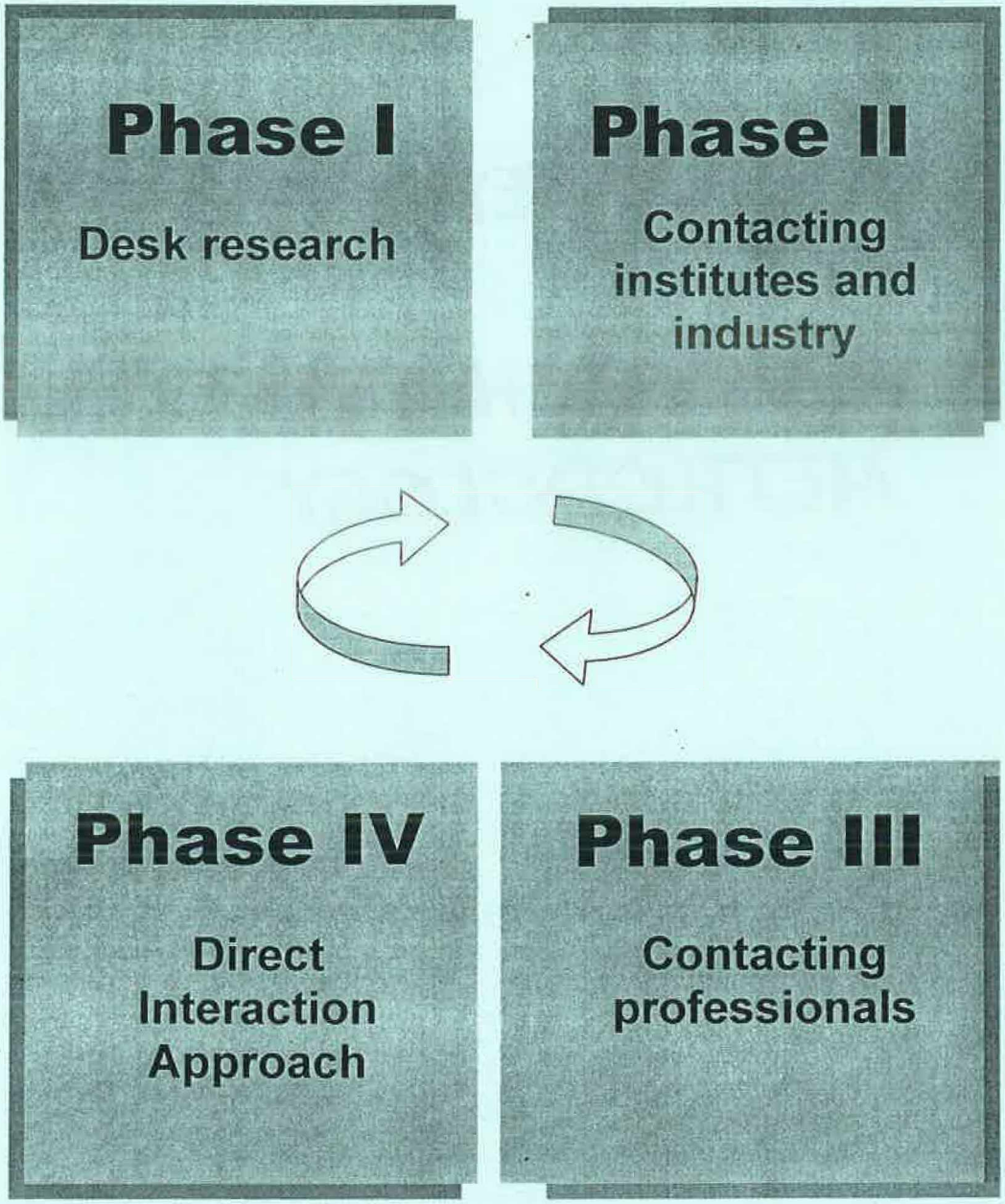
The Report also contains an **Executive Summary** for a quick appraisal of the study results and a selected bibliography for getting more details.

CHAPTER 2

APPROACH AND METHODOLOGY

Figure 2.1

Four phase approach for project execution



Chapter 2

Approach and Methodology

2.1. General

The present research study was entirely exploratory in nature. It was based on numerous independent and dependent variables. The Reverse Brain Dain or Brain Gain has not only links with migration, employment, income and education but also deals with economic, social, political aspects, as well as diasporas and psychological issues. Such migration is undoubtedly related with opportunities and economics but reversal finds linkage with multiple issues. Generally, the primary issues impacting Reverse Brain Dain or Brain Gain are:

- Concept of Diaspora (*covering general description*)
- Human Asset (*covering return of trained manpower details, etc.*)
- Resources-based Assets (*covering family background, income group information, etc.*)
- Financial Asset (*covering the occupational group information, etc.*)
- Social Assets (*covering personal reasons for home-coming*)
- Political Scenario (*covering the present political and liberalization norms being followed back home for attracting return*), and
- Economic Growth Back Home.

Hence, the methodological tools were designed to accommodate and analyze the above-mentioned issues, as far as possible, without diluting the basic objectives as proposed by the DST. The study was thus conducted with a combination of secondary as well as primary research data.

2.2. Approach

A four-pronged approach was adopted for conducting the study (See **Figure 2.1** on the opposite page):

- Desk Research
  - Bench mark characteristics of the selected Indian Firms, MNCs and their R&D Centres
  - Selected institutions like IITs, and Universities, as accredited by UGC
  - CSIR, ICMR & ICAR Institutes
  - Industrial Associations like NASSCOM, CII, FICCI, ASSOCHEM, etc.
- Contacting Institutes and Industry
  - First level questionnaire sent to the industries and institutions under Phase-I, to over 5068 Institutions and Industries)
  - Two sets of Questionnaires:
    - Industries (numbering 1120)
    - Institutions (numbering 966)

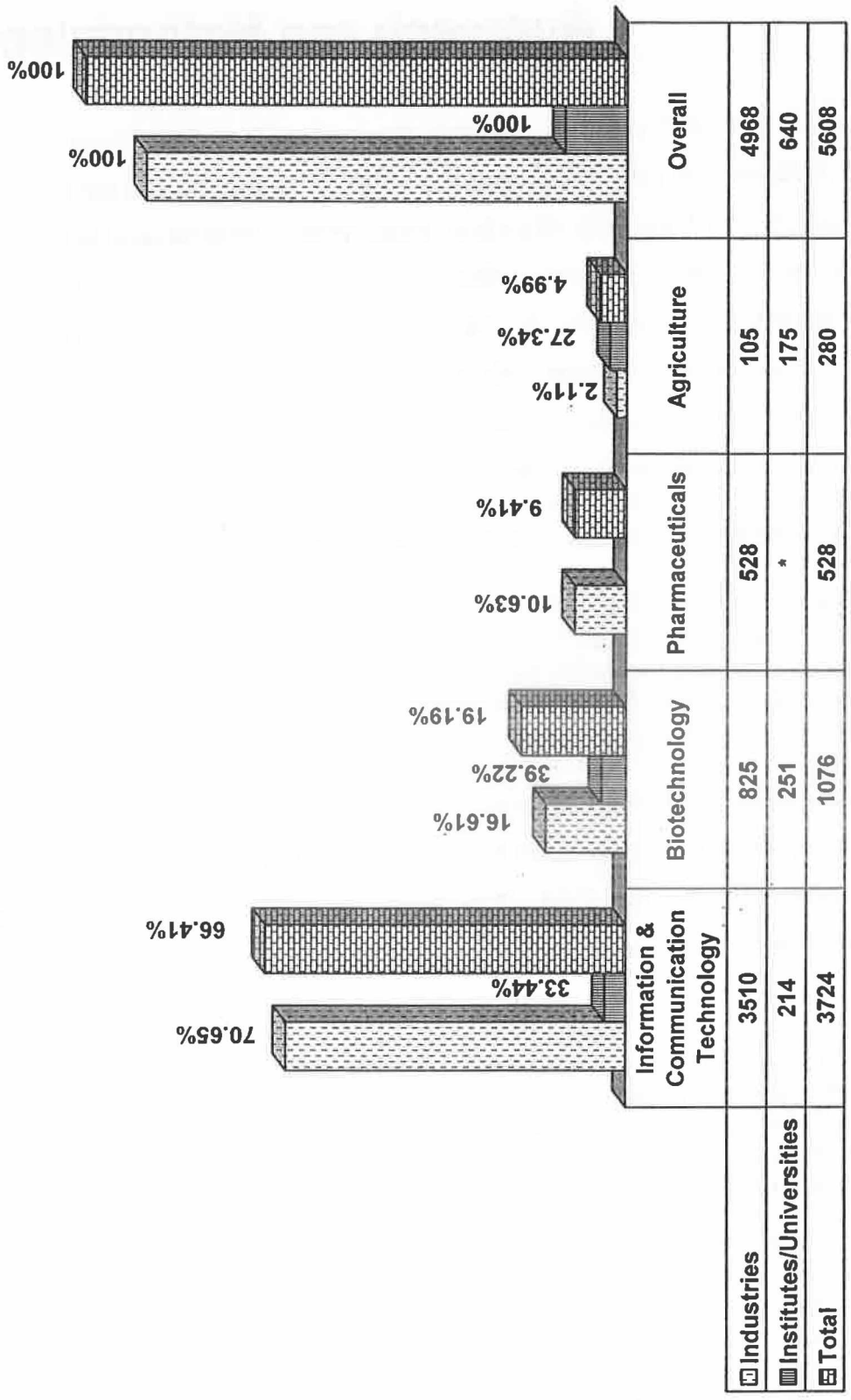


Figure 2.2: Questionnaires dispatched to industries / institutes

- Contacting Professionals: (numbering 2086)
  - The description is highlighted in the **Figures 2.2, 2.3** and **2.4.**
- Questionnaire approach to professionals [Questionnaire for these professionals was approved by the Sub-Committee appointed by 1st Local Project Advisory Committee (LPAC) meeting held on 7th November 2007]. Later on, it was put on NRIF-*website*
- Direct Interaction Approach
  - Contacting some eminent scientists, academicians, researchers, scientists, etc. in government laboratories, opinion-makers, educational experts and policy makers to know about their perception about RBG and its impact (through Case Studies / Success Stories).

- The above questionnaire was uploaded on the NRIF website <http://www.nrif.org.in>, followed by the wide publicity through print media, which included: Hindustan Times, Times of India, Indian Express, Financial Express, Mint: www.livemint.com., Google- Ad Campaign from 1st January 2008 to 31st May 2008.
- Publicity was also done through an International Website: www.craigslist.org (U S based) from March 2008–May 2008.

2.3. Primary Approach

The study subject being new, possessed a scanty database on it. The fragmentation in sample class further constrained the data availability in a contextual form. In view of this, the only source for data gathering on the subject was to follow primary approach. Hence, the study was designed as an extensive primary research exercise to solicit data having linkage with the objective variables.

The different dimensions of primary research approach were developed keeping the analysis aspect in mind. The study subject being exploratory in nature necessitated the target group analysis, particularly in terms of its asset base. The groups were categorized in terms of their professional attainment levels, fields of specialization and the geographical areas served. The universal sample could not be defined due to high level of fragmentation. Hence, disproportionate sampling method was used, resulting in a sample intensity of 5608 industries / institutes wherefrom list of 2086 professionals was obtained for a contact. Consequently we got a response from 879 (out of 2086) RBD / RBG professionals, whose distribution (technological area-wise) is given below in Table 2.1.

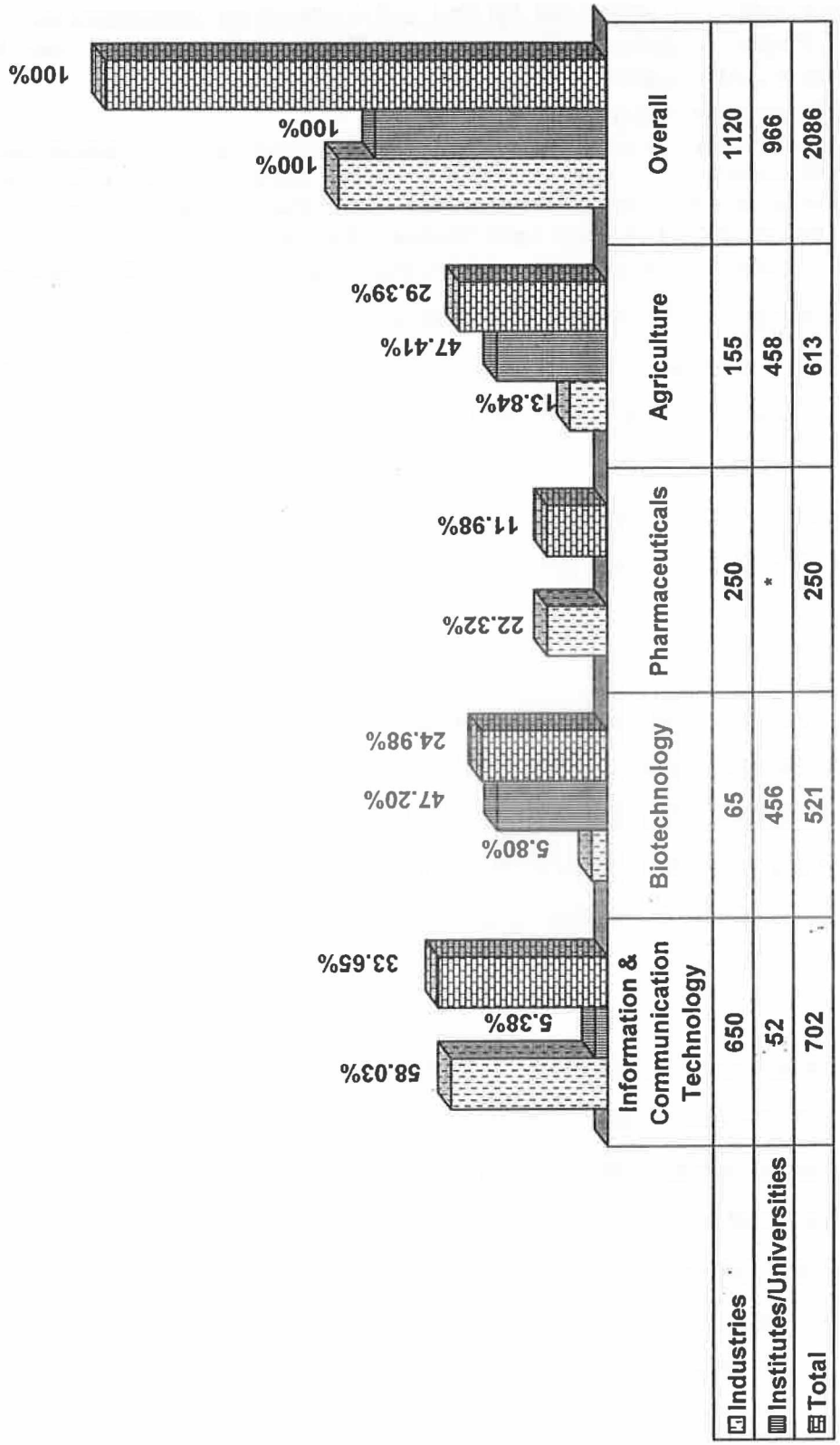


Figure 2.3: Questionnaires dispatched to individuals

For data collection questionnaire approach was followed using semi-structured and non-disguised type questionnaires, as approved by the Sub-Committee constituted by the First LPAC meeting held on 7th November 2007. Personal interviews as well as e-survey modes were adopted for data collection.

Table 2.1: Sample at different levels

Professional category	Questionnaire sent to			
	Industries / Institutes	Individual Professionals	Respondents	
			No.	%age
Information & Communication Technology (ICT)	3724	702	566	83.47
Biotechnology	1076	521	127	24.37
Pharmaceuticals	528	250	103	41.20
Agriculture	280	613	83	13.54
Total	**5608**	**2086**	**879**	**42.13**

It was brought to the notice of NSTMIS, through Progress Report for the period 15th May 2007 to 31st March 2008. The primary data analysis is based on the 879 respondents (42% of the total 2086 respondents). The results and key conclusions of the study and Draft Report were discussed at the Second LPAC Meeting held on 25th August 2008, which also resulted in providing some useful suggestions from the Members before finalization of Report.

2.4. Secondary Approach

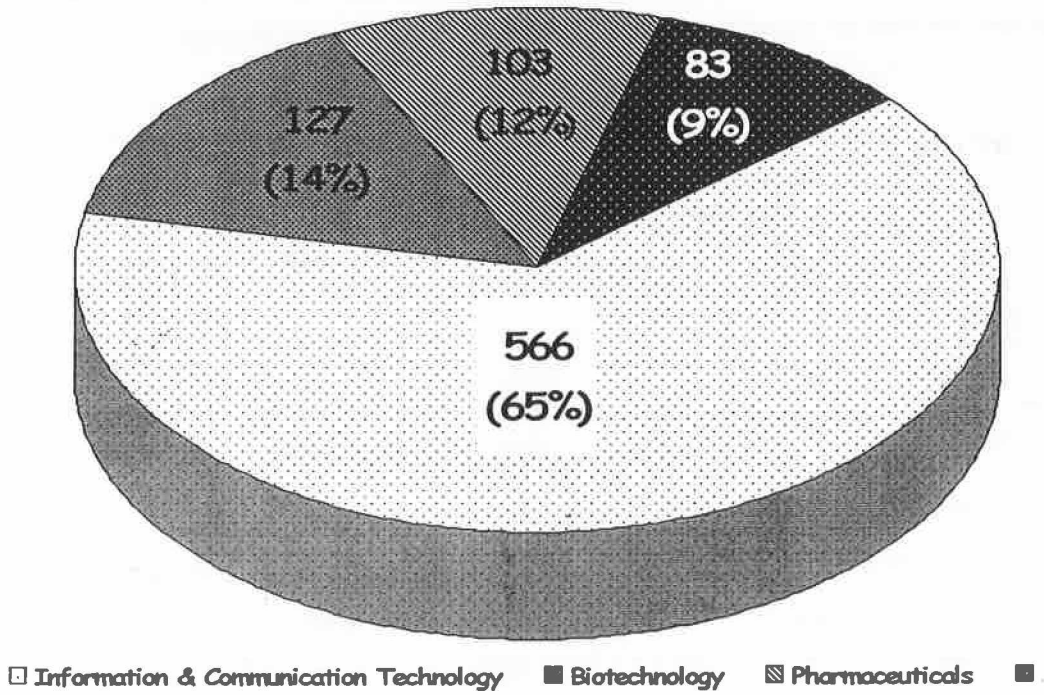
The secondary exercise was mainly attempted to solicit data on both micro and macro variables. On one hand it was attempted to identify the concerned variables, and on the other, it extended statistical back support to the study. The secondary sources utilized in the study were: -

- Targets - Data input on macro economic, sociological, political and statistical aspects.
- Sources - Books and other publications
  - Statistical compilations
  - Annual Reports of organizations, institutions, Government Ministries, and other departments
  - Internet surfing
  - Newspaper clippings
  - Journals, magazines, etc.
  - NRIF in-house data bank

Besides, contact was also established with the following sources: -

- Top 20 industries in all the four identified technological areas
- Universities-Central; Deemed; State and Tech-Institutes

Figure 2.4: Sample respondents (879) in different technological areas



Technological Area	M	F	Total
Information & Communication Technology	461	105	566
Biotechnology	95	32	127
Pharmaceuticals	83	20	103
Agriculture	76	7	83
Total	715	164	879

- ICAR-Institutes
- CSIR-Institutes
- ICMR: Institutes
- CII: Overseas Indian Facilitation Centre (OIFC)
- FICCI
- Assochem
- State Industrial Development Corporations;
- NASSOCOM
- IT Software Nasscom: Indo-association; IT. Agencies; Software cos.
- Top 100 Pharmaceutical Sources: Compiled by Cygnus Economic & Business Research
- Agricultural Industry 65 (Source: www.findouter.com);
- Dairy Development Corporation

- Ministry of External Affairs (MEA) and, Ministry of Overseas Indian Affairs (MOIA), Government of India
- Embassies & High Commissions of India in different overseas countries and that of the 20G countries in India.

The data thus collected was collated with the primary research findings to reach the final output.

2.5. Analysis

The study being a kind of opinion survey required specific statistical tools for analysis. The major tools applied for analysis were:

- **Quick-sort : Q-sort Method**[1]

Q-sort technique, the instrumental basis of Quantitative methodology (Q-methodology), was applied for rank ordering of a set of statements from 'agrees' to 'dis-agrees'. Since these statements were collected through personal interviews, they were grounded in concrete existence. Thus (as an example), the emerging set of statements were presented in the form presented in Table 2.2.

Table 2.2: Q-Sort methodology representing economic impact

Q-Sort Representing Economic Impact								
-4	-3	-2	-1	0	+1	+2	+3	+4
1	3	10	4	5	2	1	6	20
9	21	13	18	7	14	12	8	24
		22	23	15	1	19		
				16				

A perusal of Table 2.2 reveals that statements 20 and 24 have been 'agreed', by most of the respondents in an explicit way and on the other hand Nos. 1 and 9 have been totally 'dis-agreed' by the maximum respondents under all the

[1] There is a growing interest in empirical research in operations management. The **Quick-Sort (Q-sort) method**, which is a method of assessing reliability and construct validity of questionnaire items at a pre-testing stage, is described. The method is cost efficient and simple, yet provides ample insight into potential problem areas in the questionnaire items that are being tested. The method was actually applied in large-scale survey research.
http://ideas.repec.org/p/emp/wpaper/wp02-08.html .
(For details refer: <WP08/02 http://en.wikipedia.org/wiki/Quicksort Clave pdf>

categories. The column titled 0 represents the casual agreement on statements quoted below in the column and on the left hand of it are the statements which have been totally dis-agreed and on the right side are the statements on which the respondents have fully agreed. These were further strengthened by the relevant indicators. After that, the correlation options were selected followed by the **factor analytic option**.

The output tables have been presented through factor-arrays and further converted into simple table formats emerging out of factor analysis which inter-alia included:

- Attributes that were connected with the associated variables.
- Attribute that was the primary determinant of reverse brain gain.
- Classification of the demographic groups of the population in accordance with academic qualifications, professional levels and migratory outlook.
- Isolation of various "clusters" of respondents who reacted similarly to the trend and were united by demographic and other commonalities.

The findings were related to the independent variable, to cover different aspects of reverse brain gain. The functions of dependant variables were measured in terms of their weighted average and the extent to which these had guided RBG.

2.6. Constraints & Limitations:

To collect information on various facets of Brain Gain was a very difficult task, as no data sources were available. Some industries which promised to help, could not do so within the stipulated period, while NRIF was constrained for time.

The major limitation of this study has been that it could not conduct deeper investigations involving small and medium-sized organizations that have been created or transformed through 'brain gain'. The study team is of the view that this limitation can be redressed by undertaking another project which could cover selected case studies of Small Medium Entrepreneurs (SMEs) that have attracted individuals from abroad and embedded them within their domain.

CHAPTER 3

CHARACTERISTICS OF RBD / RBG PERSONS

Chapter 3

Characteristic of RBD / RBG Persons

3.1. Background

This chapter presents the classificatory characteristics of scientific and technical personnel of Indian origin who after working abroad have come back to work in the home country, i.e. denote the process of '**Reverse Brain Drain (RBD) / Reverse Bain Gain (RBG)**' in India. The study has covered 879 respondents from the following four technological areas:

- Information and Communication Technology (ICT)
- Biotechnology
- Drugs and Pharmaceuticals, and
- Agriculture

3.2. Characteristics of RBG Respondents

The characteristics covered in the study were:

- Year of return to India
- Period of study / assignments abroad
- Age and Gender of respondents
- Marital status
- Family background (socio- economic), and
- Asset base in India

All the above characteristics have been correlated, scrutinized, interpreted and analyzed for both intra (i.e. within the subject area) and overall technological areas.

Table 3.1: Triennium-wise return of RBD/ RBG respondents in different technological areas

Selected technological areas	TE 1990-1992			TE 1993-1995			TE 1996-1998			TE 1999-2001			TE 2002-2004			TE 2005-2008			No Response			Total		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
ICT	1	0	1	4	0	4	7	0	7	24	4	28	80	8	88	340	93	433	5	0	5	461	105	566
Biotechnology	5	1	6	3	1	4	6	2	8	11	4	15	20	5	25	38	17	55	12	2	14	95	32	127
Pharmaceuticals	4	1	5	1	2	3	9	0	9	15	0	15	19	4	23	21	12	33	14	1	15	83	20	103
Agriculture	2	1	3	3	0	3	6	0	6	8	2	10	17	2	19	30	2	32	10	0	10	76	7	83
Total respondents	12	3	15	11	3	14	28	2	30	58	10	68	136	19	155	429	124	553	41	3	44	715	164	879
Total respondents %	1.37	0.34	1.71	1.25	0.34	1.59	3.19	0.23	3.41	6.60	1.14	7.74	15.47	2.16	17.63	48.81	14.11	62.91	4.66	0.34	5.01	81.34	18.66	100.00

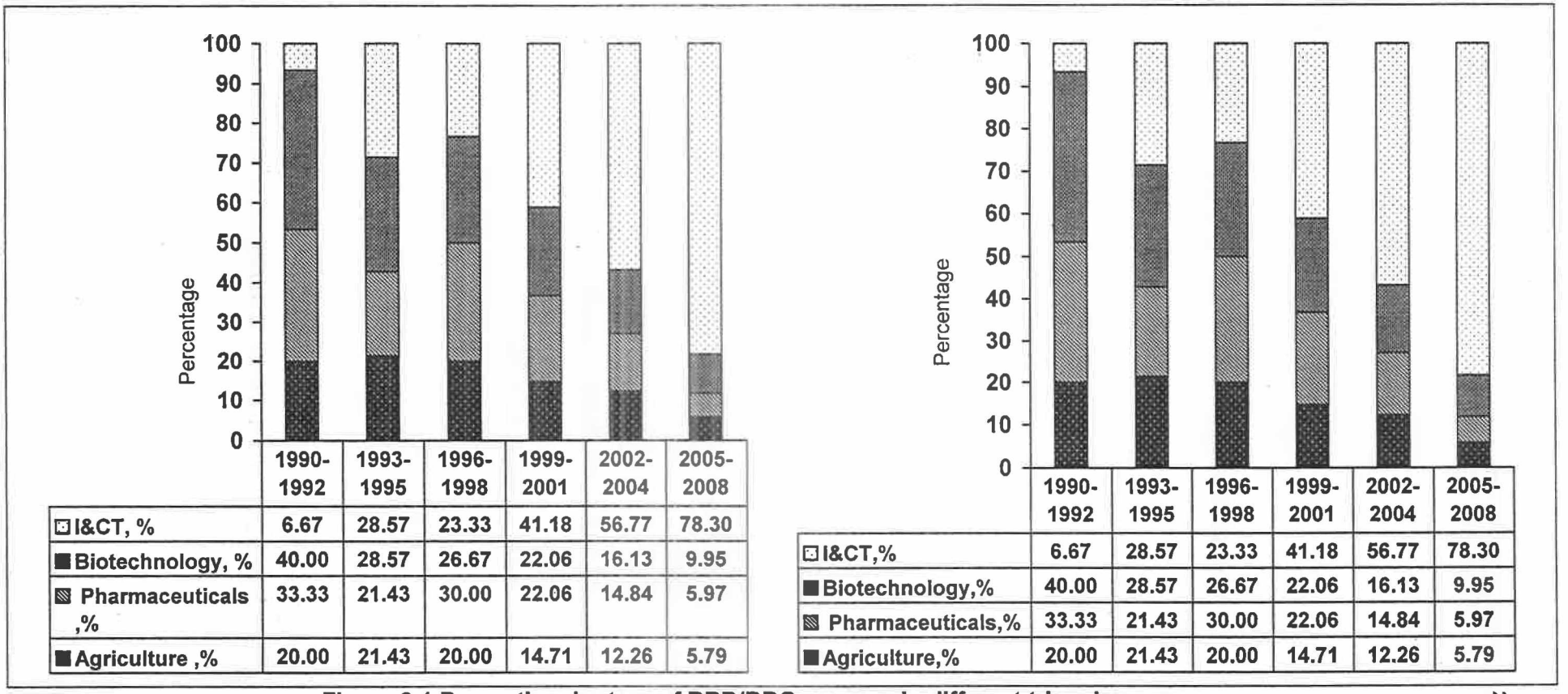


Figure 3.1 Proportional return of RBD/RBG persons in different trienniums
(A) Intra within Technological areas; (B) Overall Technological areas

3.2.1. Year of Return to India

The study has covered the S&T persons who have come back to India during the period 1990 and 2008. The period starts with the year 1990 when the policy of liberalization took up a striking shape in India, and opened the gates to MNCs for the economic development of the country. The statistical distribution of professionals by the selected technological subject groups who have come back during the six trienniums, viz. 1990-92, 1993-95, 1996-98, 1999-2001, 2002-2004 and 2005-07 has been presented in **Table 3.1 and Figure 3.1 (A & B).**

A perusal of Table 3.1 reveals that the number of persons returning to India increased in every triennium almost in all the four technological areas. It can be observed that the *maximum reverse brain drain (or / reverse brain gain) occurred in the triennium 2005-08, accounting for about 63 per cent of the total RBD / RBG persons during the period 1990-2008.* Triennium 2005-08 also witnessed the return of about 18 per cent RBD / RBG persons. Thus, in the *period 2002-2008, there has been a return of about 81 per cent professionally qualified persons.* This shows that India was able to attract the brain back only after the turn of the century. In **Figure 3.1A**, the percentage of RBD / RBG persons has been depicted within each triennium in the four technological areas individually, while in **Figure 3.1B**, the percentage of RBD / RBG persons has been depicted across all the trienniums in these four technological areas. The Q- short results have shown a repetition of similar order which has been converted in percentage distribution for different professional categories.

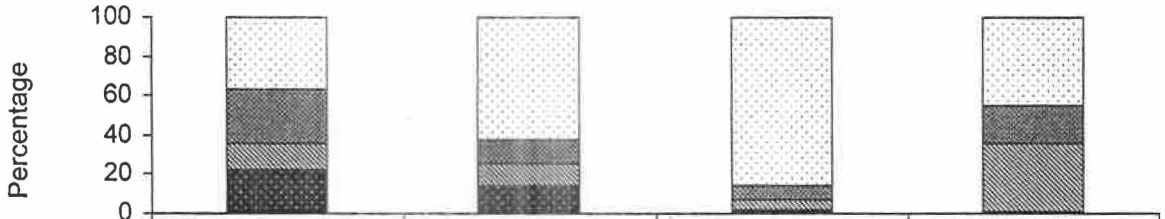
Across the technological areas, the maximum number of RBD / RBG persons has returned in information and communication technology (ICT) almost throughout the study period, the overall proportion being 64.4 per cent. It is followed by biotechnology (14.4%), pharmaceuticals (11.7%), and lastly agriculture (9.5%). In other technological areas also, the number of RBD / RBG persons has increased in every triennium, but much slowly than that in the IC&T sector.

Table 3.2: Duration of stay abroad of RBD / RBG professional in different technological areas (TA)

Selected technological areas	Short term	Medium term	Long term	Permanent	Joint Research Programme	Consultancy	Total
ICT	75	129	318	41	1	2	566
Biotechnology	56	26	26	18	1	0	127
Pharmaceuticals	28	23	19	32	0	1	103
Agriculture	46	29	7	1	0	0	83
Total	205	207	370	92	2	3	879
Percentage	23.3	23.6	42.1	10.5	0.2	0.3	100

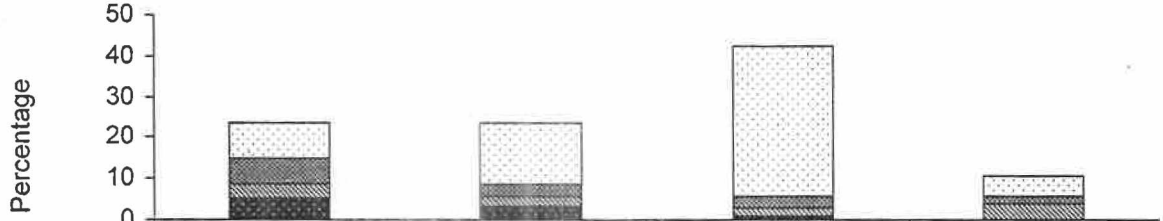
Note: The percentage of respective columns to the total respondents

Figure 3.2 A



	Short-term	Medium-term	Long-term	Permanent
I&CT, %	36.59	62.32	85.95	44.57
Biotechnology, %	27.32	12.56	7.03	19.57
Pharmaceuticals, %	13.66	11.11	5.14	34.78
Agriculture, %	22.44	14.01	1.89	1.09

Figure 3.2 B



	Short-term	Medium-term	Long-term	Permanent
I&CT, %	8.53	14.68	36.18	4.66
Biotechnology, %	6.37	2.96	2.96	2.05
Pharmaceuticals, %	3.19	2.62	2.16	3.64
Agriculture, %	5.23	3.30	0.80	0.11

Figure 3.2: The percentage of stay of RBD/RBG professionals in different technological areas in respect of (A) each term and (B) total duration

The triennium-wise data have been revealed that the proportion of ICT persons coming back to India increased from 6.7 per cent during 1990-92 to 78.3% during 2005-08. However, in other technological areas, the percentage within each triennium hovered around 20% till 2002-04 but it dropped drastically in the triennium 2005-08.

3.2.2. Duration / Type of Assignment Abroad

The duration of stay abroad on assignments (by type) for individual RBD / RBG professionals was analyzed in terms of its periodicity: (a) short-term (less than 6 months), (b) medium-term (up to two years), (c) long-term (more than 2 years); (d) permanent, (e) joint industrial visit, (f) joint research programme, and (g) consultancy. The relevant information in selected four technological areas has been presented in **Table 3.2.**

A perusal of Table 3.2 reveals a majority (42.1%) of persons returning to India had gone on long-term basis, which shows their strong desire to come back to India. Almost an equal proportion (23%) of RBD / RBG persons was on short-term and medium-term visits. The persons who had gone permanently was also quite significant (>10%).

The proportion of RBD / RBG persons who had gone on consultancy assignments or under joint research ventures was very low.

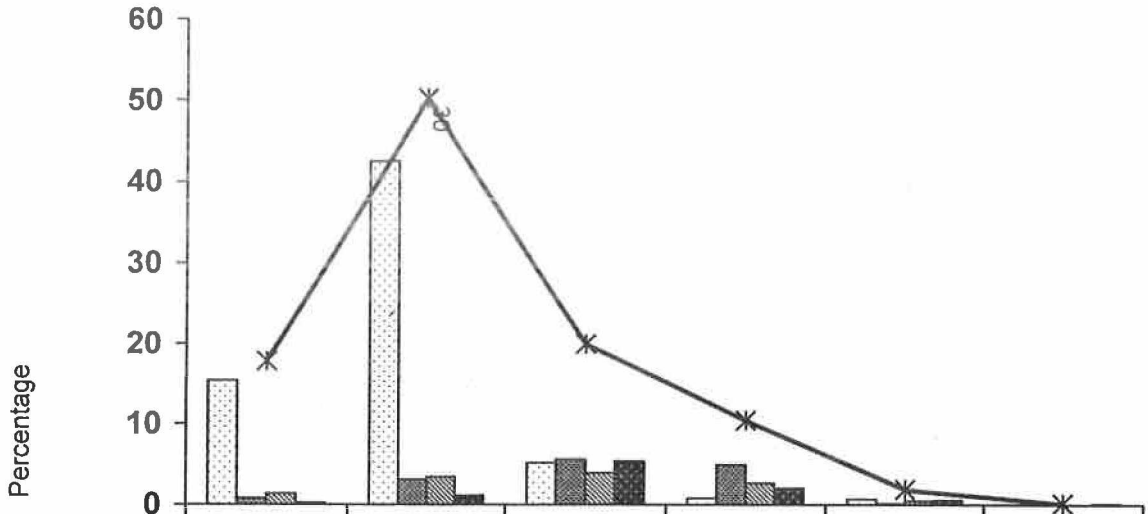
The technological area-wise, the study has revealed that maximum professionals have returned in ICT area, accounting for 64.4 per cent of all the persons returned. It was followed by biotechnology (14.4%), pharmaceuticals (11.7%) and lastly agriculture with 9.5 per cent RBD / RBG persons. Thus, the proportion of ICT professionals has been far more than that of other technological areas.

The percentage of RBD / RBG professionals in different technological areas in respect of duration of stay has been shown term-wise in **Figure 3.2 A** and overall duration **Figure 3.2 B**. On higher level scale nearly 42% of respondents agreeing to the situation belong to ICT category.

Table 3.3: Age-group-wise number of RBD/RBG professionals in different technological areas

Selected technological area	Up to 30 years			31-40 years			41-50 years			51-60 years			61-70 years			Above 70 years			Total		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
ICT	89	46	135	317	56	373	43	2	45	7	0	7	5	1	6	0	0	0	461	105	566
Biotechnology	4	3	7	22	5	27	39	10	49	29	14	43	1	0	1	0	0	0	95	32	127
Pharmaceuticals	6	6	12	23	7	30	29	5	34	21	2	23	4	0	4	0	0	0	83	20	103
Agriculture	2	0	2	7	3	10	44	3	47	17	1	18	5	0	5	1	0	1	76	7	83
Total	101	55	156	369	71	440	155	20	175	74	17	91	15	1	16	1	0	1	715	164	879

Figure 3.3: The percentages of RBD/RBG persons in different age-groups across the selected technological areas



	Up to 30 Years	31-40 Years	41- 50 Years	51-60 Years	61-70 Years	Above 70 Years
I&CT, %	15.36	42.43	5.12	0.80	0.68	0.00
Biotechnology, %	0.80	3.07	5.57	4.89	0.11	0.00
Pharmaceuticals, %	1.37	3.41	3.87	2.62	0.46	0.00
Agriculture ,%	0.23	1.14	5.35	2.05	0.57	0.11
Total, %	17.75	50.06	19.91	10.35	1.82	0.11

3.2.3. Age of RBD / RBG professionals

The age of RBD / RBG professionals was studied by grouping them into six age-categories, viz. up to 30 years, 31-40 years, 41-50 years, 51-60 years, 61-70 years, and above 70 years at return to India. (**Table 3.3**). A perusal of Table 3.3 reveals that the age group of 31-40 years was biggest (about 50%), followed by age-group of 41-50 years (about 20%), up to 30 years (about 18%) and 51-60 years (about 10%). Both the age-group beyond 60 years had a very small percentage of RBD / RBG professionals.

The percentage of RBD / RBG persons in different age-groups across the selected technological areas has been depicted in **Figure 3.3.** This information has been further examined for inter-technological areas and also inter-age groups after eliminating the non-responsive groups. The vague responses were also eliminated using Q-short technique.

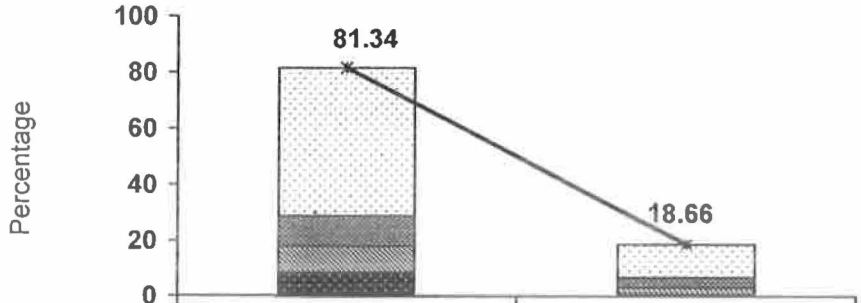
It reveals that among the respondents, about 58 per cent of the ICT personnel (the most repetitive respondent group) were comparatively young, being below 40 years of age, as compared to RBD / RBG professionals in biotechnology (3.87%), pharmaceuticals (4.78%) and agriculture (1.37%). The figure also shows that the proportion of ICT personnel first increased up to 40 years group but started declining in higher age groups.

The proportion of persons in the remaining three technological area increased up to the next higher age-group of 41-50 years, and declines from the age-group of 51-60 and 61-70 years, i.e. in a declining proportionate distribution order tested on Q-short analysis.

Table 3.4: Gender-wise distribution of RBD persons in selected technological areas

Selected technological areas	Male	Females	Total
ICT	461	105	566
Biotechnology	95	32	127
Pharmaceuticals	83	20	103
Agriculture	76	7	83
Total	715	164	879

Figure 3.4: Proportion of males and females in different technological areas



	Males	Females
I&CT ,%	52.45	11.95
Biotechnology, %	10.81	3.64
Pharmaceuticals,%	9.44	2.28
Agriculture,%	8.65	0.80
Total ,%	81.34	18.66

3.2.4. Gender Composition

The Reverse Brain Gain scenario has been found to enjoy male dominance since overall composition of randomly selected target respondents has revealed that about 81.3 per cent of the respondents were males and only 18.7% were female (**Table 3.4**).

The technological areas-wise study has revealed that in terms of absolute numbers, ICT dominated in both RBD / RBG males and RBD / RBG females, but in terms of proportion, agriculture dominated in RBD / RBG males with 91.6 per cent, followed by ICT (81.4%), pharmaceuticals (80.5%) and biotechnology (74.8%). It was probably because the fact that agriculture in India is dominated by males today.

The proportion of RBD / RBG females was maximum in biotechnology (25.2%), followed by pharmaceuticals (19.5%), ICT (18.6%) and lastly agriculture (8.4%). This shows that technological area, biotechnology, is more popular among females than males.

It was also found that in terms of absolute numbers or percentage of total RBD / RBG persons, the order was same for both males and females in four technological areas.

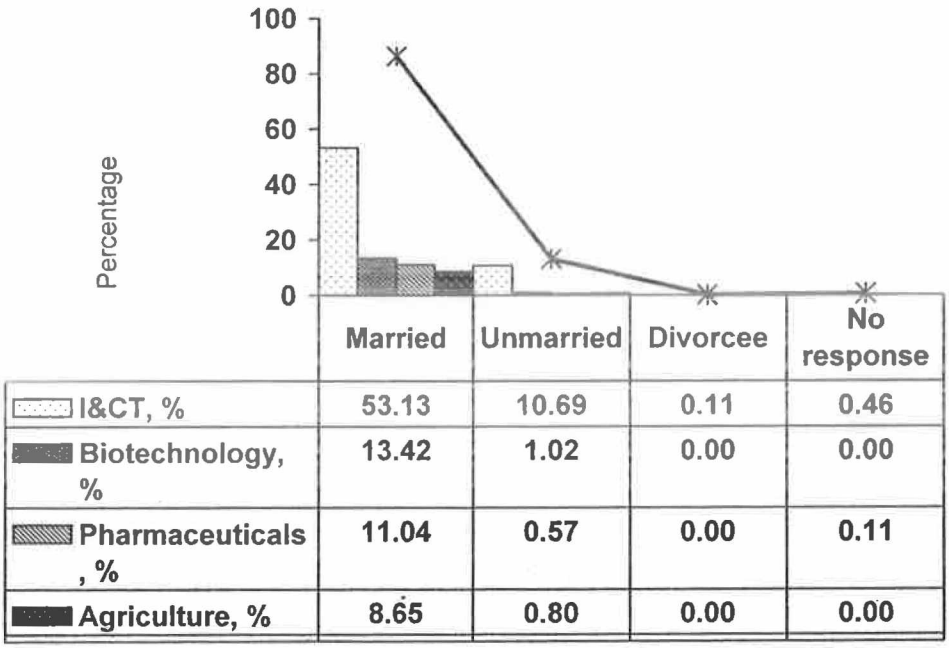
The study has revealed that among females, even the maximum proportion was only 11.9 per cent (in ICT) and minimum was less than 1 per cent (0.81%) in agriculture.

The proportion of males and females in different technological areas has been depicted in **Figure 3.4**

Table 3.5: Marital status-wise distribution of RBD/RBG persons in selected technological areas

Selected technological areas	Married	Unmarried	Divorcee	No response	Total
ICT	467	94	1	4	566
Biotechnology	118	9	0	0	127
Pharmaceuticals	97	5	0	1	103
Agriculture	76	7	0	0	83
Total	758	115	1	5	879

Figure 3.5: Technological areas -wise Proportion of each category of marital status of RBD/RBG persons



3.2.5. Marital Status

The overall scenario about marital status has shown that about 86.2% of RBD / RBG persons were married and only 13.1% were unmarried, and, one person out of a sample of 879 was a divorcee (**Table 3.5**).

Across different technological areas, the proportion of married persons was highest in pharmaceuticals (94.2%), followed by biotechnology (92.9%), agriculture (91.6%) and ICT (82.5%).

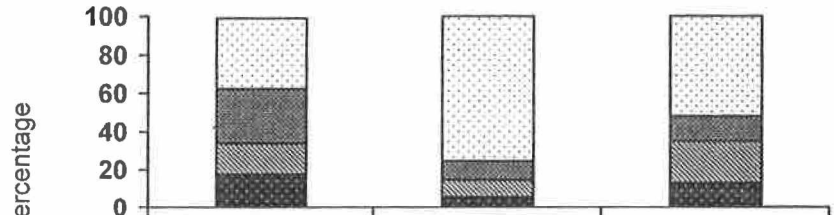
Consequently, the proportion of unmarried RBD / RBG persons depicted a reverse trend, i.e. ICT (16.6%), was followed by agriculture (8.4%), biotechnology (7.1%) and pharmaceuticals (4.9%).

Within each category of marital status, the proportional distribution in the four technological areas has been depicted in **Figure 3.5**.

Table 3.6: Family income status of RBD/RBG persons in different technological areas

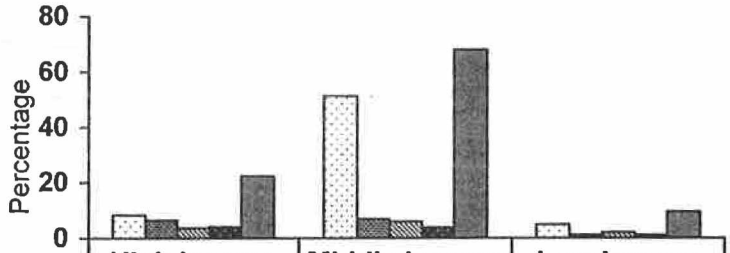
Selected technological areas	High income group	Middle income group	Low income group	No response	Total
ICT	72	450	43	1	566
Biotechnology	56	60	11	0	127
Pharmaceuticals	32	53	18	0	103
Agriculture	37	35	11	0	83
Total	197	598	83	1	879

Figure 3.6: A (Intra TA)



	High income group	Middle income group	Low income group
I&CT,%	36.55	75.25	51.81
Biotechnology ,%	28.43	10.03	13.25
Pharmaceuticals, %	16.24	8.86	21.69
Agriculture ,%	17.78	5.85	13.25

Figure 3.6: B



	High income group	Middle income group	Low income group
I&CT ,%	8.19	51.19	4.89
Biotechnology ,%	6.37	6.83	1.25
Pharmaceuticals, %	3.64	6.03	2.05
Agriculture ,%	4.21	3.98	1.25

3.2.6. Family Background – Income Status

This sub-section makes an attempt to find the family status of professional persons who had gone abroad. The income status of families was assessed by classifying them into three groups, viz. High, Middle, and Low income groups. Their responses have been further stratified by category and then analyzed on Q-sort matrix. The results have been translated and presented in succeeding paragraphs. It was examined in two ways: first, by finding the proportion of persons of each technological area in each income group, and second by assessing their proportions in inter-technological areas and also in inter-income groups.

The family income status of RBD / RBG persons belonging to different technological areas has been presented in **Table 3.6.** A perusal of this table revealed the domination of middle income group with a overall share of 68.0 per cent. It was followed by high income group (22.4%) and lastly low-income group (9.4%).

Across technological areas within a group, presented in **Figure 3.6 A**, it was found as follows:

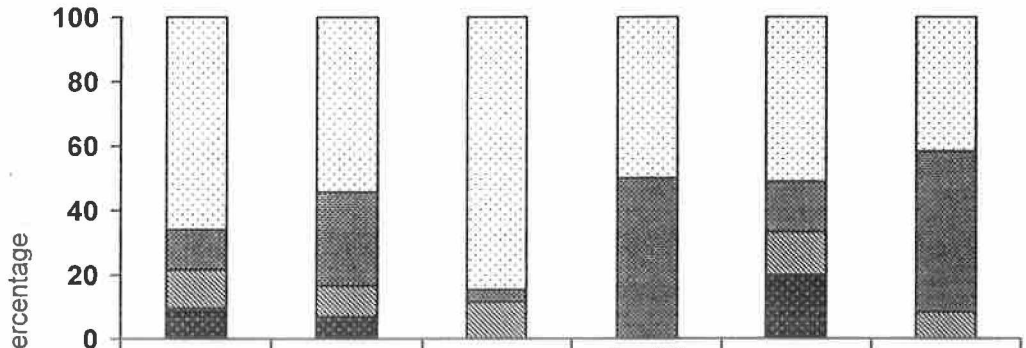
a) Within high income group, IC&T dominates (36.5%), followed by biotechnology, agriculture and pharmaceuticals
b) Within middle income group, IC&T dominated followed by biotechnology, pharmaceuticals and agriculture
c) Within low income group, IC&T dominated followed by pharmaceuticals, and agriculture and biotechnology being at par.

The overall comparison of technological areas in different income groups presented in **Figure 3.6 B** also revealed the dominance of middle income group and ICT technological area. The study has shown that the technological area ICT is more popular among the middle income group. The proportion of remaining respondents ranged from 1per cent to 8 per cent in the remaining three technological areas in each of the income group. Their responses have been further stratified by category and then analyzed on Q-sort matrix. The results have been translated and presented in succeeding paragraphs.

Table 3.7: Family occupational status of RBD/RBG persons who went abroad in different technological areas

Selected technological areas	Professionals	Business & trade	Industry	Small & medium enterprises	Farming	Others	No response	Total
ICT	474	39	22	1	23	5	2	566
Biotechnology	91	21	1	1	7	6	0	127
Pharmaceuticals	86	7	3	0	6	1	0	103
Agriculture	69	5	0	0	9	0	0	83
Total	720	72	26	2	45	12	2	879

Figure 3.7: A (Intra TA)



	Professional	Business & trade	Industry	Small & medium enterprises	Farming	Others
I&CT ,%	65.83	54.17	84.62	50.00	51.11	41.67
Biotechnology, %	12.64	29.17	3.85	50.00	15.56	50.00
Pharmaceuticals, %	11.94	9.72	11.54	0.00	13.33	8.33
Agriculture, %	9.58	6.94	0.00	0.00	20.00	0.00

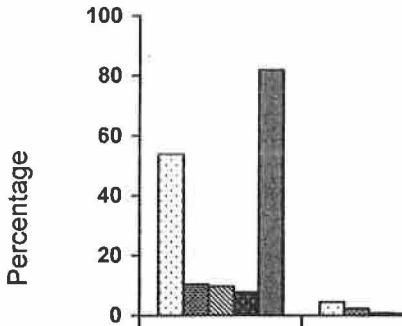


Figure 3.7: B

	Professionals	Business & trade	Industry	Small & medium enterprises	Farming	Others
I&CT,%	53.92	4.44	0.03	0.00	1.02	0.57
Biotechnology,%	10.35	2.39	0.00	0.00	0.68	0.68
Pharmaceuticals,%	9.78	0.80	0.34	0.11	0.80	0.11
Agriculture,%	7.85	0.57	0.11	0.11	2.62	0.00
overall total ,%	81.90	8.20	2.50	0.20	5.10	1.40

3.2.7. Family Background – Occupational Group

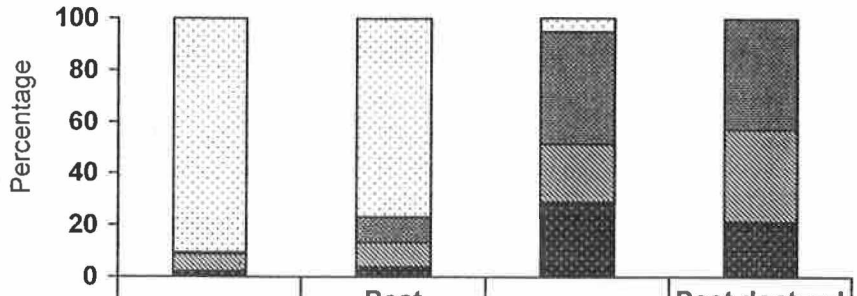
Table 3.7 and **Figure 3.7A** presents technological area-wise distribution of persons who have come back from abroad within different occupational groups of the family. The occupational groups of the family were classified as professionals, business and trade, industry; small and medium enterprises, farming and others. The Table 3.7 shows that the ICT persons constituted a majority proportion in each occupational group and it ranged from 50 per cent in small and medium enterprise background to 84.6 per cent in industry background.

The study has revealed absolute dominance of professional background in RBD / RBG persons, with a share of 81.9 per cent. It shows that families with professional background groom their children to go abroad. Across technological areas within a professional group (**Figure 3.7 B**), 53.9 per cent of the persons were from ICT professional group, followed by biotechnology (10.3%), pharmaceuticals (9.7%) and agriculture (7.8%) groups.

Table 3.8: Academic qualification and discipline of RBD/RBG persons at the time of leaving India

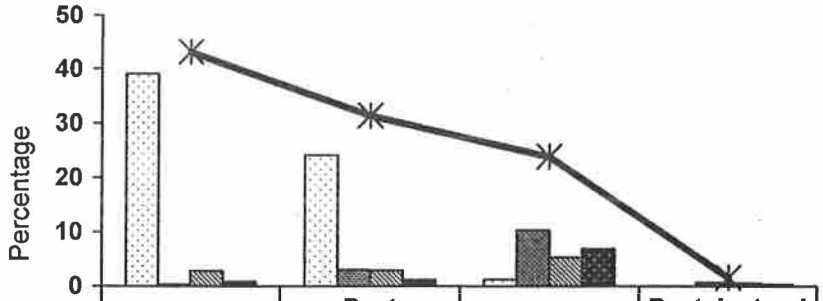
Selected technological areas	Graduation	Post graduation	PhD	Post doctoral research	Total
ICT	343	212	11	0	566
Biotechnology	3	27	91	6	127
Pharmaceuticals	25	26	47	5	103
Agriculture	8	11	61	3	83
Total	379	276	210	14	879

Figure-3.8 A (Intra TA)



	Graduation	Post graduation	PhD	Post doctoral research
I&CT, %	90.50	76.81	5.24	0.00
Biotechnology, %	0.79	9.78	43.33	42.86
Pharmaceuticals, %	6.60	9.42	22.38	35.71
Agriculture, %	2.11	3.99	29.05	21.43

Figure -3.8 B



	Graduation	Post graduation	PhD	Post doctoral research
I&CT ,%	39.02	24.12	1.25	0.00
Biotechnology, %	0.34	3.07	10.35	0.68
Pharmaceuticals ,%	2.84	2.96	5.35	0.57
Agriculture ,%	0.91	1.25	6.94	0.34
Total ,%	43.12	31.40	23.89	1.59

3.2.8. Pre-Migration Status of Academic Qualifications and Area of Specialization of RBD / RBG persons

The study of academic qualifications of RBD / RBG persons was an important parameter. It has been studied at both levels viz. pre-migration and post-migration (Section 3.2.9). The academic qualifications and discipline of RBD / RBG persons at the time of leaving India have been summarized in **Table 3.8** under the four selected technological areas. The intra-technological area comparison has been depicted within each qualification in **Figure 3.8 A** and overall in **Figure 3.8 B**.

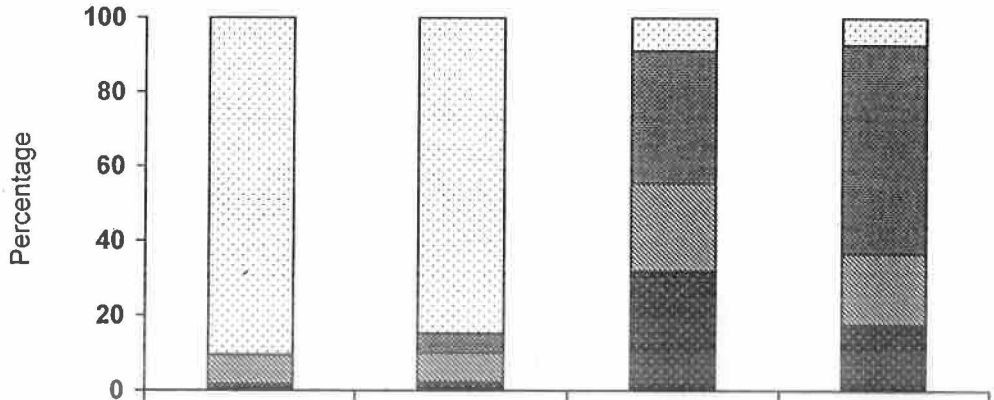
The study has revealed that the proportion of graduates was slightly higher (43.1%) than that of post-graduates (31.4%). The persons with PhD degree were 23.9 per cent and with post-doctoral research, 1.6 per cent. The study has revealed the same striking facts related to academic background of the professionals contacted under this study. It was found that 90.5% per cent of the ICT persons who went abroad were graduates and 76.8 per cent were post-graduates. The proportion of PhD holders among ICT persons was only 5.2 per cent. On the other hand, there were large proportions of persons with PhD degrees in agriculture (29.05%), pharmaceuticals (22.4%) and biotechnology (43.3%). Similarly, none of the ICT persons had post-doctoral research experience, about 21.43%, 35.71%, and 42.86% were having post-doctoral research experience in agriculture, pharmaceuticals and biotechnology, respectively, at the time of going abroad.

The higher percentage of post-graduates and PhD degree-holders in biotechnology, agriculture and pharmaceuticals was attainment of a MSc. or PhD degree to become a professional in that area, while in the ICT, only a graduate level degree is sufficient to become a professional.

Table 3.9: Academic qualifications and discipline of RBD/RBG Persons on return from abroad

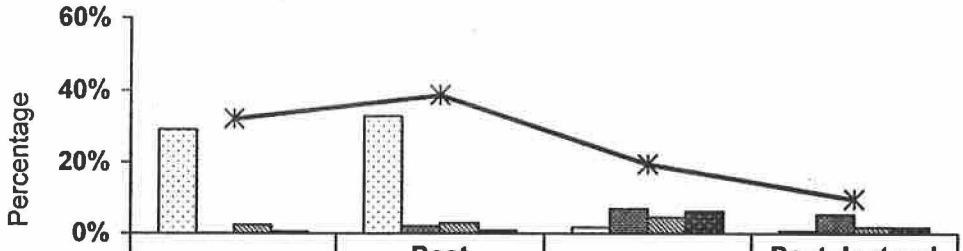
Selected technological areas	Graduation	Post graduation	PhD	Post doctoral research	Total
ICT	256	289	15	6	566
Biotechnology	1	18	61	47	127
Pharmaceuticals	21	26	40	16	103
Agriculture	5	8	55	15	83
Total	283	341	171	84	879

Figure-3.9 A (Intra TA)



	Graduation	Post graduation	PhD	Post doctoral research
I&CT,%	90.46	84.75	8.77	7.14
Biotechnology, %	0.35	5.28	35.67	55.95
Pharmaceuticals, %	7.42	7.62	23.39	19.05
Agriculture, %	1.77	2.35	32.16	17.86

Figure -3.9 B



	Graduation	Post graduation	PhD	Post doctoral research
I&CT, %	29.12%	32.88%	1.71%	0.68%
Biotechnology ,%	0.11%	2.05%	6.94%	5.35%
Pharmaceuticals, %	2.39%	2.96%	4.55%	1.82%
Agriculture ,%	0.57%	0.91%	6.26%	1.71%
Total ,%	32.20%	38.79%	19.45%	9.56%

3.2.9. Post-Migration Status of Academic Qualifications and Area of Specialization of RBD / RBG persons

It has been observed that after going abroad the process of learning and thirst for knowledge have continued in a majority of the RBD / RBG persons. **Table 3.9 and Figure 3.9 (A& B)** depict the level of education possessed by respondents after coming back from abroad in the four selected technological areas. The responses have shown a fairly high level of correlation between age, profession and income level.

A perusal of Table 3.9 revealed that on return, the proportion of post-graduates was at the top position (38.8%), followed by graduates (32.7%), PhDs (19.5%) and post-docs (9.6%).

The study on intra-technological areas at each degree level (**Figure 3.9A**) revealed graduates and post-graduates dominated in ICT area with 90.5 per cent and 84.5 per cent, respectively.

The PhD degree was dominated among RBD / RBG persons belonging to biotechnology (35.7%) as well as agriculture (32.2%); while pharmaceuticals had 23.4% and ICT, 8.8% PhD degree holders.

3.2.10. A Comparison of Pre-Migration and Post-Migration Qualifications of RBD / RBG persons

A comparison of pre-migration and post-migration qualifications of persons who have come back to India was also made to get an idea of their qualifications status (Table 3.10 A). Again the ICT sector professionals occupied the top slot on Q-short analysis matrix.

A perusal of **Table 3.10A** revealed that a significant proportion of persons who had gone-abroad tried to get higher qualifications in terms of post-graduate or PhD degrees. Similarly, persons having post-graduate or PhD degrees, had acquired post-doc research experience.

Table 3.10A: A comparison of pre-migration and post-migration qualifications of RBD / RBG persons

(in number)

Selected Technological areas	Graduation		Post-graduation		PhD		Post-doctoral research	
	Pre-migration	Post-migration	Pre-migration	Post-migration	Pre-migration	Post-migration	Pre-migration	Post-migration
ICT	343	256	212	289	11	15	0	6
Biotechnology	3	1	27	18	91	61	6	47
Pharmaceuticals	25	21	26	26	47	40	5	16
Agriculture	8	5	11	8	61	55	3	15
Total	**379**	**283**	**276**	**341**	**210**	**171**	**14**	**84**
Percentage	**43.1**	**32.2**	**31.4**	**38.8**	**23.9**	**19.5**	**1.6**	**9.6**

Source : Graph-3.9 A & B; Overall sample: Total respondents (879)

Thus, under post-migration scenario, the percentage of graduates went down from 43.1% to 32.2%, while that post-graduates increased from 31.4% to 38.8%. There was a significant rise in the proportion of post-graduates research holders from 1.6% to 9.6%. The proportions of qualification levels in different technological areas have been depicted in **Table 3.10B**. The significant gain in qualifications has been at post-graduates level in ICT area and at post-doctoral research in biotechnology, pharmaceuticals and agriculture.

Table 3.10B: Pre-Migration and post-migration proportion of different qualification levels of persons in different technological areas *(in %age)*

Selected Technological area	Graduation		Post-graduation		PhD		Post doctoral research	
	Pre-migration	Post-migration	Pre-migration	Post-migration	Pre-migration	Post-migration	Pre-migration	Post-migration
ICT	39.02	29.12	24.12	32.88	1.25	1.71	0.00	0.68
Biotechnology	0.34	0.11	3.07	2.05	10.35	6.94	0.68	5.35
Pharmaceuticals	2.84	2.39	2.96	2.96	5.35	4.55	0.57	1.82
Agriculture	0.91	0.57	1.25	0.91	6.94	6.26	0.34	1.71
Total	43.12	32.20	31.40	38.79	23.89	19.45	1.59	9.56

Source: Graph-3.9 A & B; Overall sample: Total respondents (879)

The proportions of qualification levels in different technological areas have been depicted in **Table 3.10B**. The significant gain in qualifications has been at post-graduates level in ICT area and at post-doctoral research in biotechnology, pharmaceuticals and agriculture.

The study has thus concluded that persons after return were more qualified and more experienced in the selected technological areas.

3.2.11. Specialization of RBD / RBG Persons

The specializations of RBD / RBG persons were studied in terms of natural sciences, applied sciences, business or management, applied social sciences, social sciences, humanities and fine arts and others. Information on specialization-wise distribution of persons in the four selected technological areas has been presented in **Table 3.11**. A perusal of Table 3.11 revealed that a majority of RBD / RBG persons belonged to the applied sciences theme, followed by the themes of business / management (14.8%), natural sciences (4.4%), humanities & fine arts (2.7%) and pure social sciences (0.2%). Other themes also covered more than 10% RBD / RBG persons.

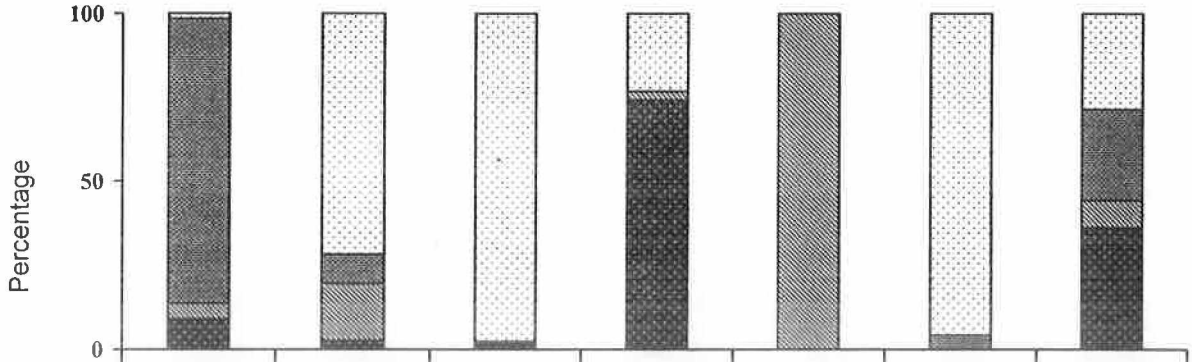
The study on intra-technological areas in each specialization has been presented in **Figure 3.10 A** through higher level analysis and on overall basis in **Figure 3.10 B**. A notable aspect of the intra-technological areas study was a clear-cut demarcation of a theme. In natural sciences theme, biotechnology topped (84.8%); in applied sciences and business / management, ICT areas, topped with proportions of 71.8% and 97.7%, respectively; in applied social sciences, pharmaceuticals had a clean sweep with 100% share, in humanities & fine arts, ICT topped (95.8%)..

The higher level analysis has shown a declining trend by professional category, explaining dominance of professionals from a particular sector and so on.

Table 3.11: Specialization of RBD/RBG persons in different areas

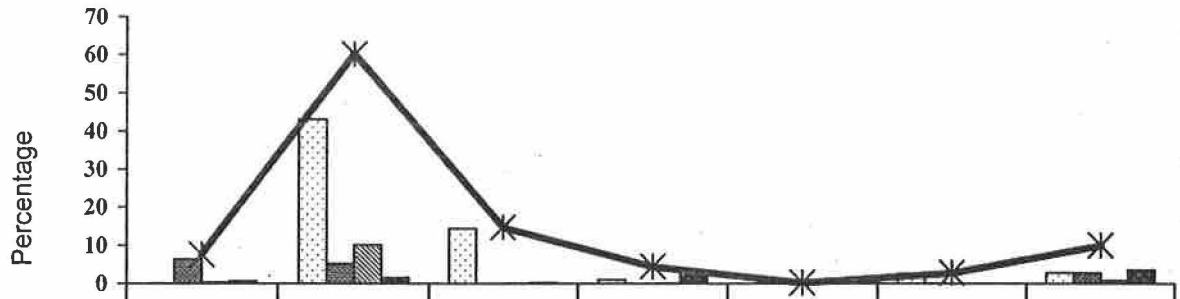
Selected technological areas	Natural sciences	Applied sciences	Business or management	Applied social sciences	Social sciences	Humanities & fine arts	Others	No response	Total
ICT	1	379	127	9	0	23	25	2	566
Biotechnology	56	46	0	0	0	1	24	0	127
Pharmaceuticals	3	89	1	1	2	0	7	0	103
Agriculture	6	14	2	29	0	0	32	0	83
Total	66	528	130	39	2	24	88	2	879

Figure 3.10 A (Intra TA)



	Natural sciences	Applied sciences	Business Management	Applied social sciences	Social science	Humanities & fine arts	Others
I&C.T %	1.52	71.78	97.69	23.08	0.00	95.83	28.41
Biotechnology %	84.85	8.71	0.00	0.00	0.00	4.17	27.27
Pharmaceuticals %	4.55	16.86	0.77	2.56	100.00	0.00	7.95
Agriculture %	9.09	2.65	1.54	74.36	0.00	0.00	36.36

Figure 3.10 B



	Natural sciences	Applied sciences	Business/ Management	Applied social sciences	Social sciences	Humanities & fine arts	Others
I&CT ,%	0.11	43.12	14.45	1.02	0.00	2.62	2.84
Biotechnology, %	6.37	5.23	0.00	0.00	0.00	0.11	2.73
Pharmaceuticals, %	0.34	10.13	0.11	0.11	0.23	0.00	0.80
Agriculture ,%	0.68	1.59	0.23	3.30	0.00	0.00	3.64
Total ,%	7.51	60.07	14.79	4.44	0.23	2.73	10.01

Figure 3.10: Specialization-wise proportional distribution of RBD/RBG persons in different technological areas (A) Within each specialization, and (B) on overall basis

3.2.12. Nature of Responsibility of RBD / RBG Persons: Overseas

The nature of responsibility overseas was examined in terms of the type of work assigned to the persons while working abroad. The data presented in **Table 3.12** revealed that the overall responsibility of RBD / RBG persons was technical in nature, followed by engagement in R&D and management spheres. A significant proportion (27.0%) of RBD / RBG persons belonging to ICT area reported the nature of responsibility in software and hardware development for computers, communication network, etc.

A considerable portion of RBD / RBG persons was engaged in R&D work in all the technological areas; on overall basis, their proportion was maximum in biotechnology (7.7%), followed by agriculture (5.6%), pharmaceuticals (2.7%), and ICT (1.0%), as depicted in **Figure 3.11 B.**

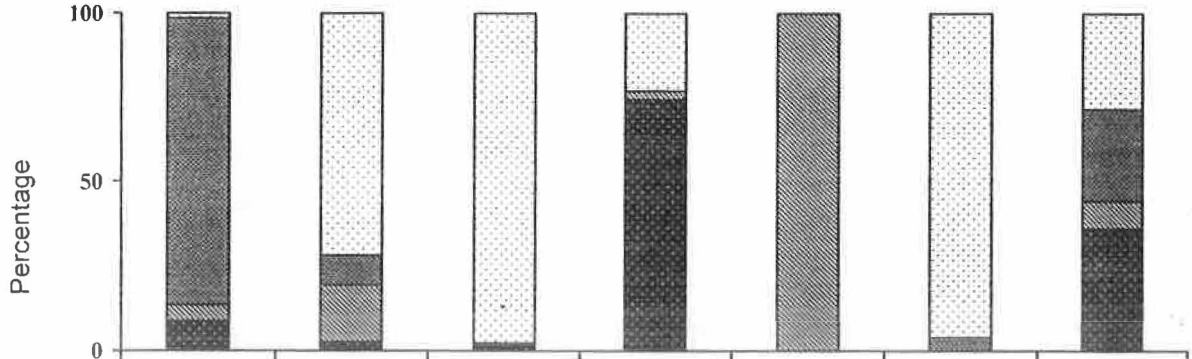
The study on intra-technological areas in each category of responsibility has been presented in **Figure 3.11 A**.

A perusal of this Figure 3.11 A revealed that RBD / RBG persons having background of agriculture and biotechnology were largely engaged in R&D work, while ICT persons were engaged in technical and management jobs. The persons with pharmaceuticals background were engaged in technical and R&D jobs.

Table 3.11: Specialization of RBD/RBG persons in different areas

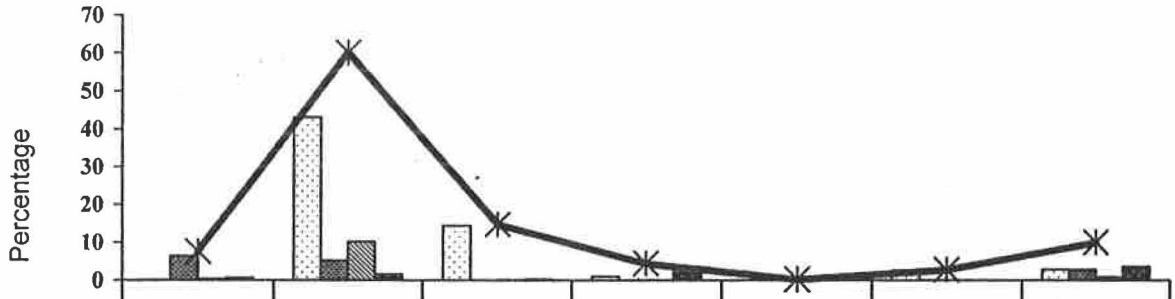
Selected technological areas	Natural sciences	Applied sciences	Business or management	Applied social sciences	Social sciences	Humanities & fine arts	Others	No response	Total
ICT	1	379	127	9	0	23	25	2	566
Biotechnology	56	46	0	0	0	1	24	0	127
Pharmaceuticals	3	89	1	1	2	0	7	0	103
Agriculture	6	14	2	29	0	0	32	0	83
Total	66	528	130	39	2	24	88	2	879

Figure 3.10 A (Intra TA)



	Natural sciences	Applied sciences	Business Management	Applied social sciences	Social science	Humanities & fine arts	Others
I&C.T %	1.52	71.78	97.69	23.08	0.00	95.83	28.41
Biotechnology %	84.85	8.71	0.00	0.00	0.00	4.17	27.27
Pharmaceuticals %	4.55	16.86	0,77	2.56	100.00	0.00	7.95
Agriculture %	9.09	2.65	1.54	74.36	0.00	0.00	36.36

Figure 3.10 B



	Natural sciences	Applied sciences	Business/ Management	Applied social sciences	Social sciences	Humanities & fine arts	Others
I&CT ,%	0.11	43.12	14.45	1.02	0.00	2.62	2.84
Biotechnology, %	6.37	5.23	0.00	0.00	0.00	0.11	2.73
Pharmaceuticals, %	0.34	10.13	0.11	0.11	0.23	0.00	0.80
Agriculture ,%	0.68	1.59	0.23	3.30	0.00	0.00	3.64
Total ,%	7.51	60.07	14.79	4.44	0.23	2.73	10.01

Figure 3.10: Specialization-wise proportional distribution of RBD/RBG persons in different technological areas (A) Within each specialization, and (B) on overall basis

3.2.13. Country / Region Last Worked

Respondents were asked to indicate the country in which they had worked last. This information, compiled gender-wise and technological area-wise, has been presented in **Table 3.13**. The country-wise information has been compiled in **Table-3.14** and depicted in proportionate terms in **Figure 3.12**.

A perusal of **Table 3.12, Table 3.14** and **Figure 3.12** revealed that there were 17 countries where 10 or more persons have worked last. **Table 3.15** gives the names of the other countries, where less than 10 persons had indicated to have worked last.

The information presented in **Table 3.13, Table 3.14** & **Figure 3.12** shows that the largest proportion (36.18%) of the respondents had indicated to have last worked in the USA, followed by UK (12.17%), Singapore (5.01%), Australia (4.44%), Germany (3.41%), UAE (3.30%), Japan (2.73%), etc.

An attempt was also made to find the proportion of persons in each of the four selected technological areas who had worked in a country and this information has been presented in **Table 3.16**. It shows that between 60% and 93% of ICT personnel had last worked in most of the countries; their proportion was 60% in the USA, Germany and Italy;

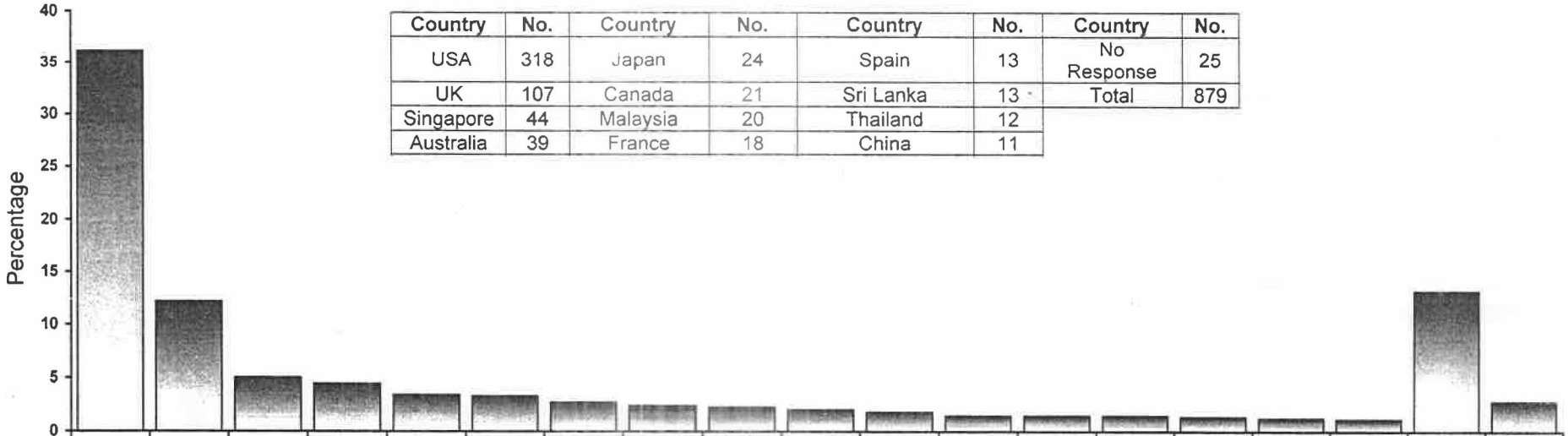
Table 3.13: Name of country last worked abroad by RBD/RBG persons: Gender-wise

(No.)

Selected technological areas	USA			UK			Germany			Japan			Australia			Singapore			France			UAE		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
ICT	152	41	193	71	19	90	16	2	18	15	2	17	25	5	30	34	7	41	11	1	12	9	2	11
Biotechnology	54	16	70	3	2	5	4	4	8	2	1	3	1	2	3	3	0	3	4	0	4	0	0	0
Pharmaceuticals	26	4	30	7	1	8	1	0	1	1	0	1	3	1	4	0	0	0	0	0	0	3	5	8
Agriculture	24	1	25	3	1	4	2	1	3	3	0	3	2	0	2	0	0	0	2	0	2	1	0	1
Total	256	62	318	84	23	107	23	7	30	21	3	24	31	8	39	37	7	44	17	1	18	13	7	20
Selected technological areas	**Italy**			**Canada**			**China**			**Malaysia**			**South Africa**			**Spain**			**Sri Lanka**			**Thailand**		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
ICT	3	3	6	11	2	5	4	4	8	18	1	19	9	1	10	9	4	13	2	0	2	1	0	1
Biotechnology	1	0	1	3	2	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	1	2	3
Pharmaceuticals	1	0	1	0	0	3	2	0	2	0	0	0	0	0	0	0	0	0	2	0	2	4	1	5
Agriculture	2	0	2	2	1	21	1	0	1	0	0	0	2	0	2	0	0	0	8	1	9	3	0	3
Total	7	3	10	16	5	13	7	4	11	19	1	20	12	1	13	9	4	13	12	1	13	9	3	12
Selected technological areas	**No response**																							
	M	F	T																					
ICT	9	1	10																					
Biotechnology	2	1	3																					
Pharmaceuticals	11	1	12																					
Agriculture	0	0	0																					
Total	22	3	25																					

Table 3.14: Name of country last worked abroad by respondents

Country	No.	Country	No.	Country	No.	Country	No.
USA	318	Japan	24	Spain	13	No Response	25
UK	107	Canada	21	Sri Lanka	13	Total	879
Singapore	44	Malaysia	20	Thailand	12		
Australia	39	France	18	China	11		



	USA	UK	Singapore	Australia	Germany	UAE	Japan	Canada	Malaysia	France	Saudia Arabia	South Afriaca	Spain	Srilanka	Thailand	China	Italy	Rest of the world	No response
%	36.18	12.17	5.01	4.44	3.41	3.3	2.73	2.39	2.28	2.05	1.82	1.48	1.48	1.48	1.37	1.25	1.14	13.2	2.84

Figure 3.12: country-wise percentage of RBD/RBG persons in which they worked last

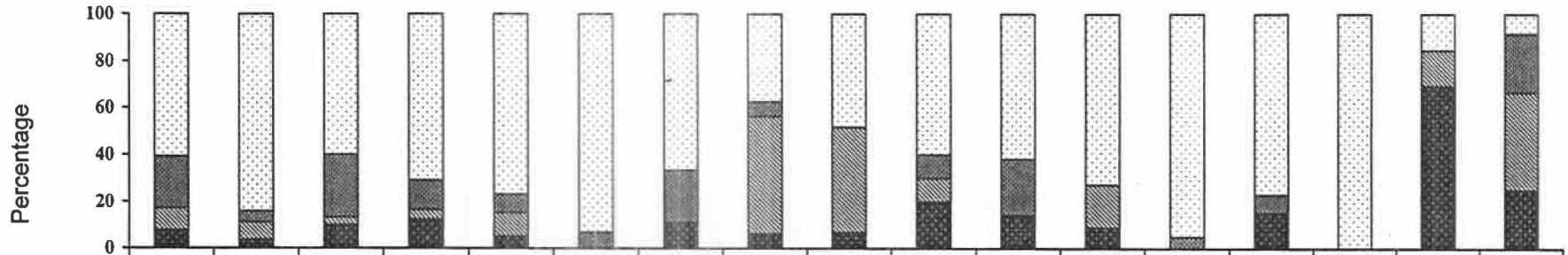
Table 3.15: Break-up of rest of the world countries

Country	No.	Country	No.	Country	No.
Austria	1	Indonesia	8	Oman	2
Bangladesh	5	Ireland	1	Pakistan	3
Bahrain	2	Israel	1	Philippines	7
Belgium	5	Jamaica	6	Poland	6
Bhutan	1	Kenya	4	Russia	6
Brazil	3	Kuwait	1	Senegal	1
Czechoslovakia	1	Myanmar	1	South Korea	5
Columbia	2	Mexico	2	Sweden	4
Congo	1	Morocco	1	Switzerland	5
Denmark	1	Nairobi	1	Taiwan	2
Ethiopia	2	Nepal	5	Tanzania	1
Finland	1	New Zealand	6	Uganda	1
Hong Kong	4	Nigeria	1	Total	116
Hungary	1	Norway	5		

Table 3.16: Technological area- wise name of the country last worked

Selected technological areas	USA	UK	Germany	Japan	Australia	Singapore	France	Saudi Arabia	UAE	Italy	Canada	China	Malaysia	South Africa	Spain	Srilanka	Thailand	No response
ICT	193	90	18	17	30	41	12	6	11	6	13	8	19	10	13	2	1	10
Biotechnology	70	5	8	3	3	3	4	1	0	1	5	0	1	1	0	0	3	3
Pharmaceuticals	30	8	1	1	4	0	0	8	8	1	0	2	0	0	0	2	5	12
Agriculture	25	4	3	3	2	0	2	1	1	2	3	1	0	2	0	9	3	0
Total	318	107	30	24	39	44	18	16	20	10	21	11	20	13	13	13	12	25

Figure 3.13A



	USA	UK	Germany	Japan	Australia	Singapore	France	Saudi Arabia	UAE	Italy	Canada	China	Malaysia	South Africa	Spain	Srilanka	Thailand
I&CT,%	60.69	84.11	60.00	70.83	76.92	93.18	66.67	37.50	48.28	60.00	61.90	72.73	95.00	76.92	100.00	15.38	8.33
Biotechnology,%	22.01	4.67	26.67	12.50	7.69	6.82	22.22	6.25	0.00	10.00	23.81	0.00	5.00	7.69	0.00	0.00	25.00
Pharmaceuticals,%	9.43	7.48	3.33	4.17	10.26	0.00	0.00	50.00	44.83	10.00	0.00	18.18	0.00	0.00	0.00	15.38	41.67
Agriculture,%	7.86	3.74	10.00	12.50	5.13	0.00	11.11	6.25	6.90	20.00	14.29	9.09	0.00	15.38	0.00	69.23	25.00

Figure 3.13B

	USA	UK	Germany	Japan	Australia	Singapore	France	Saudi Arabia	UAE	Italy	Canada	China	Malaysia	South Africa	Spain	Srilanka	Thailand	No response
I&C.T	21.96	10.24	2.05	1.93	3.41	4.66	1.37	0.68	1.25	0.68	1.48	0.91	2.16	1.14	1.48	0.23	1.14	1.14
Biotechnology	7.96	0.57	0.91	0.34	0.34	0.34	0.46	0.11	0.00	0.11	0.57	0.00	0.11	0.11	0.00	0.00	0.34	0.34
Pharmaceuticals	3.41	0.91	0.11	0.11	0.46	0.00	0.00	0.91	0.91	0.11	0.00	0.23	0.00	0.00	0.00	0.23	1.37	1.37
Agriculture	2.84	0.46	0.34	0.34	0.23	0.00	0.23	0.11	0.11	0.23	0.34	0.11	0.00	0.23	0.00	1.02	0.00	0.00
Total	36.18	12.17	3.41	2.73	4.44	5.01	2.05	1.82	2.28	1.14	2.39	1.25	2.28	1.48	1.48	1.48	2.84	2.84

Figure 3.13 Country-wise percentage of RBD/RBG persons in four technological areas (A) within a country and (B) overall basis

84% in the UK, 95% in Malaysia and 100% in Spain. Agricultural scientists (among the four technological areas) constituted 69.2% in Sri Lanka, 25% in Thailand, 20% in Italy, and around 14-15% in South Africa and Canada; pharmaceuticals constituted 50% in Saudi Arabia and 44% in UAE; biotechnology constituted about 27% in Germany and between 22% and 23% in the USA, France and Canada.

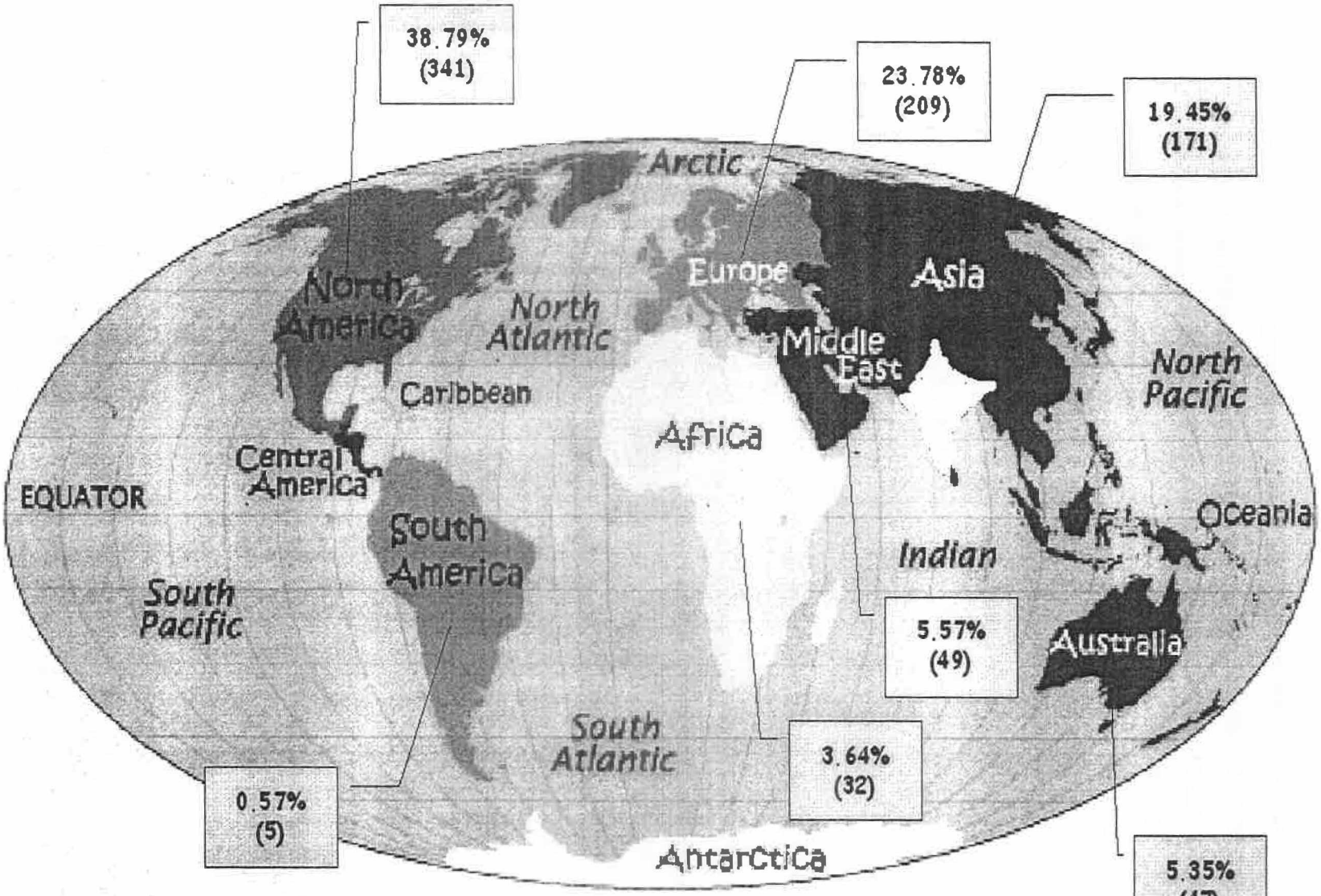
An inter-country and inter-technological subject group analysis of the above data has been presented in **Figures 3.13 A&B**. It shows that 36.2% of the respondents had last worked in the USA; 12.17% in the UK; 5.01% in Singapore; 4.44% in Australia and 3.14 % in Germany. In almost all the countries, the ICT personnel constituted a far higher proportion of respondents.

3.2.14. Continents--Respondents Last Worked:

The continental / geographical map presented in **Figure 3.14** provides continent / region-wise information on the proportion of RBD / RBG respondents last worked in. It shows that the largest proportion (38.8%) had worked last in the North America, followed by the Europe (23.8%) and Asia (19.5%). In other countries, the percentage was less than 10 percent.

Continent	RBD / RBG professionals	
	Number	percentage
o North America	341	38.8
o Europe	209	23.8
o Asia	171	19.5
o Middle–East	49	5.8
o Australia	47	5.4
o Africa	32	3.6
o South America	5	0.6
o No responses	25	2.8

Figure 3.14: Share of different continents of the world from where RBG/RBD persons retuned to India



Major Countries:

- There were 18 major countries ranging from 318 in the USA to 10 in Italy. 116 persons had worked last in 40 countries and 25 gave no-response.

- **Major Countries vis-à-vis Technological Areas: (Refer Table 3.13)**

  - Generally, USA has been found leading in all the technological areas: throughout (USA: 60.7% of sample)
  - ICT (USA: 60.7% of sample)
  - Biotechnology (USA: 22.01% of sample)
  - Pharmaceuticals (USA: 9.4% of sample);
  - Agriculture (USA: 7.8% of sample);

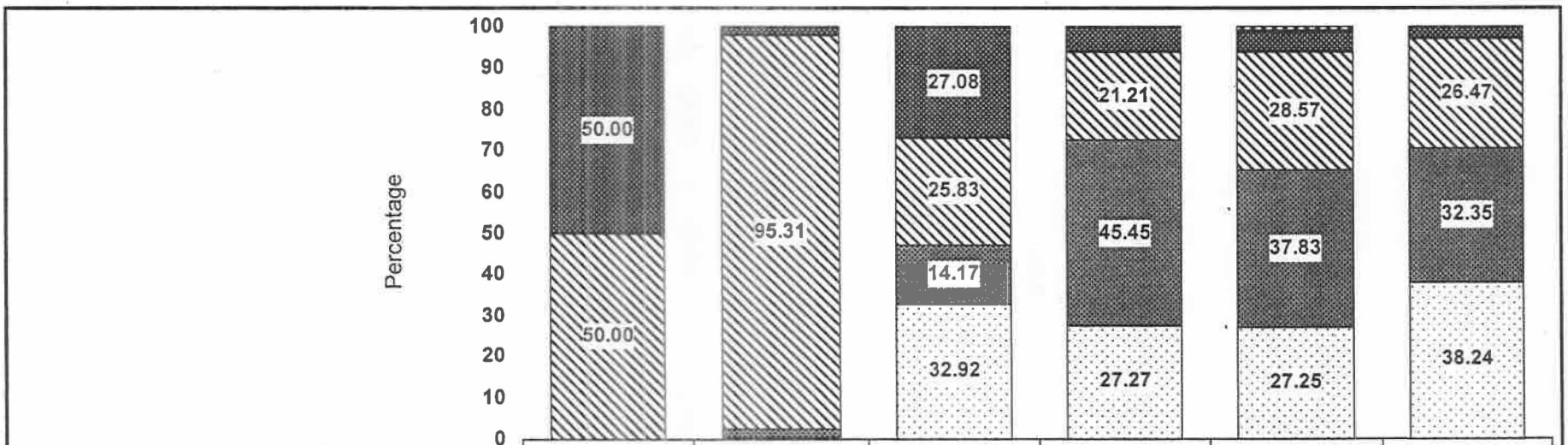
- **Gender-wise distribution of RBD / RBG persons vis-à-vis technological areas (Refer Table 3.13)**

  - 41 Females (against 152 Males) having expertise in ICT returned from USA;
  - 16 Females (against 54 Males) having expertise in Biotechnology returned from USA;
  - 5 Females (against 3 Males) having expertise in Pharmaceuticals returned from UAE;
  - 1 Female (against 8 Males) having expertise in Agriculture returned from Sri Lanka.

Table 3.17: Category of visa held by RBD/RBD persons vis-à-vis duration of stay abroad

Duration/ Type of assignment	Citizen	Permanent resident	Temporary visa status	Student visa	Other	No Response	Total
Short- term (less than 6 months)	0	1	79	9	103	13	205
Medium- term (up to 2 years)	0	4	34	15	143	11	207
Long -term (more than 2 years)	1	183	62	7	108	9	370
Permanently	1	4	65	2	19	1	92
Joint research programmes / pursues research with Indian counterpart	0	0	0	0	2	0	2
Consultancy	0	0	0	0	3	0	3
Total	2	192	240	33	378	34	879
Percentage	0.22	21.84	27.30	3.75	43.00	3.87	100

Figure 3.15: Proportions of different categories of visas as per type of assignment /stay



	Citizen	Permanent resident	Temporary visa status	Student visa	Other	No response
Consultancy , %	0.00	0.00	0.00	0.00	0.79	0.00
Joint research programme / pursue research with Indian counterpart, %	0.00	0.00	0.00	0.00	0.53	0.00
Permanent,%	50.00	2.08	27.08	6.06	5.03	2.94
Long- term (more than 2 years),%	50.00	95.31	25.83	21.21	28.57	26.47
Medium-term (upto 2 years),%	0.00	2.08	14.17	45.45	37.83	32.35
Short -term (less than 6 months),%	0.00	0.52	32.92	27.27	27.25	38.24

3.2.15. Category of Visa Held by RBD / RBG Professionals vis-à-vis Their Duration of Stay Abroad

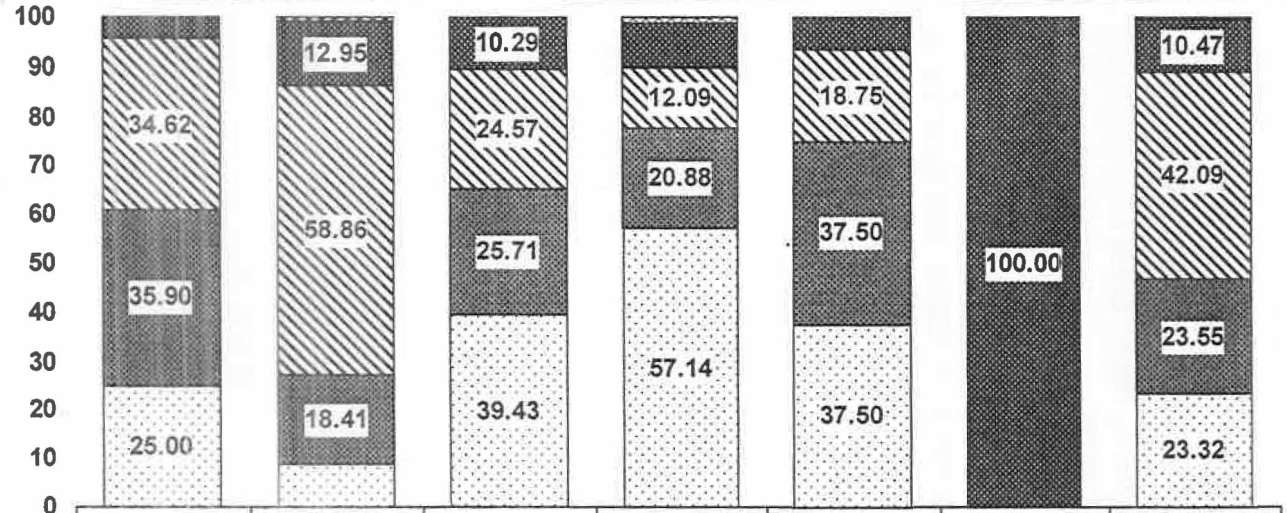
Table 3.17 and **Figure 3.15** depict the analysis of the RBD / RBG professionals who had held different categories of visa while staying abroad and their corresponding duration of stay abroad.

The Figure and Table revealed as follows:

- It was commendable to note that a good percentage (21.8%) of permanent visa holders had preferred to come back to India. These included mostly from the pharmaceutical technological area comprising 183 (95.3%)
- 27.30% (240) RBD / RBG professionals having temporary visa had to return in any case
- 43% (378) respondents from 'other' category included 37.8% from biotechnology, followed by 28.57% from the pharmaceutical and, 27.3% from ICT technological areas, who preferred to return back to India. Even though, these included 37.8% RBD / RBG professionals who had stayed up to 2 years, followed by 28.6% who had stayed for more than 2 years abroad.

Table 3.18 & Figure 3.16: Category of visa held by RBD/RBG persons vis-à-vis age-range

Duration/ Type of study	Up to 30 Years	31-40 Years	41-50 Years	51-60 Years	61-70 Years	Above 70 Years	Total
Short Term (less than 6 months)	39	39	69	52	6	0	205
Medium Term (up to 2 years)	56	81	45	19	6	0	207
Long term (more than 2 years)	54	259	43	11	3	0	370
Permanently	7	57	18	8	1	1	92
Joint research programmes / pursues research with Indian counterpart.	0	1	0	1	0	0	2
Consultancy	0	3	0	0	0	0	3
Total	156	440	175	91	16	1	879
Percentage	17.75	50.06	19.91	10.35	1.82	0.11	100



	Up to 30 years	31-40 years	41-50 years	51-60 years	61-70 years	Above 70 years	Total
⊠ Consultancy,%	0.00	0.68	0.00	0.00	0.00	0.00	0.34
⊠ Joint research programme / pursue research with Indian counterpart, %	0.00	0.23	0.00	1.10	0.00	0.00	0.23
■ Permanent,%	4.49	12.95	10.29	8.79	6.25	100.00	10.47
⊠ Long-term (more than 2 years),%	34.62	58.86	24.57	12.09	18.75	0.00	42.09
■ Medium-term (upto 2 years),%	35.90	18.41	25.71	20.88	37.50	0.00	23.55
⊡ Short -term (less than 6 Months) ,%	25.00	8.86	39.43	57.14	37.50	0.00	23.32

Figure 3.16: Age-group wise Proportions in type of assignment /duration of stay

3.2.16. Category of Visa Held by RBD / RBG Professionals vis-à-vis Their Age-group

Table 3.18 & **Figure 3.19** provides a brief analysis of the category of Visa held by RBD / RBG professionals abroad vis-à-vis their age-group viz. up to 30 years, 31-40 years, 41-50 years, 51-60 years, 61-70 years and above 70 years. The analysis of data presented in Figure 3.16 and Table 3.18 clearly revealed as follows:

- 50 % returnees were in the age-group of 31-40 years and, their distribution in the descending order of duration of stay was:
    - Long-term (58.9%); Medium-term (18.4%) and Permanent (13.0%). Interesting situation is that 58.9% come from pharmaceuticals, followed by 18.4% from the biotechnology technological area
- The next age-group of returnees was of 41-50 years comprising 19% of the total and, their distribution in the descending order of duration was:
    - Medium-term (25.7%), Long-term (24.6%) and Permanent (10.3%).
- About 17.8% RBD / RBG professionals were up to 30 years of age and their distribution in the descending order of duration of stay was:
    - Medium term (35.9%), Long term (34.6%), Short-term (25%) and Permanent (4.5%).
- Some 10.4% returnees were from the age-group of 51-60 years and, their distribution in the descending order of duration of stay was:
    - Short-term (57.1%), Medium-term (20.9%), Long-term (12%) and Permanent (8.8%).
- *The overall scenario revealed that a large number of RBD / RBG persons (370; 42.1%) were on long-term assignments. The number of RBD / RBG persons on medium-term assignment was also significant 207 (23.5%).*

CHAPTER 4

THE RBD / RBG SCENARIO IN INDIA

Chapter 4

The RBD / RBG Scenario in India

4.1. General

The Reverse Brain Drain (RBD) / Reverse Brain Gain (RBG) scenario in India depicts a situation where highly qualified persons had gone to other countries (Brain Drain) on short-term, medium-term, long-term visits or permanently and had returned home with higher qualifications, more experience, advanced-knowledge and a strong will to serve the nation. In this chapter, an attempt has been made to understand the parametric and non-parametric forces for going abroad, as well as, coming back to India. It has also discussed the guiding variables, e.g. type of employment in India, technological and non-technological contributions on return and the emerging multiplier effect on the Indian economy, etc. The emerging variables derived Q-short and higher level analysis of the responses of the primary stakeholders has been outlined in the preceding paragraphs.

4.2. Motivations for Going Abroad

The study has identified ten motivating factors influencing the going of scientific and technological persons abroad. These could be broadly classified into two groups, viz. Push factors from India and Pull factors of foreign countries. The push factors:

Push Factors

a) Lack of career opportunities / stagnation,
b) Resource crunch for research,
c) Lack of freedom for research,
d) No-recognition of merit,
e) Low / unattractive salary-structure in India,
f) Poor academic environment, and
g) Perception that conditions are not going to improve.

Pull Factors

a. Shortage of highly skilled professionals,
b. Better basic living conditions, and
c. Modern infrastructure for R&D.

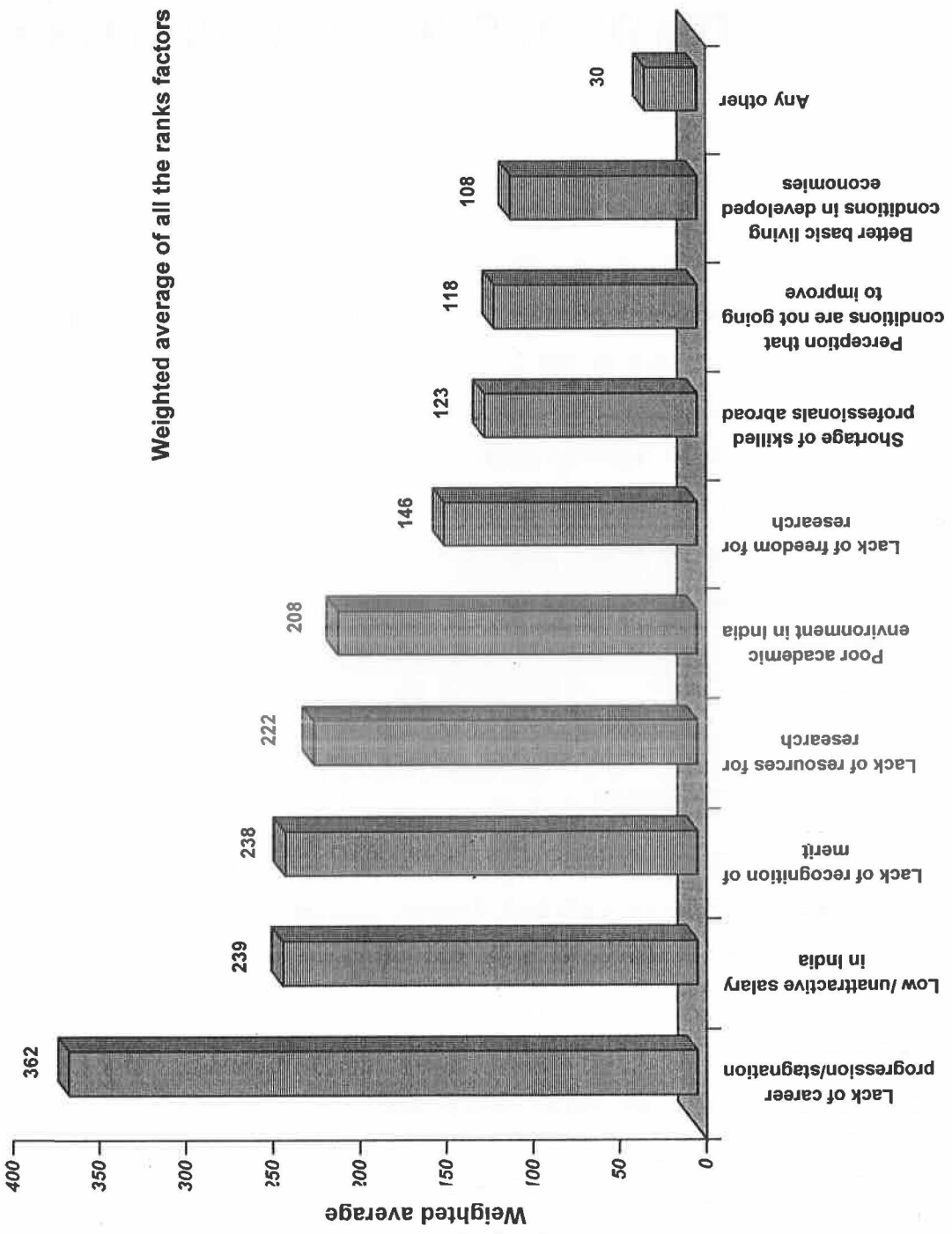


Figure 4.1: Motivation factors for going abroad

However, it may be mentioned that positive perception on each of the push factors (with respect to a foreign country) also acted as a pull factor in a way. The absolute responses measured on Q-short technique reveals the opinions of respondents reflected in succeeding paragraphs and tables.

The weighted average of each of the motivational factors has been provided in **Figure 4.1** (*on the opposite page*). It shows that most of the highly qualified persons opted to go abroad as they found lack of career progression in the country. Figure 4.1 also shows that most of the scientific and technological persons went abroad for lack of recognition of merit, low salary, lack of resources for research, etc. in India.

Following additional reasons were also indicated by RBD / RBG respondents that necessitated their migration abroad:

- The declining standards in Indian universities,
- Freeze on the fresh appointments in university faculties,
- Abnormally low investment on R&D infrastructure,
- Poor incentives to scientific researchers,
- Bureaucratic interference at every step for innovation, and
- Political interference in various facets of science & technology.

4.3. Reasons for Home-coming

There could be multitude of reasons for home-coming, ranging from social reasons to individual concerns having linkage with asset bases and belongingness. In this section, response given by RBD / RBG persons on this important aspect has been analyzed by classifying the reasons into three broad categories viz.

- Professional,
- Personal, and
- Others.

Professional Reasons

The respondents expressed professional reasons to be responsible to a great extent for their return home. These included availability of better options / choices; change in work culture in India now and then; improvement in infrastructure in India; appreciation of merit in homeland, etc. The cost-factor was

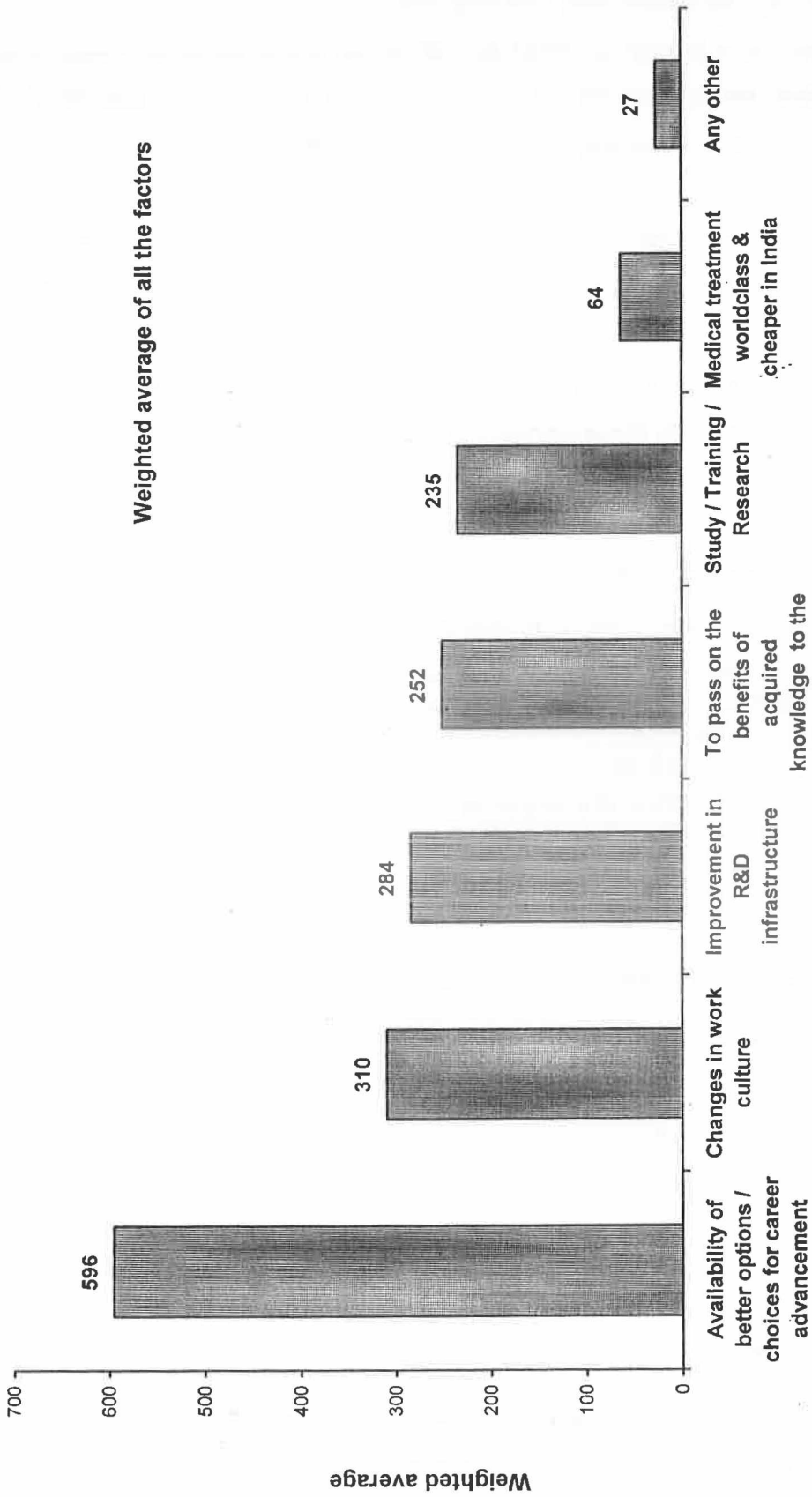


Figure 4.2 Professional reasons for home-coming

another reason for study / training / research. And, medical treatment in India has become world class and cheaper. The reasons mentioned above showed the positive response to economic liberalization policy adopted by India since 1990s. It further showed that most of reasons that had motivated them to go abroad earlier had taken a different turn. Earlier these persons of Indian origin went abroad in search of 'greener pastures', but now they find the country 'greener'.

The weighted average of responses RBD / RBG persons on each aspect has been depicted in **Figure 4.2**. The responses up to fifth observation on Q-short are in favour of the above cited observation. It shows that a majority of the respondents have reported better options / choices for career advancement in the country and some of them have find positive changes in work culture, as reasons for their return.

The professional reasons for returning home, as reported by the respondents included the following:

- During the past couple of years, India is becoming a global research, design and development hub.
- More than 100 companies around the world have set up their R&D centres in India, employing thousands of people.
- GE in Bangalore is the second largest R&D centre of GE in the world, employing over 2500 people -- 400 PhDs--out of which 40% are young.
- There are more challenging career opportunities in India now.
- Remunerations in India have become attractive.
- There has been a decrease in opportunities in the US, especially in the Information Technology sector.
- India is emerging as a promising market than the overseas countries.
- There is an improvement in the standard of living in India.
- Multi-national companies in India pay well, provide facilities and opportunities.
- The US and UK economies are facing recessions, there is a big economic fall and jobs are being cut, house prices are falling and interest rates are on the rise, and more young professionals are moving abroad from these countries for work.
- And, India is one of the prospective destinations.
    - FRRO (Foreigners Regional Registration Office) in Mumbai has reported an increase in registration by 40% this year as there are huge opportunities in India
    - FRRO, Mumbai has put the number of expatriates at 4,000 at present, which is likely to increase to over 15,000 by 2012
    - Some Companies like Tata Consultancy Services (TCS) are employing foreigners for their language skills, market knowledge and, global human resource experience

Other Reasons for returning home, as reported by the respondents, included the following:

- The big-budget foreign companies are moving their R&D centres to India.

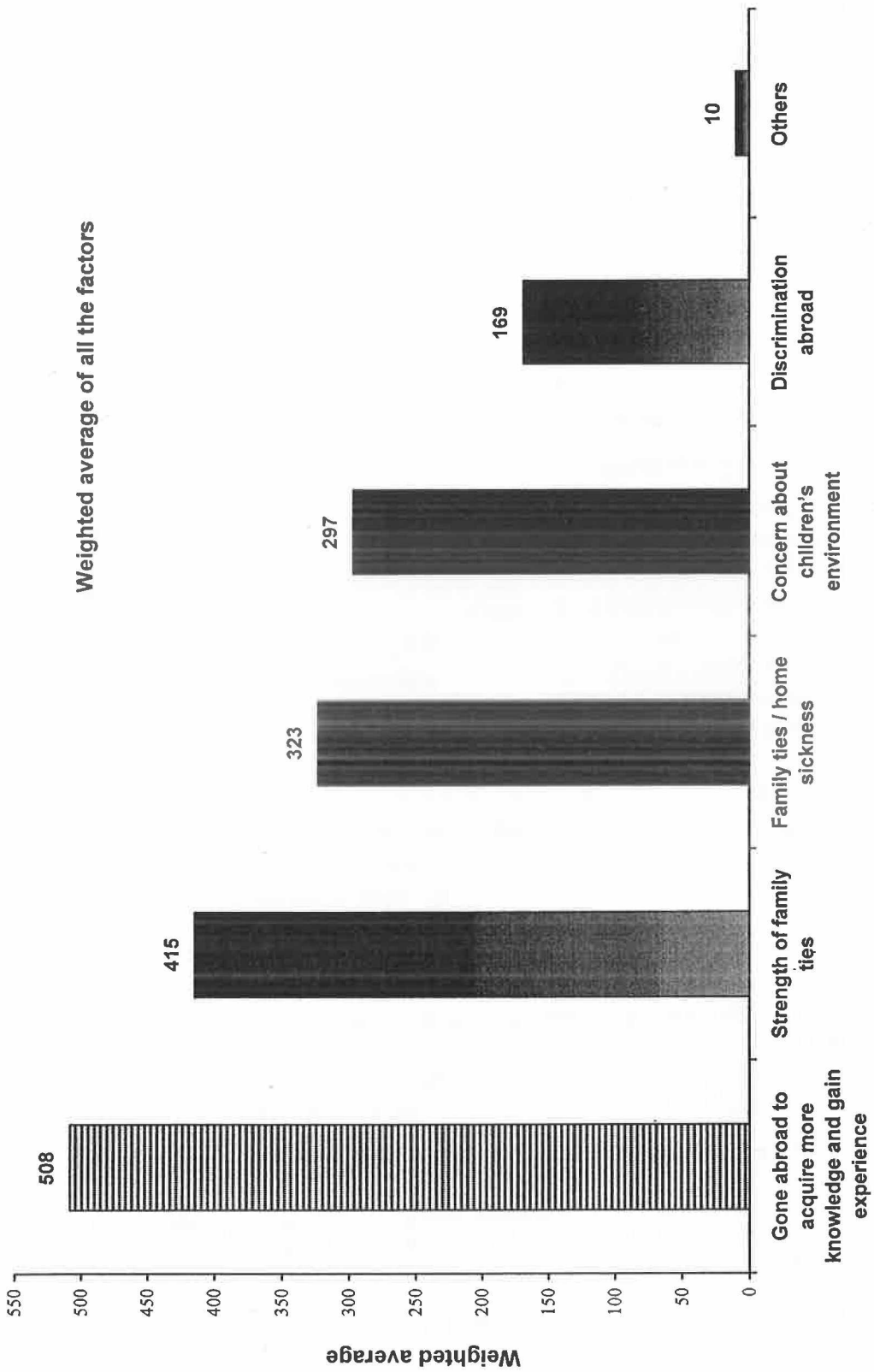


Figure 4.3: Personal reasons for home- coming

- India has 1500 R&D units; IITs, Universities, Engineering & Other Technical Institutions.
- In some industrialized countries, there is a shortage of R&D personnel, and most of them are seeking, in outsourcing, and calling it 'Destination India'.
- Demand for telecommunication services continues to be robust in India.
- Mergers are taking place: e.g. Bharti Airtel & Singapore Telecom (Sing-Tel)
- Connectivity: Modern technology has made world connectivity easy.
- Collaboration, Connections, Outsourcing, and Partnerships are increasing.
- Six empowered collaborations are predominant in India, viz. a) Open-sourcing; b) Out-sourcing; c) Off-shoring; d) Supply-chaining; e) In-sourcing; f) In-forming

Personal Reasons

Some personal reasons were reported by RBD / RBG persons for home-coming. These included:

- Gone abroad to acquire more knowledge and gain experience.
- The strength of family ties/ home sickness.
- Concern about children's environment.
- Discrimination abroad.
- Wife's inability to adapt local language and culture, and
- Love for the motherland.

The response of RBD / RBG persons weighted duly on each of the reasons mentioned above has been depicted in **Figure 4.3** (*on the opposite page*). It reveals that quite a majority of respondents had gone abroad for acquiring more knowledge and experience in the area of their interest and had, therefore, returned after gaining the same. The second strongest factor was the 'strength of family ties', which also played a role in motivating the respondents to come back to India.

4.4. Scenario after Home-coming

In this sub-section, the scenario has been provided after coming back of RBD / RBG respondents from abroad. The observations have been analyzed through mode of the frequency and tested on Q-short matrix to arrive at the conclusions. The highlights of the achievements covered two aspects:

- Working responsibility in India and work responsibility in the foreign country,
- Major achievements made by RBD / RBG persons in their professional domain.

Table 4.1: Work responsibility of RBD/RBG persons in the present institution in different technological areas

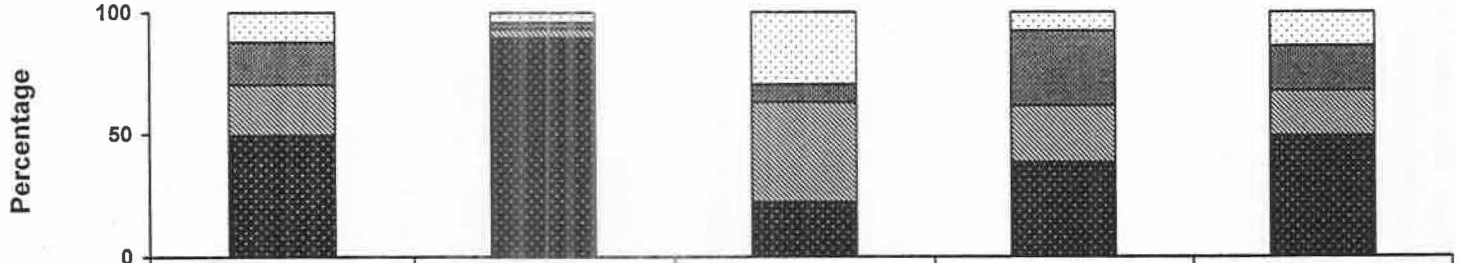
Technological area	Technical	Managerial	R&D	Any other	No response	Total
ICT	204(36.0)	314(56.5)	6(1.1)	10	32	566
Biotechnology	85(66.9)	13(10.2)	11(8.7)	6	12	127
Pharmaceuticals	72(70.0)	9(8.7)	2(2.0)	8	12	103
Agriculture	50(60.0)	14(16.9)	8(9.6)	2	9	83
Total	411(46.8)	350(39.9)	27(3.1)	26	65	879

Note: Figures within the parentheses show the percentages across a technological area

Figure 4.4 A

	Technical	Managerial	R &D	Any other	No response
I&CT, %	23.21	35.72	0.68	1.14	3.64
Biotechnology, %	9.67	1.48	1.25	0.68	1.37
Pharmaceuticals ,%	8.19	1.02	0.23	0.91	1.37
Agriculture ,%	5.69	1.59	0.91	0.23	1.02

Figure 4.4 B



	Technical	Managerial	R &D	Any other	No response
I&CT ,%	12.17	4.00	29.63	7.69	13.85
Biotechnology ,%	17.52	2.57	7.41	30.77	18.46
Pharmaceuticals ,%	20.68	3.71	40.74	23.08	18.46
Agriculture ,%	49.64	89.71	22.22	38.46	49.23

Figure 4.4: Proportional distribution of work responsibility in different technological area (A): On overall basis, and (B) Across each responsibility

4.4.1. Work Responsibility

Analysis of the work responsibility of RBD / RBG persons in foreign countries has already been presented in Chapter III. Here, analysis of the work responsibility in the present place of work has been presented. Detailed information on this aspect has been given in **Table 4.1**. A perusal of Table 4.1 revealed that 46.8% of the RBD / RBG persons are engaged on technical jobs and, the ICT persons constitute 23.2% in the jobs. Managerial responsibilities are being performed by 39.9% of these persons. The **Table 4.1** also shows that most of the persons belonging to the subject areas of biotechnology; pharmaceuticals; and agriculture are engaged in technical and managerial jobs.

Table 4.2: A comparative scenario of working responsibility – Abroad and India

Technological subjects	Technical		Managerial		R & DT		Any other		No Response	
	Abroad	In India	Abroad	In India	Abroad	In India	Abroad	In India	Abroad	In India
ICT %	20.59	23.21	7.17	35.72	1.02	0.68	27.08	1.14	8.53	3.64
Biotechnology %	4.44	9.67	0.11	1.48	7.74	1.25	0.68	0.68	1.48	1.37
Pharmaceuticals, %	6.37	8.19	0.34	1.02	2.73	0.23	0.34	0.91	1.93	1.37
Agriculture, %	1.02	5.69	0.46	1.59	5.57	0.91	1.02	0.23	1.37	1.02
Total %	32.42	46.76	8.08	39.82	17.06	3.07	29.12	2.96	13.31	7.39

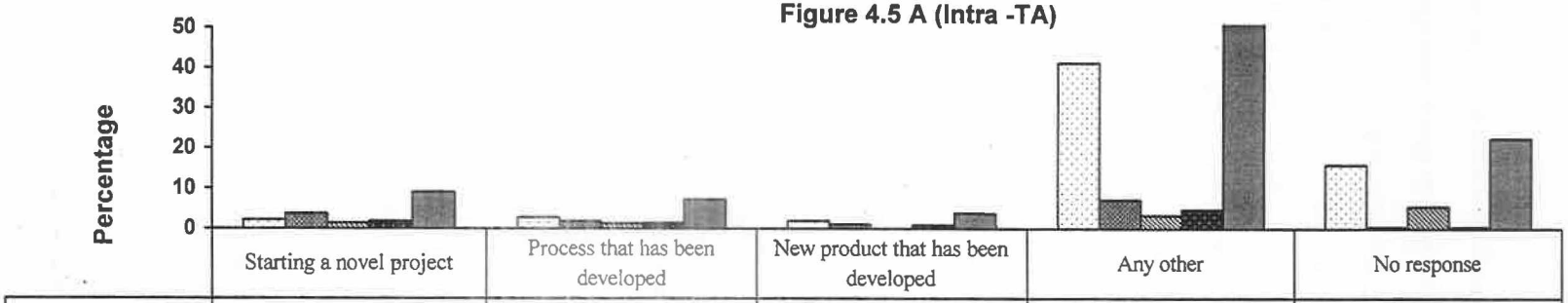
Source : Figure 3.12 and Figure 4.4 B

The data on work responsibility have been depicted graphically in percentage terms in **Figure 4.4 A** and across each responsibility in different technological areas in **Figure 4.4 B**. The information presented in **Table 4.1** and **Figure 4.4 A** and **4.4 B** highlighted as follows:

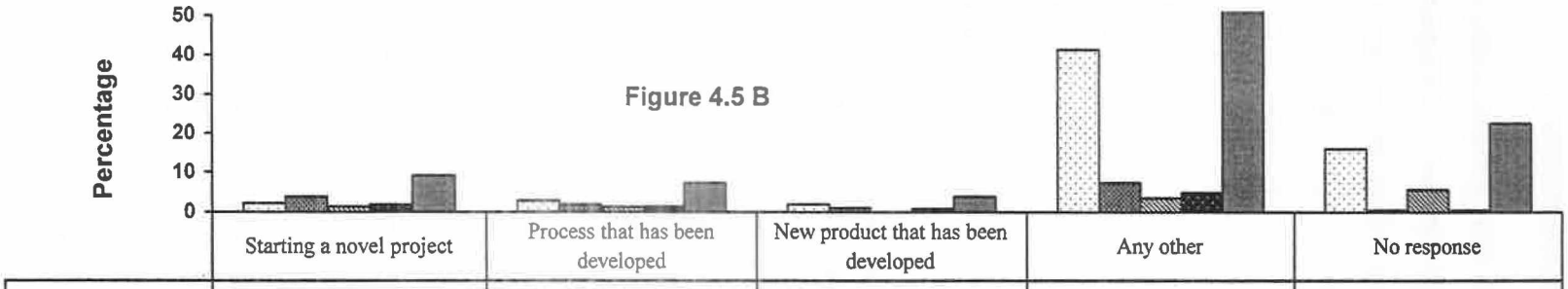
- A higher proportion (90%) of personnel in each of the four selected technological areas is working at technical and managerial positions in India as compared to that (585) abroad (Table 4.2).
- The proportion of persons working in R & D sector has declined from 17.06% abroad to 3.07% in India. This decline is observed in each of the four technological areas. It could be due to lower investments in R&D in India than abroad
- A large proportion of the persons have been in a position to identify jobs that they are doing in India. It is evident by the fact that while only 2.96% of persons in India could define their jobs, the proportion of such persons was 29.12% abroad.

Table 4.3 Major achievements in the professional domain in India after return – Technological capabilities

Technological area	Starting a novel project	Process that has been developed	New product that has been developed	Any other	No response	Total
ICT	19	25	17	364	141	566
Biotechnology	33	16	9	65	4	127
Pharmaceuticals	12	11	0	31	49	103
Agriculture	16	12	8	43	4	83
Total	80	64	34	503	198	879



	Starting a novel project	Process that has been developed	New product that has been developed	Any other	No response
I&CT,%	2.16	2.84	1.93	41.41	16.04
Biotechnology,%	3.75	1.82	1.02	7.39	0.46
Pharmaceuticals,%	1.37	1.25	0.00	3.53	5.57
Agriculture,%	1.82	1.37	0.91	4.89	0.46
Total,%	9.10	7.28	3.87	57.22	22.53



	Starting a novel project	Process that has been developed	New product that has been developed	Any other	No response
I&CT,%	2.16	2.84	1.93	41.41	16.04
Biotechnology,%	3.75	1.82	1.02	7.39	0.46
Pharmaceuticals,%	1.37	1.25	0.00	3.53	5.57
Agriculture,%	1.82	1.37	0.91	4.89	0.46
Total,%	9.10	7.28	3.87	57.22	22.53

Figure 4.5: Proportional distribution of major achievements in different technological area (A): within an achievement, and (B) on overall basis

4.5. Impact of RBD / RBG on India S&T Scenario

4.5.1. Major Achievements

Major achievements in the professional domain, after return to India, have been discussed under two dimensions:

(a) Technological inputs, and

(b) Non-technological inputs.

Major Achievements: Technological Inputs

Technological inputs have been addressed under four categories:

(1) Starting / started a novel project,
(2) Developing / developed a novel process.
(3) Developing / developed a novel product; and
(4) Any other achievements.

The intra-discipline responses on each of the above four inputs have been presented in **Figure 4.5 A**. It shows that in the starting of a new project, the proportion of biotechnology personnel is higher (41.2%), followed by ICT (23.7%), agriculture (20.0%) and pharmaceuticals (15.0%). In the development of a process as well as a product, ICT personnel have excelled other technological persons.

The overall percentage of each achievement in the four technological areas has been presented in **Figure 4.5 B**. It shows that amongst all respondents, only 9.10% have reported to have started new projects; 7.28% have been engaged in process development; and 3.87% have developed new products. A high percentage of RBD / RBG persons have reported 'any other' (57.2%) or have not responded on this aspect (22.5%).

The study on major achievements of RBD / RBG persons after return to India, based on the data presented in **Table 4.3** and **Figure 4.5 A** and **Figure 4.5 B**, has revealed as follows:

- 80 persons (9.0%) have started / working on a novel project.
- 64 persons (7.3%) have developed / developing a novel process. The ICT personnel top in this achievement, followed by persons in biotechnology, agriculture and pharmaceuticals.

Table 4.4: Major achievements in the professional domain in India after return – Non-Technological capabilities

Technological area	Explored a new client	Devised market access	Suggested organizational changes	Helped the company in creating new branding	Instrumental in imparting the tacit knowledge to other staff of company	Any other	No response	Total
ICT	14	13	15	23	14	360	127	566
Biotechnology	11	7	10	8	7	82	2	127
Pharmaceuticals	10	2	6	1	8	32	44	103
Agriculture	3	5	9	4	5	57	0	83
Total	38	27	40	36	34	531	173	879

Figure 4.6 A

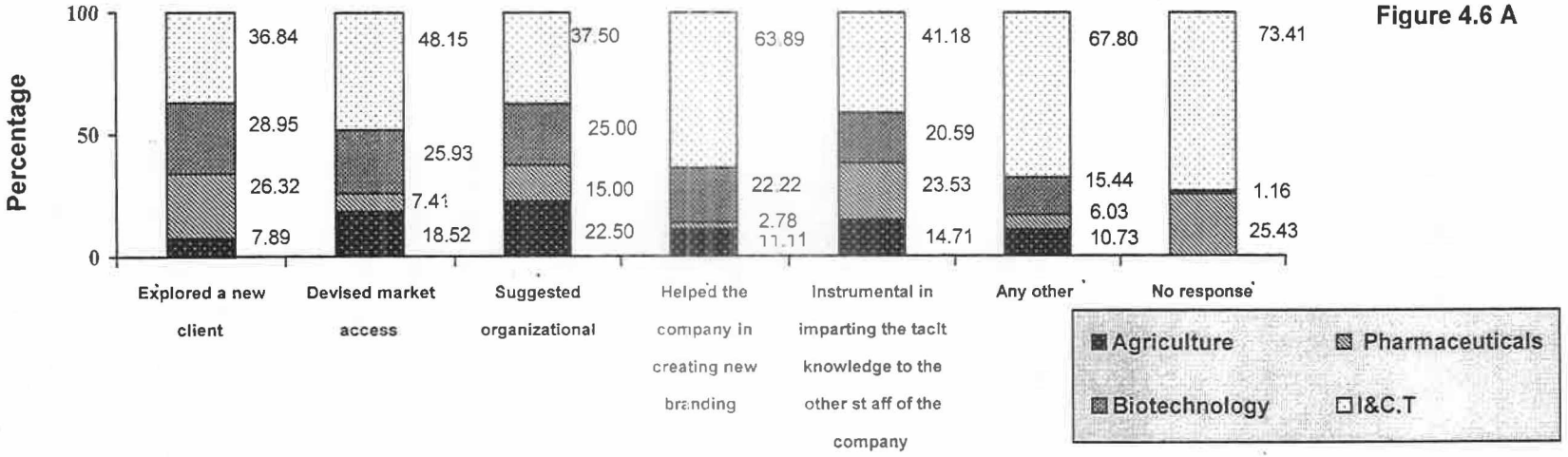


Figure 4.6 B

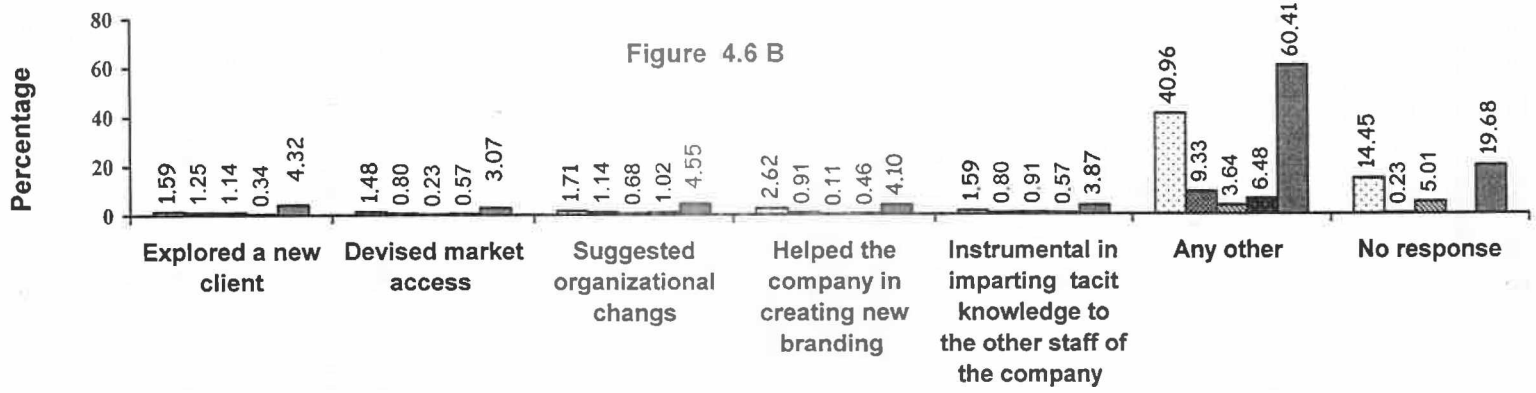


Figure 4.6: Proportional distribution of major achievements in non-technological capabilities in different technological area (A): Across a non-technological capability, (B) on overall basis

- 34 persons (3,9%) have developed / developing a novel product. In this achievement, ICT have topped, followed by biotechnology and agriculture.
- A large proportion of RBD / RBG personnel has responded to the query in terms of 'Any other' (57.2%) or has made 'No repose' (22.5%). It could be due to the following reasons :
    i. Do not want to divulge information about achievements before publication or taking a patent,
    ii. Are 'under contract', not to divulge any information,
    iii. Do not want to get into any problem / controversy regarding their personal achievements ,
    iv. It is too early to commit anything,
    v. Want to encash the achievement, as is quite common in some overseas countries, and
    vi. The achievement does not fall in any of the three categories included in the questionnaire.

- **Major Achievements: Non-Technological Capabilities**

Non-technological capabilities have been classified in six categories:

(a) Explored a new client,
(b) Devised market access,
(c) Suggested organizational changes,
(d) Helped the company in creating new branding,
(e) Instrumental in imparting the tacit knowledge to the other staff of the company, and
(f) Any other non-technological achievements.

The responses of RBD / RBG persons on each of the above capabilities have been given in **Table 4.4** across the four selected technological areas. It shows that among all the four technological areas, a larger proportion of ICT personnel is engaged in each of the six identified capabilities. For instance, in ICT area about 64% RBD / RBG persons are helping the country in creating new branding, 48% have devised / devising market access. 41% are imparting tacit knowledge, and 37% have explored a new client. This technological area is followed by biotechnology, pharmaceuticals, and agriculture in non-technological capabilities of RBD / RBG persons.

Information on proportions in each non-technological capability across four selected areas has been presented in **Figure 4.6 B**. It shows that about 4 % of RBD / RBG personnel are reported to have helped in each of following: (a) explored new clients; (b) suggested organizational changes; (c) helped in creating

new branding, and (d) have been instrumental in imparting the tacit knowledge to organization's staff.

Box 4.1
Major Achievements of RBD / RBG Personnel in their Professional Domain in India

- **General**
  - Starting of novel projects in their field of specialization
  - Development of innovative and technologically superior processes as well as products
  - Setting up enterprises in their field of specialization
  - List of the achievements of respondents is too long and too techno-complex, only a few from each of the four areas are mentioned below :

- **Information Technology**
  - New and improved teaching techniques
  - Development of a two-year programme in MSc Maths with Computer Science
  - Development of new software for education
  - Development of new programmes to help achieve the objectives of their organizations
  - Contributors in development of more efficient computers

- **Biotechnology**
  - Manufacturing of new-bio products, e.g. poly lactic acid from renewable resources
  - Conducting basic research on bacterial poly hydroxyl alkanoates with a view to commercialization.
  - Establishment of a laboratory for polymeric biometric research
  - Process development for large-scale production of low cost alpha amylase
  - Establishment of the Departments of Biotechnology and Biochemistry in the University of Jammu and imparting of research and training
  - Working on genome mapping of the silk worm *Bombyx mori*
  - Doing basic research in the field of 'transcription', in which not many Indians are working
  - Instrumental in starting a school of structural biology at NII;
  - Important scientific contributions with impact on fundamental immunological issues
  - Working on basic understanding of tumour genesis; and formulation of combination chemotherapy
  - Working on developing gene markers for cancer

- **Pharmaceuticals**
  - Setting up three organisations in the fields of rural livelihood, human resources development and skill development through training
  - Working on policy and programme issues in Public Health, which have impact at the national level
  - Designing and synthesis of novel privileged structures and drug delivery systems

- **Agriculture**
  - Contributions towards building and bringing the REC Srinagar, J&K to its present status
  - Appropriate consultancy and better priced micro-finance projects offered to farmers in India

- **Further analysis has revealed as follows:**
  - 40 (4.55%) respondents have suggested new organizational structure in their institutes for increasing efficiency,
  - 38 (4.32%) respondents have explored new clients for their institutes,
  - 34 (3.86%) respondents have been instrumental in imparting training to other staff in their institutes,
  - 27 (3.07%) respondents have devised new market access for their institutes,
  - Like technological achievements, in non-technological capabilities also a large proportion of RBD / RBG persons has responded to this question in terms of 'Any other' (60%) or have made 'No response' (20%) to this question. This could be due to the reasons already outlined at Para 4.5.1. on Page- 75 above, viz.
    - Inhibition to divulge information,
    - 'Under contractl or oath' for not divulging any information,
    - Safe playing to avoid any controversy, and
    - Achievements not falling within the six capabilities included in questionnaire.

Summing-up

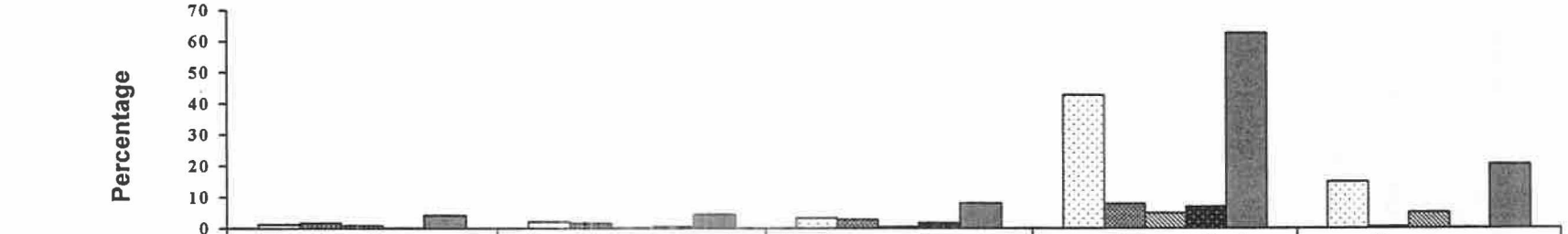
- Respondents affiliated to companies have been able to explore new clients
- Have helped their companies in creating new brands, and also in accessing new and bigger markets
- Some have been able to suggest organisational changes, which have benefited their organisations in terms of increased efficiency
- Some have been instrumental in contributing towards a positive change in the work culture of the organisation
- A few have been able to motivate their teams to get the best out of them
- Respondents have devised market access to farmers in India through their contacts with foreign firms, e.g. with a Dutch company

Table 4.5: Tangible S&T contributions made by professionals after coming back home

(No. of respondents)

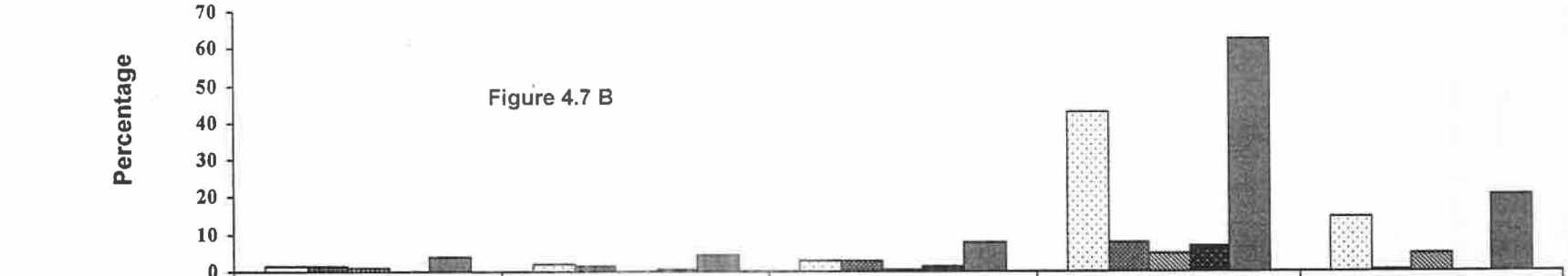
Technological area	Number of patents	New designs developed	Quality assurance evolved	Any other contribution	No response	Total (respondents)
ICT	11	19	28	377	131	566
Biotechnology	15	14	24	70	4	127
Pharmaceuticals	9	2	4	43	45	103
Agriculture	1	4	15	62	1	83
Total	36	39	71	552	181	879

Figure- 4.7 A (Intra TA)



	Number of patents	New designs developed	Quality assurance evolved	Any other contribution	No response
I&CT,%	1.25	2.16	3.19	42.89	14.90
Biotechnology,%	1.71	1.59	2.73	7.96	0.46
Pharmaceuticals,%	1.02	0.23	0.46	4.89	5.12
Agriculture,%	0.11	0.46	1.71	7.05	0.11
Total,%	4.10	4.44	8.08	62.80	20.59

Figure 4.7 B



	Number of patents	New designs developed	Quality assurance evolved	Any other contribution	No response
I&CT %	1.25	2.16	3.19	42.89	14.90
Biotechnology %	1.71	1.59	2.73	7.96	0.46
Pharmaceuticals %	1.02	0.23	0.46	4.89	5.12
Agriculture %	0.11	0.46	1.71	7.05	0.11
Total %	4.10	4.44	8.08	62.80	20.59

Figure 4.7 Proportional of tangible S&T contribution made by RBD/RBG persons in different technological area (A): within a tangible contribution capability, and (B) on overall basis

- **Tangible Contributions of RBD / RBG Personnel in India**

Tangible contributions of persons who have come back to India have been grouped under two classes:

(1) S& T contributions, and
(2) Non- S&T contributions.

The tangible S&T contributions were identified on the basis of

(a) Number of patents granted / applied / sealed,
(b) New designs developed,
(c) Quality assurance evolved, and
(d) Any other.

The information received from RBD / RBG persons has been complied in **Table 4.5.** It shows that 30 persons (4.1%) have obtained patents for their S&T contributions. Similarly, 39 persons (4.4%) have developed designs and 71 persons (8.1%) have evolved quality assurance mechanisms.

The technological area-wise proportions of each S&T contribution across different areas have been depicted in **Figure 4.7 A** and overall proportions of each S&T contribution across different areas have been shown in **Figure 4.7B**.

A perusal of **Figure 4.7 A** revealed that in obtaining patents, biotechnology has the lead, followed by ICT. In both, development of new designs and evolution of quality assurances, ICT has the lead, followed by biotechnology.

To this question also, a very high proportion of RBD / RBG persons have responded in terms of 'Any other' (62.8%) and 'No response' (20.6%), probably for the reasons already explained at Para 4.5.1. on Page-75 above.

Table 4.6:Tangible non–S&T contributions made by professionals after coming back home (No. of respondents)

Technological area	Creating just-in-time inventory system	Accounting system in concordance with internal accounting practices	MIS	Any other	No responce	Total
ICT	7	5	16	141	397	566
Biotechnology	3	6	1	111	6	127
Pharmaceuticals	0	0	1	56	46	103
Agriculture	0	2	5	74	2	83
Total	10	13	23	382	451	879

Figure 4.8 A (Intra-TA)

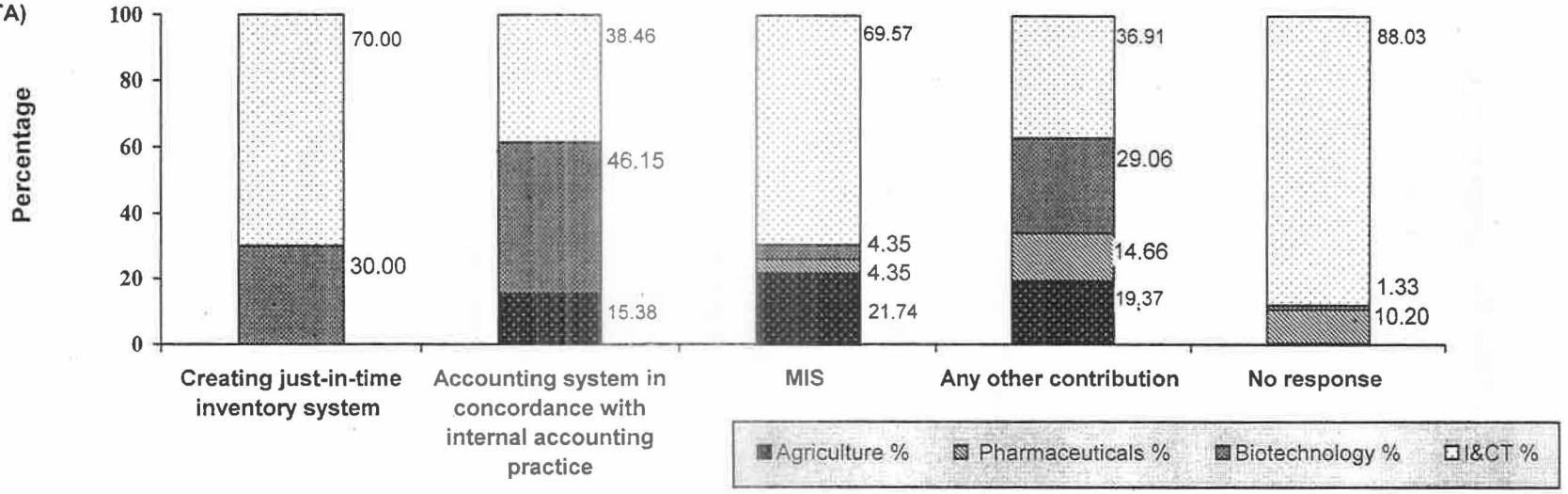


Figure 4.8 B

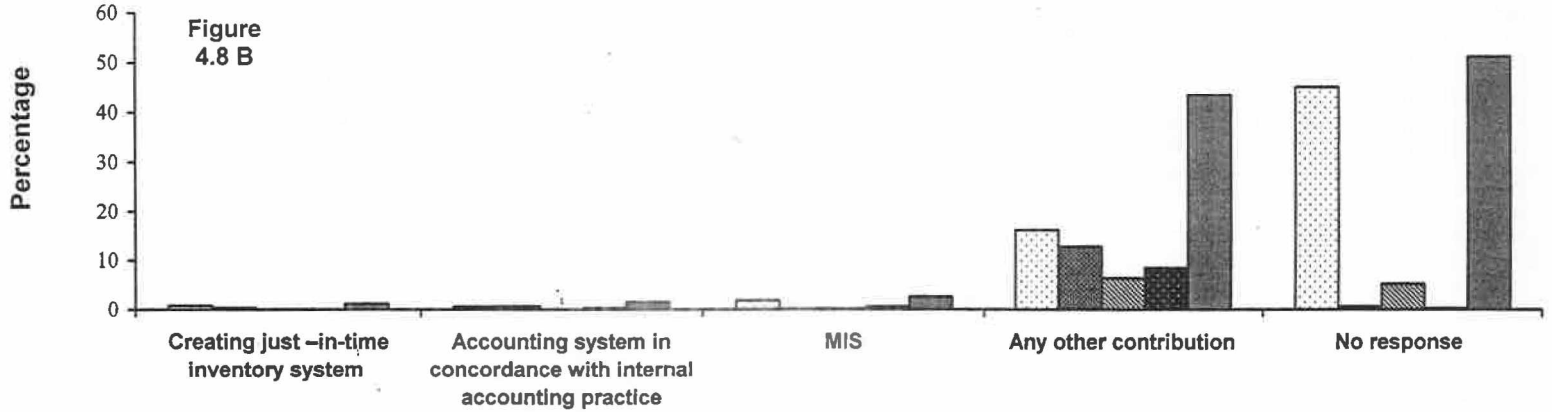


Figure 4.8 Proportional of tangible non- S&T contribution made by RBD/RBG persons in different technological area (A): Within a tangible non-S&T contribution, and (B) on overall basis

- **Non-S&T Contributions of RBD / RBG Personnel in India**

The tangible non-S&T contributions were studied on the basis of:

(a) Creating just-in-time system,

(b) Development of accounting system in accordance with internal accounting practices,

(c) Evolution of management information system, and

(d) Any other contribution.

The information received from RBD / RBG personnel on this aspect has been complied in **Table 4.6**. The technological area-wise proportions in each non-S&T contribution across different areas have been depicted graphically in **Figure 4.8 A**. and overall proportions in each non-S&T contribution have been depicted in **Figure 4.8 B**.

A perusal of **Table 4.6** and **Figure 4.8 A & B** revealed that 10 respondents (1.1%) had created just-in-time inventory system. To this specialty, contributions were made by ICT and biotechnology related persons only. For MIS development, ICT had the lead position, followed by agriculture sector. For development of accounting system, biotechnology people had the lead, followed by ICT sector.

To this question also, a very large number of respondents had answered under 'Any other' (43.5%) and, 'No response' (51.3%) columns, again for the reasons already outlined in this chapter, as explained at Para 4.5.1. on Page-57 above.

A few examples of S&T contributions, including patents, have been reported in **Box 4.2**.

Box4.2:

Some Examples of S&T Contributions by RBD / RBG Personnel

- A reusable bio-reactor for plant shoot culture
- A process for the preparation of granulated non-living biomass of the fungus *Rhizopus* species.
- A process for the absorption of toxic trace and heavy metals and organic chemicals from effluents using granulated non-living biomass of the fungus *Rhizopus* species.
- A chemotherapeutic composition used in treatment of cancer
- Implementation of array based CGH technique for the first time in India
- Development of new design for shrimp hatcheries
- Development of a vaccine for controlling street dog population in collaboration with industry
- Three high-yielding silk worm hybrids named 'Swarnandhra', 'Kalpataruvu' and 'Hemavati' were produced through molecular breeding and released to farmers for the first time in India
- Development of basmati DNA typing protocols for protection IPR
- Displacement chromatography of proteins using low molecular weight displacers.

4.6. The Hope and Reality of RBD / RBG Personnel in India

The feelings of RBD/ RBG persons using Q-short matrices were studied on three aspects:

1. Level of satisfaction on return
2. Reasons for return, and
3. Necessary steps needed for encouraging RBD / RBG to India.

4.6.1. Level of Satisfaction on Return

The satisfaction was assessed in terms of:

(a) Fully satisfied,

(b) Partially satisfied, and

(c) Not satisfied.

The information on each level of satisfaction has been depicted in **Table 4.7 (Figure 4.9 A& B)**. It shows that 82% of the sample respondents were fully satisfied after their return to India. These included 70% from ICT areal. Only 1% of the personnel have expressed dissatisfaction on return to India. It is quite remarkable that most of RBD / RBG personnel are fully satisfied on return to India.

4.6.2 Reasons for Return to India

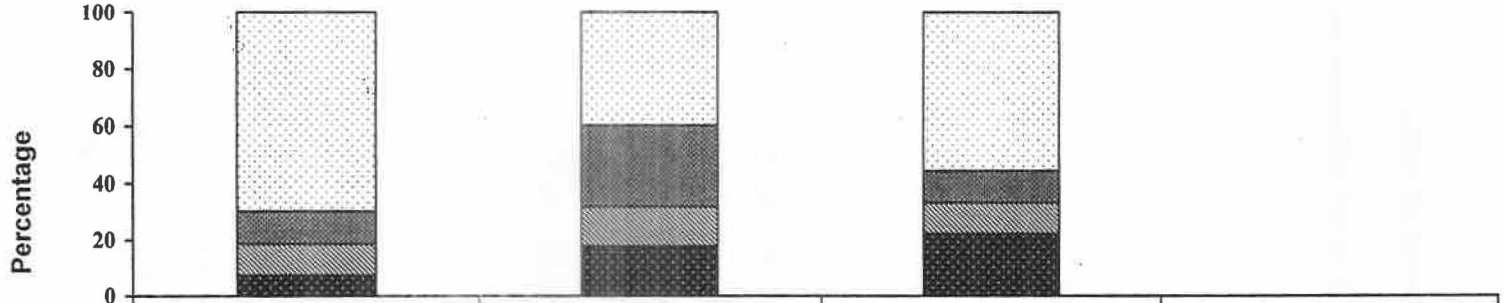
The primary issues impacting RBD / RBG, as per the responses given have been summarized below:

- Attainment of the purpose for which one went abroad
  - This included getting a higher degree, advanced level training in a particular field for which a person was sent abroad, especially in cases of companies and even in the case of govt organisations; particularly for short 3-6 month courses,
- Getting a better job back home;
- Offered to head an organisation back home,
- Company's decision to give posting in India
- To look after aged parents,
- Want the children to grow up in their own cultural background,
- Easier life with help, both paid and from family,

Table 4.7: Level of satisfaction on the decision to return to India

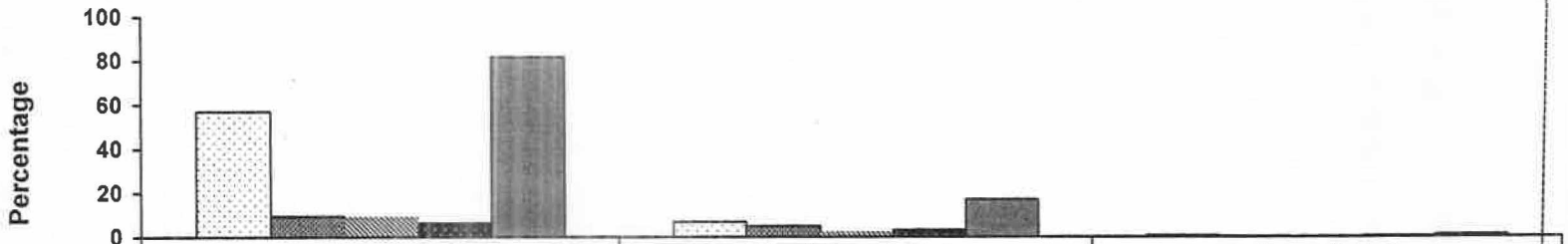
Technological area	Fully satisfied	Partially satisfied	Not satisfied	No Response	Total
ICT	500	60	5	1	566
Biotechnology	82	43	1	1	127
Pharmaceuticals	81	21	1	0	103
Agriculture	54	27	2	0	83
Total	717	151	9	2	879

Figure 4.9 A



	Fully satisfied	Partially satisfied	Not satisfied	
I&CT,%	69.74	39.74	55.56	
Biotechnology,%	11.44	28.48	11.11	
Pharmaceuticals,%	11.30	13.91	11.11	
Agriculture,%	7.53	17.88	22.22	

Figure 4.9 B



	Fully satisfied	Partially satisfied	Not satisfied
I&CT,%	56.88	6.82	0.57
Biotechnolog, %	9.33	4.89	0.11
Pharmaceuticals, %	9.22	2.39	0.11
Agriculture,%	6.14	3.07	0.23
Total,%	81.60	17.20	1.00

Figure 4.9: Proportional level of satisfaction among RBD/RBG persons in different technological area ;(A): Within a level, and (B) on overall basis

- Sense of belonging to the motherland,
- Desire to serve the nation,
- Expiry of visa and other similar reasons, and
- Changed circumstances back home.

These included economic liberalisation, political situation, policies of the government to woo back highly trained / skilled personnel by giving them special fellowships, etc.

4.6.3 Necessary Steps to Encourage RBD/ RBG to India

The participants of the study were of the opinion that in order to ensure the return of more 'human capital' to the country (that is for the RBD / RBG to continue and their numbers to increase) a number of changes will have to be brought about in the existing policies on Education / Research / Industries. These have been summarized as under:

Education

- Primary education should be broad based and of very high quality and should not be ignored under the pretext of it being a state subject.
- Compulsory free education for all till class 12.
- Good higher education is the need of the hour; good support should be made available to students of higher education.
- Infrastructure in educational institutions needs to be improved.
- Costs of education need to be looked into and corruption in the system should be removed.
- New study areas / disciplines should be introduced.
- Education should focus more on creative thinking and value addition in the form of knowledge and skill building rather than just mugging.
- Teachers at all levels of education are extremely important and in order to attract motivated people to teaching profession, there is a need to improve the existing scales of pay and promotional avenues.
- The existing large number of educational institutions are creating specialists with no where to go. There is not enough University-industry integration. Hence, industrial linkage in the final year of under-graduation should be made compulsory.
- The 200+ universities in India need thorough overhauling. Selection for the top positions and promotions should be based on quantifiable indices.
- Removal of reservation in education system.

Research

- Salaries for academic scientists in India need to be at par with or at least close to those in the Industry, as it is one of the major factors being considered when scientists return home.
- Freedom in research will improve work environment. Researches should be motivated to publish in Indian journals, so that with good research papers, Indian journals will achieve International standards and recognition.
- Many more research-intensive educational institutions need to be established. Today our system is more theory based and the focus of the students should be to learn 'how' to do things. Hence, there is need for practical learning where the focus is on' why' rather than 'how'.
- In order to transform the outcome of research into products, policies should encourage interaction between research establishments and industries.
- Funding for research should be increased. Bureaucratic procedures must be dispensed with to ensure that basic resources are easily available in labs. Grants must be given judiciously based on accountability of principal investigators.
- Most of the students go in for research to get better jobs. Many a times they never make use of their special training, resulting in loss to the society. Hence, adequacy of well-paid jobs where the training can be fully utilized, is to be ensured.
- Students must be encouraged to take up research in basic sciences and the emerging fields like biotechnology, environmental science, etc.

Industry

- Policies should be modified to increase industry-funded research.
- Policies should be modified to support medium level enterprise to benefit. A cue can be taken from the Chinese model so that we can build on our strengths and are able to compete globally.
- Subsidies need to be provided to industries, particularly new ones.
- Concessions should be given to innovative industries.

4.7. Spread of RBD / RBG Persons in India

The study has attempted to find out in which part(s) of the country, the RBD / RBG persons have spread. The names of cities from where the responses of RBD / RBG persons were received under the four technological areas have been reported in Table 4.8.

Table 4.8: Spread of RBD / RBG returnees in India: technological area-wise

IC&T	Biotechnology	Pharmaceuticals	Agriculture
Hyderabad -AP	Chennai -TN	New Delhi	Pune-MAH
Bangalore-KTK	New Delhi-NCT	Chennai -TN	Chennai -TN
Chennai -TN	Hyderabad-AP	Gurgaon-HAR	Hyderabad -AP
New Delhi-NCT	Bangalore-KTK	Faridabad-Har	Coimbatore -TN
Noida-UP	Agra-UP	Agra-UP	New Delhi
Gurgaon-HAR	Patna-BIH	Hydrabad-AP	Noida-UP
Faridabad-HAR	Noida-UP	Anand-GUJ	Bangalore-KTK
Dharbhanga-BIH	Madurai-TN	Bangalore- KTK	Hissar -HAR
Coimbatore-TN	Pune-MAH	Ahmadabad-GUJ	Dona Paula-GOA
Trichy-TN	Patiala-PNB	Kolkata-WB	Kanpur-UP
Patna-BIH	Uttarakhand	Mohali-PNB	Raipur- CHG
G Noida-UP	Coimbatore-TN	Patna-BIH	Secunderabad -AP
Pune-MAH	Shimla-HP	Rourkela-ORS	Srinagar-J&K
Secundarabad-AP	Thiruvananthapuram-KER		Trichy -TN
Samastipur-BIH	Vellore-TN		
Thrissur-KER	Kolkata-WB		
Kochi-KER			
Kolkata-WB			
Lucknow-UP			
Mumbai-MAH			

A perusal of Table 4.8 has revealed the following facts:-

- The RBD / RBG persons have responded from 14 States / Union territories across the whole country,
- The biggest congregation of RBD/RBG persons seems to be from Andhra Pradesh with 399 (45.4%)respondents
- From six states, there was only one response each from RBD / RBG person, and
- Technological area-wise the spread of RBD / RBG persons may be regarded almost same across the four selected areas. The maximum agglomeration is of ICT persons in 20 cities, followed by biotechnology (16 cities), agriculture (14 cities), and pharmaceuticals (13 cities).

The fragmentation given in Table 4.8 almost matches with the mapping forecasted by NASSCOM. The emergence of major centres on India IT-BPO map has been depicted in Table 4.9.

According to a NASSCOM study, "Big cities like Mumbai, Chennai, Bangalore, Hyderabad, Kolkata, the National Capital Region and Pune are still the preferred destinations for setting up InfoTech or business process outsourcing company".

Table 4.9: Top 50 cities on India's IT-BPO map

LEADERS	CHALLENGERS	FOLLOWERS	ASPIRANTS
o Bangalore	o Ahmedabad	o Aurangabad	o Allahabad
o Chennai	o Bhubaneswar	o Bhopal	o Dehradun
o Hyderabad	o Chandigarh	o Goa	o Durgapur
o Kolkata	o Coimbatore	o Gwalior	o Gangtok
o Mumbai	o Indore	o Hubli-Dharwad	o Guwahati
o NCR *	o Jaipur	o Kanpur	o Ludhiana
o Pune	o Kochi	o Mysore	o Patna
The Leaders account for over 85 per cent of jobs in IT-BPO space. That share is expected to drop to 75 per cent by 2018	o Lucknow	o Nashik	o Raipur
	o Madurai	o Pondicherry	o Ranchi
	o Mangalore	o Salem	o Shimla
	o Nagpur	o Surat	o Siliguri
	o Thiruvananthapuram	o Vijaywada	o Srinagar
	o Tiruchirapalli		o Varanasi
	o Vadodara	**But, if the smaller cities are able to upgrade their infrastructure, then their share could go up to 40 per cent by 2018**	
	O Visakhapatnam		

- NCR= National Capital Region

- **IMPLICATIONS**
- As per the latest status, NCR has the second rank with 21% of IT companies. It is going to be the next IT hub in the country, because of its proximity to Gurgaon and Greater NOIDA. The other cities in the country are: Bangalore (22%); NCR (21%); Mumbai (19%); Chennai (11%); Hyderabad / Secundrabad (10%); Pune (6%); Kolkatta (31%); Others (8%);
- Most of the MNCs are gradually shifting from Gurgaon, because of the *lack of infrastructure and other civic amenities*, as was experienced during the previous monsoons. That is a word of caution for the Gurgaon Municipal Board in particular and, Haryana Govt. in general.

- **Hyderabad** has earned the epithet of the *bulk drugs capital of India* for the role it played in the growth of the country's pharmaceuticals industry. The city now accounts for one-third of India's total bulk drug production, or the chemicals that go into making of drugs. It is because of development of infrastructure and talent-pool attraction for pharma and IT companies. The

city is growing faster and becoming the favorite destination for information technology (IT) firms too.

- **Therefore, it is suggested all the cities need to develop world-class infrastructure to attract more.FII and FDIs.**

4.8. Indian R&D Outsourcing: People, Infrastructure, Cost and Government

The interaction with the respondents revealed that in recent years, multi-national companies (MNCs) have evinced a growing interest in India as a destination for their Research and Development (R&D) work. Over 100 MNCs have initiated R&D activities in India, of which 70 have started operations during the past five years and account for an investment of nearly USD 1 billion[1].

India's globally reputed academic institutions contribute to its large and highly skilled talent pool. Around 250 universities, 1,500 research institutions and 10,428 higher educational institutes churn out annually over 5,000 PhDs, 200,000 engineering graduates, 300,000 technically trained graduates and 2 million graduates in other streams.

Institutions such as the IITs and IISc are well known for their academic excellence, and their graduates are comparable to the best in the world. Indians constitute the largest number of foreign-born residents in the US, possessing degrees in Science and Technology (S&T). About 164,600 of them have the highest qualifications in S&T with 30,100 PhDs. It has been possible because:

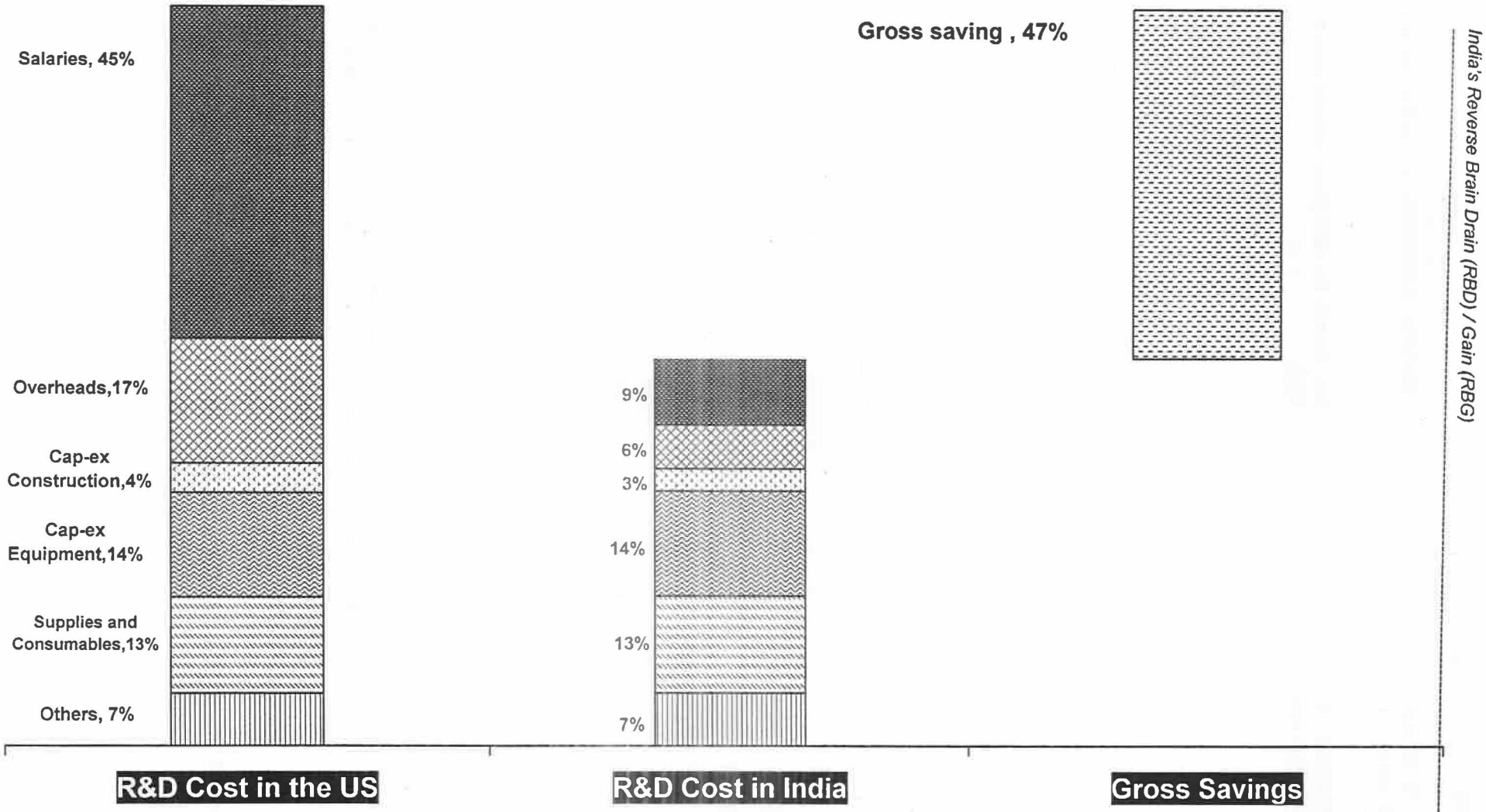
a. Most of the research in India in the past was sponsored by the government, which is the major reason why there are over 400 state-run laboratories, 250 universities and 1,300 R&D establishments in the country today. Ready availability of this infrastructure

Figure 4.10: Cost of undertaking R&D in India and USA: A Comparison

(Refer next page)

[1] *Source: Evalueserve Analysis*

Figure 4.10: Cost of undertaking R&D in India and USA: A comparison



Source: Evalueserve Analysis

allows MNCs to leverage India's R&D capabilities without having to set up their own operations in the country.

a. For instance, the 40 laboratories under the Council of Scientific and Industrial Research (CSIR) form the core of industrial R&D activities in India. With 55 years of experience, USD 222 million in R&D infrastructure investments and over 25,000 employees, the IP generated from the CSIR network comprises over 1200 commercialized technologies and accounts for industrial production amounting to over USD 800 million per year. Firms such as Hewlett Packard, IBM, Intel, Texas Instruments, GM, Samsung and HLL have set up collaborations with various universities and R&D laboratories in India.

Complementing the talent pool and infrastructure are the lower costs of conducting R&D in India. The average cost of a researcher in India is about one-fifth to one-eighth of that in the US. Supplementing this differential is the savings in laboratory establishment costs and the lower salary levels of the administrative staff. Overall, these translate to an estimated gross saving of 47% on R&D spending. However, empirical observations suggest that the hidden costs of operating an offshore centre reduce the net savings to 30-40%. A detailed break-up of the cost savings has been provided in **Figure 4.11**.

4.9. Career Opportunities in India's Knowledge Process Outsourcing (KPO) Sector

Interaction with respondents from Evalueserve has revealed that the success of Information Technology and Business Process Outsourcing to low-wage countries. The resulting cost savings have prompted several multinational companies to experiment with outsourcing higher-end knowledge-based work.

The term "Knowledge Process Outsourcing" (KPO) was first coined by Evalueserve in 2003. It published the first article on this industry, which estimated its potential market size to be of $17 billion worldwide and $12 billon for India (by 2010-11). Since then "KPO" has been referred to those outsourcing activities that require significant expertise domain (e.g., market research, business research, investment research, and data mining) and it has become a part of the lexicon of the outsourcing industry worldwide.

Currently, it is reported that at least twelve firms providing such services have KPO[2] as part of their name. The majority of the mid-sized and large IT and BPO companies in India have a KPO division. And, there are over 280 "niche" companies in India providing third-party KPO services. Given this rapid growth in

[2] There are at least five annual conferences worldwide that are solely about KPO (and some even have "KPO" as part of their names); about 120 captive units of large multinational companies are providing KPO services to their offices in North America and Europe;

the Indian KPO industry, there are clearly abundant career opportunities in this industry for fresh university graduates or post-graduates as well as experienced professionals. KPO outsourcing firms function at a higher level and can be differentiated from BPO[3] firms in the following ways:

- A KPO firm requires substantially more domain expertise (unlike a BPO firm, where the skills can usually be taught in a matter of days or weeks). In fact, Knowledge Process Outsourcing and Offshoring is an area where professionals continue to learn, just as doctors and lawyers undergo continuous training to learn new treatments and procedures and newer interpretations of the existing laws. Hence, it is not surprising that training such professionals can range anywhere between two months (in Market Research & Data Collection) to a year or so (in Intellectual Property). Consequently, a good KPO firm is likely to care more about the depth of knowledge and experience and the judgment skills of its professionals than just its size.

According to Evalueserve's research, the revenue earned by the Knowledge Process Off-shoring industry worldwide was of approximately US $1.2 billion in 2003-04 and US $4.4 billion in 2006-07. This implies an annual growth rate of 54 per cent.

The Knowledge Process Off-shoring industry employed approximately 34,000 professionals in 2003-04 and 106,000 professionals in 2006-07. Our forecast has also shown that the industry is expected to grow to US $16.7 billion in revenue in 2010-11 worldwide. It would imply an annual growth rate of 39 per cent during the next four years; and employment of approximately 350,000 professionals globally.

In contrast, the rest of the Business Process Off-shoring industry worldwide showed revenue grew from US $7.7 billion in 2003-04 to US $15.8 billion in 2006-07. It corresponds to an annual growth rate of approximately 27 per cent. During the next four years, the BPO industry is expected to grow annually at the rate of 26 per cent, and is expected thereby to earn US $39.8 billion in revenue during 2010-11.

Evalueserve's current research forecasts have predicted that the Knowledge Process Off-shoring industry in India will grow to US $11.2 billion in revenue by 2010-2011 and will employ approximately 255,000 professionals by March 2011.

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[3] A **Business Process Outsourcing (BPO)** or Offshoring firm's business process is repeatable, scalable and does not require the physical presence of a worker near the client, can theoretically be outsourced and offshored; this forms the basis of Business Process Outsourcing or BPO. A BPO firm's function has been simply defined as: it acquires a process from the end-client and runs it at its site until the process has reached its logical conclusion, after which it sends the results – if any – to the client.

According to Evalueserve's research, although this industry had only 9,000 billable professionals in India that generated the total revenue of US $260 million during 2000-01, this number had already grown to 75,400 by 2006-07. And, these billable professionals generated US $3.05 billion. This implies a cumulative annual growth rate of 51 per cent in US Dollar terms and 43 per cent with respect to the increase in the number of billable professionals during these six years.

While the above macro trends are excellent in terms of creating knowledge-based jobs, the KPO sector in India is experiencing substantial employee turnover, which hurts this sector in particular because these employees are unable to gain sufficient domain expertise and knowledge before they move on to their next job.

It has been reported that, if the attrition is not controlled properly within the KPO industry in India, then this growth may be stymied even further, and this industry may not be able to generate more than US $9.9 billion in revenue or employ more than 225,000 professionals by 2010-11.

The Evalueserve's research provides an estimate for the number of billable professionals likely to be employed in various sub-sectors within the KPO industry in India by 2010-11 and the revenue likely to be generated within these sectors. (**Table 4.10**). Admittedly, the delineation between some of the sub-segments is somewhat arbitrary and both the revenue as well as the number of billable professionals can vary based on how these sub-segments are defined.

Given this backdrop, it is not surprising that the KPO industry needs a lot of MBAs, accountants, medical doctors, engineers, IT professionals, PhDs, lawyers, architects, pharmaceutical experts, editors, publishers, game designers and animators, and even bachelors and masters in biotech, commerce and economics. However, what differentiates the KPO sector from other sectors is the experience that the professionals have – or get – within their domain of expertise. Clearly, because of the nature of the work involved, "soft skills" are significantly more important in the KPO industry than IT or BPO industries and these include good presentation skills with respect to speaking and writing, leadership, and project management.

Table 4.10: India's KPO industry in 2006-07 and estimates for 2010-11

Description of Sub-segment	Revenue (in million $)	No. of professionals	Revenue (in million $)	No. of professionals
	2006-07	2006-07	Expected, 2010-11	Expected, 2010-11
▪ Banking, Securities & Insurance Research	175	3500	600	12000
▪ Data Management, Searching, & Analytics	590	15,000	2,500	60,000
▪ Business & Consulting Research	125	3,200	450	11,000
▪ Human Resources - Research & Analytics	25	600	120	2,500
▪ Market Research & Comp. Intelligence	175	4,500	460	12,000
▪ Eng. Design & Architecture, CAD	315	8,000	950	21,000
▪ Game-design & Animation Services	245	7,000	900	22,500
▪ Legal, Paralegal & Intellectual Property	95	2,500	500	12,000
▪ Scientific & Medical Content Publishing	165	400	100	2,000
▪ Remote Education. Publishing, Technical. Writing	300	9,000	1,000	25,000
▪ Contract Research. Orgs, Biotecnology services	580	15,000	2,500	50,000
▪ Translation and Localization	75	2,000	360	9,000
▪ Marketing & Sales Support, Answering RFPs	20	500	150	3,000
▪ Remote Logistic services & Procurement	40	1,100	160	4,000
▪ Network Optimization & Analytics	125	3,100	450	9,000
TOTAL	**3,050**	**75,400**	**11,200**	**255,000**

4.10. Outcome of the Study- As per the Responses Given in Nutshell:

- Today is an era of globalization and; positive thinking. It is global inter-dependence, connectivity of countries and societies, cooperation in scientific & technological fields, and healthy challenges that galore in economic fields.
- Modern communication network all over the world keeps the global 'players' in constant touch with one another.
- **RBD / RBG persons** are participating in a big way in nation-building activities; in a way, it is replenishment of what was drained away. The slogan has been "Reverse Brain Drain".
- The Indian migrants worldwide have seen transformation from "**humble migrants**" to holding high positions in universities and academic fields, industries, politics, economic sphere, etc., coinciding with the emergence of India as a strong economic power!
- The UN University has recently reported that some successful Indians employed in USA are setting-up hardware & software companies in their country.
- The industrialized countries, with shortage of R&D personnel, are trying to obtain access to India's world-class technical and scientific manpower. Outsourcing is the buzz word!
- Modern communication networks keep the global players in constant touch with each other. It is "**Destination India**"! i.e. "**Reverse Brain Drain**".
- 95% of the people have returned to India giving good reason like that '**India has developed a lot in terms of Facilities, Infrastructure, Communication, and Connectivity**'.
- The returnees are satisfied with the developments in India, which are comparable to anywhere in the world.
- Every one feels that it would be great if someone could think of creating a new society that will have commonality in thinking, adapt to the mix of new and old culture and environment of fast growing technology. Why can't all think about this!

Collaboration, Connecting, Outsourcing

- The best companies are the best collaborators. The reason lies in the fact that in technology, marketing, etc., things are becoming so complex that no

single firm or department is going to be able to master them alone. Thus, several new forms of collaborative supply-chains, outsourcing, in-sourcing and all the contacts can transform a small enterprise into a big enterprise from a local company to international company. In their own way, at their own place and in their own time and according to their own tastes. Big companies can collaborate with their customers in a totally different way.

- There is a wave of world-wide connectivity that which has been made possible with modern technology. Through the medium of tele-conferencing and new software use (Optical Fibre), meetings can be hosted by the whole global chains, without moving from their homes or offices. It can now connect all the knowledge centres on the planet together into a single global network.
- Outsourcing is done to save money, improve quality and free company resources for other activities. Outsourcings, started with data processing industry, have spread to areas including tale-messaging and call centres. Some firms use outsourcing primarily to cut costs, enhance innovation and speed up growth. Its other dimensions are: to acquire knowledge talent and to grow business faster—not simply to cut costs and cutbacks. In the process it helps multinationals foster an ethical corporate culture around and an employee-base spread all over the world.
- In India, a small unit can provide the same backroom support at Gurgaon, Noida, etc, that is provided at Seattle or Silicon Valley in California.
- In outsourcing more technology pieces, it is necessary to partner first with small subsidiary units and then create ones own regional network and alliances. Collaboration is necessary to reach farther and wider. The aim should be to do all new jobs oneself (even small all encompassing) because competitive market and technology will force everyone to do every subsidiary job.
- *The findings explicitly reveal that human capital, financial capital and physical expected gain of physical assets has been the main contributor for brain drain. However, the brain gain has been pushed by social capital i.e. recognition within own society. The other factors found responsible to a great extent are again the human capital, financial capital, the natural resources inherited in India and of course the emerging opportunities.*

CHAPTER 5

SOME SUCCESS STORIES OF RBD / RBG PERSONS, AND DEVELOPMENTS IN SELECTED FOUR TECHNOLOGICAL AREAS

First generation of Brain Drain

The poor spent on training, the rich made use of that training at relatively low cost. This was first generation of Brain Drain

Reverse Brain Gain

As journey to brighten India gets momentum there is a slow return of most Indians who had left earlier to seek greener pastures abroad.

They come to India better equipped intellectually and with better acquired knowledge. Their pockets are bulging. The term used for this phenomenon is "Brain gain"

Return flow of resources

Return flow of resources that can replace and replenish what has been drained away.

Chapter 5

Few Success Stories of RBD / RBG Persons and Development in Selected Technological Areas

This section has been divided in two parts.

- In **Part A**, case studies of some successful RBD / RBG persons have been outlined, and
- In **Part B**, developments in the four technological areas have been presented.

PART A

5.1. SOME SUCCESS STORIES OF RBD / RBG PERSONS

☐ **Sansken, Communication Technologies Ltd., Mr. Rajiv C.Mody, CEO**

- *Academic Achievements*
  - B. Tech degree in electrical engineering from Baroda University, Vadodara
  - Masters in Computer Science from Polytechnic Institute of New York. USA

- *Professional Achievements*
  - Mr. Mody has served at various technical positions at Seattle Tech, Inc. and Advanced Micro Devices (AMD) from 1983 to 1986. Prior to Sasken, he was a project leader at VLSI Technology.
  - He has co-authored a patent in the area of physical design and presented a paper at the ICCAD Conference.
  - Mr. Mody came back to India after working in the Silicon Valley. He worked there for seven years writing software used for designing of silicon chips.

- Meanwhile, American lifestyle made Mr. Mody feel alienated and hence he did not want to settle there.
- Despite having successful career, he decided to take the plunge and realize his dreams early in his life, instead of having regrets later. As such in 1989 at the age of 32, he left his job at AMD and started a business named 'Sasken', in a garage in California and within two years, he shifted his company to Bangalore, India.

- *Significant Contributions*
  - Today, Sasken Communication Technologies Limited, with top three clients, viz. Nokia, Texas Instruments, and Nortel, is a public company in Bangalore which offers research and development consultancy, wireless software products, software services and network engineering services to semiconductor manufacturers, wireless handset developers, network equipment, test and measurement companies, and service providers globally. Software applications designed by Sasken can be found inside all major mobile phone brands in the world.
  - Sasken is ranked the second best company to work for in India, according to the survey conducted by Business Today.

☐ **Avesthagen, India**

- **DR. Villoo Morawala Patell, Founder and Managing Director of Avesthagen, India's leading fully Integrated Biotechnology and Bioinformatics Company**

- Dr Villoo Morawala Patell was born in Navsari, a small town in Gujarat, where the Parsis first settled on arriving from Iran.

- *Academic Achievements*
  - M. Sc. (Medical Biochemistry) from Sophia College, Mumbai
  - Researcher (10 years), International Crops Research Institute for Semi Arid Tropics (ICRISAT) at Hyderabad. Done research on drought tolerance in pigeon pea, groundnut, sorghum and millet. During these years, she worked with a number of eminent international scientists with enormous interest and passion.
  - PhD (Molecular Biology) from the University of Louis Pasteur, Strasbourg, France,

- She wrote two projects "Making Money with Biology" for a seeds project for VST Industries and "From DNA to Drugs" for Dr Reddy's organization
- She contacted Marc Van Montagu, winner of the Japan prize, inventor of GMO technology, etc., of University of Ghent, Belgium, and asked for a scholarship for about 6-9 months and got the same.
- Meanwhile, Dr Anji Reddy had put her in touch with the Tatas, and they gave her a project to help set up a biotech lab. She agreed to set up the Rallis Biotech Lab after her stint in Belgium.
- She witnessed the foundation of three companies. This was when a realization came within her, 'you have to first build an array of technologies, mix them continuously in a cauldron and when something matures, spin it off into a company'. She returned to India in December 1994 and set up the Ralli's Lab in 3 months, but later decided mutually to part ways with them.
- National Centre for Biological Sciences (NCBS) in Bangalore was the right place for her and NCBS supported her with a stipend of Rs60,000 per month, and Dr Vijayaraghavan introduced her to the officers at Rockefeller Foundation to whom she applied for research grants.
- By 1998, she formed a team of 10 people working with her, fell short of space, and went to find space at the University of Agricultural Sciences (UAS), Bangalore, met Prof. G.K. Veeresh.

- *Professional Achievements*
  - She became a Professor Emeritus at the age of 43.
  - She registered a 'not-for-profit' company and a' for-profit' company , and wanted to call these Gengraine Technologies combination of genetics and grain on which she was researching. When she was asked to add another name, she added 'Avestha' and the company therefore became 'Avesthagen'.
  - Starting the company was considered such a hare-brained idea that she had to find someone who could believe in her project to sign the documents as a second director, and she could only think of her mother, who, therefore, became the co-founder of Avesthagen.

- By March 2000, she raised about 1.5 crore from relatives and friends, the 33 original investors of mixed races and nationalities. Her four major investors advised her to make it a a pure private play, but she resisted.
- She decided to change the two companies, private-public model in September 1999, and also moved out of institutional framework and started work at a rented office.

- *Significant Contributions*
  - Dr Patell, Founder and Managing Director of Avesthagen was presented the "Entrepreneur of the Year Award for the year 2006' by Biospectrum.
  - She received 'Outstanding Woman Entrepreneur' for the year 2005-06' from FICCI.
  - Avesthagen has also been declared a Red Herring Magazine 100 Asia Winner for 2006 for "disruptive innovation".

☐ **Shanta Biotech**

- **Mr. Varaprasad Reddy, Founder and engineer turned into a biotechnologist, producer of Hepatitis B vaccine in India**

- *Academic Achievements*
  - Mr. Varaprasad Reddy is basically an electronics engineer from Osmania University, Hyderabad. He plunged into the brave, though difficult, new world of biotechnology in 1993 after exiting the family-owned electrical goods business, because he was convinced that India needed its own manufacturers of affordable, life-saving drugs rather than being dependent on the benevolence of expensive foreign producers.
  - World Health Organization had mandated that Hepatitis-B should be incorporated into the immunisation schedule. India, however, was unable to do so because of serious foreign exchange crunch and because Hepatitis-B vaccine was very costly. It was priced at Rs780 per dose and three doses were to be administered in each case.

- *Professional Achievements*
  - Mr Reddy approached a western company for technology. The company spokesperson told him that India neither has the resources to pay for the

high technology fee for buying the vaccine nor ability to absorb the technology.

- Dr Reddy wanted to prove to such persons that Indians are capable of producing high quality vaccines and could offer them at affordable prices to the masses. To begin with, he initiated the project as an R&D exercise at Osmania University under the industry-university interaction programme in 1993.
- Further research was conducted at the Centre for Cellular and Molecular Biology (CCMB), Hyderabad, until the time they developed their own R&D facility. Funding proved difficult in the beginning, but finally they received funding from the Sultanate of Oman, to the extent of 50% of the equity and also got a long-term loan from the Oman International Bank at a much subsidised rate of interest. After this, they also received a loan from the ICICI bank for technology development. When the R&D results were viable for commercialization of the product, the newly established Technology Development Board (TDB) under the Ministry of Science and Technology, Government of India, New Delhi, provided funding to it. This gave the requisite impetus to the project.
- India's first recombinant vaccine, Shanvac-B, for Hepatitis-B, was launched in 1997, followed by Shankinase, a recombinant streptokinase. The indigenous development of recombinant Hepatitis-B vaccine enabled India to join the elite club of five countries in the world to have the know-how to produce Hepatitis-B vaccine. The entry of Shanvac-B into the market brought down the prices of imported vaccine drastically from Rs780 per dose to Rs50 in 1997 and further down to Rs25 per dose in 2003.

- *Significant Contributions*
  - The Hepatitis B vaccine is currently being exported to 50+ countries through UNICEF and PAHO.
  - A child in the third world country is able to get the vaccine at $0.23, while his counterpart in the U.S. is paying $70 for the same.
  - According to Mr. Reddy, he set up Shanta Biotech in his mother's memory to offer affordable healthcare to each and every Indian. He promised to his mother that he would always keep in mind the needs of

the poor while fixing the profit margins on his products. He believes that India has a vast pool of talented people who can develop the latest technology available in the world.

☐ **Dr Gopalan Sampathkumar, Triplicane, Chennai, Tamil Nadu**

- *Academic Achievements*
  - PhD in organic chemistry from the Indian Institute of Science (IISc), Bangalore,
  - Post-doctoral fellowship from Zürich, Germany
  - Post-doctoral fellowship from USA, in Carbohydrate Chemistry.
  - Post-doctoral fellowship (2003-07) at John Hopkins, USA
  - Scientist at the National Institute of Immunology, New Delhi

- *Professional Achievements*
  - He and his colleagues are working in the lab worked on making synthetic vaccines. They are trying to synthesize Vaccine for dysentery, which affects a large number of people, particularly in Asia.
  - Trained in biology, he has also worked on the chemical biology of carbohydrates.

- *Significant Contributions*
  - Awarded 'Ramalingaswami Fellowship' of the Department of Biotechnology
  - He is now in the process of setting up his lab at NII, where he hopes to give something novel to India through 'competitive research'.

☐ **Dr. Maheshwari Kalyanpur, Rare Paediatric Cardiologist**

- Dr Maheshwari Kalyanpur is one of the 14 paediatric cardiologist in India.
- She received her training at Yale-New Heaven Hospital
- Today, she examines more patients and treats different medical problems than she ever faced at Yale.

☐ **Shri Arjun Kalyanpur, Centring tele radiologist**

- Sh. Arjun Kalyanpur, a radiologist returned to India in 1999. Says he impulsively, "why should my country be any way less than the country I was in!"
- American-trained Arjun reads images for the emergency room night shifts of about 40 American hospitals
- There is a shortfall of night-time radiologist in the United States. He proved to Yale that he could accurately read CT scans and other images transmitted via broad-band to India
- Teleradiology solutions are his business, which he started it in 2002.

☐ **Shri Suresh Sharma, Inventor of herbal treatment for diabetics**

- Shri Suresh Sharma of Jaipur has developed an herbal medicine from the leaves of 'Kadamba Tree' for treating diabetic people – an ailment which is fast growing in India
- He has already treated more than 1300 diabetic patients suffering form type II diabetes, without any side effects
- The two types of alkaloids found in the tree leaves have received international classification from the world Trade Organization (WTO)
- The herb containing alkaloids from cadambine and dihydro-conchonine, found in the tree, has been granted " diabetes control patent" by the Controller General of Patents, India

PART B

5.2. DEVELOPMENT IN THE SELECTED TECHNOLOGICAL AREAS

5.2.1. Information and Communication Technology

- The past two decades have witnessed an exciting world scene in the area of information & communication technology (ICT). Achievements of Indians in ICT and other sectors include development of NSE, WWW, FII, cell phones, plethora of TV channels, computers, laptops, palmtops, iPods, mp3players, PoD screens, plasma TVs cameras, French mobile markets, Sagem's, Blue 466X (including music player, an FM radio on speaker phone, Blue tooth connectivity, VGA quality cameras & video recording), etc.

- Internet is making on-line teachers to take advantage of 'People Process Outsourcing' to reach distant areas and to provide them general information for social transformation.
- The rural India is getting the advantage of tele-education, TV mobile phones, etc. Tele-education has started reaching the remote areas of India making reaching the un-reached possible.
- In recent years more than two dozen global IT sector companies have set-up their R&D Centres in India, tapping India's talent for conducting cutting-edge research:
  - BPO (Business Process Outsourcing) has changed urban life-style
  - RFID (Radio Frequency Identification Device) has been providing real-time information on patient diagnostic and healthcare services
  - Intel's (Indian Development Centre) has demonstrated that it can make one trillion simple scientific calculations per second

Information Technology

Jack Welch, former CEO of GE says, "India is a developing country but it is a developed country as far as its intellectual capital is concerned". "We get the best intellectual capital per dollar here"

Box 5.1

Some Facts about Achievements of Indians in ICT, and other Sectors,

- **GM of Hewlett Packard (hp) is an Indian** - Mr. Rajiv Gupta
- **Creator of Pentium chip (used in 90% of the computers today) is an Indian**- Mr. Vinod Dahm
- **The third richest man in the world is an Indian:** According to the latest November 2008 report of Fortune Magazine, it is Azim Premji, who is the CEO of Wipro Industries. The Sultan of Brunei is at the 6th position now.
- **Founder and creator of Hotmail is an Indian** : (Hotmail is world's No.1 web based email program) - *Mr.* Sabeer Bhatia
- **The President of AT & T-Bell Labs is an Indian** - Mr. Arun Netravalli (AT & T-Bell Labs is the creator of program languages such as C, C++, Unix to name a few)
- **New MTD *(Microsoft Testing Director)* of Windows 2000, responsible to iron out all initial problems is an Indian** - Mr. Sanjay Tejwrika
- **Amongst Chief Executives of CitiBank, Mckensey & Stanchart is an Indian.** They are M/s Victor Menezes, Rajat Gupta, and Rana Talwar.
- **Pepsio Co's first lady Chairperson and CEO, and, the first lady Chairperson of the United States India Business Council, a forum that has worked tirelessly to improve the India-US business relationship for more than 30 years is** - Ms Indra K Nooyi.
- **Indians are the wealthiest among all ethnic groups in America, faring even better than the whites and the natives.**
  - There are 3.22 million people of Indian origin in the USA *(1.5% of the population)*.
  - 38% of doctors in the US are Indians.
  - 12% of scientists in the US are Indians.
  - 36% of NASA scientists are Indians.
  - 34% of Microsoft employees are Indians.
  - 28% of IBM employees are Indians.
  - 17% of INTEL scientists are Indians.
  - 13% of XEROX employees are Indians.
- **IMPLICATIONS:** *The Indian talent has reached the zenith in both knowledge and corporate leadership all over the world.*

- Google has brought advanced Internet opportunities of answering questions in one shot by bringing together text, videos, images, excerpts from books, etc. called "Universal Search",
- Airtel is trying to retain leadership in mobile telephone industry. It intends to invest US$ 8 billion in India.
- Oracle India started its Indian operations in August 1993 and today has software development facilities in Bangalore and Hyderabad with over 600 people. Oracle is the world's second largest software company with annual revenues of more than US$ 10.9 billion. The company has operations in more than 145 countries around the world. Oracle India has achieved a CAGR of about 40 per cent since its inception and has a market share of more than 50 per cent in the Random Database Management System (RDMS) segment. Oracle sells more call-centre software in India than the rest of Asia Pacific combined.

- Software industry in India is represented and supported by NASSCOM (National Association of Software and Services Companies). Currently, more than 1000 IT companies in India are members of NASSCOM. The Indian IT companies like Infosys, TCS, WIPRO, Satyam got USD 29 billion from software export during 2006-07 (*this could, however, be doubtful after the recent revelations*). These internationally recognized global software companies have reputation of successful delivery and operational system.
- IT sector has witnessed breath-taking speed in globalization. Many techno-entrepreneurs of India have come back. Out of all returnees to India, 90 per cent are IT professionals; for example, WIPRO, has 66,176 software engineers in IT services.
- Many of the RBD / RBG persons have opted to work in their companies in India rather than USA. They are improving and innovating, in response to consumer demands.
- Around 50,000 families in Delhi alone have learnt computer operation at home under National Computer Literacy Mission with the help of few returnees under **Tele-education programme.**
- The knowledge gain through Brain Drain (RBD) / Reverse Brain Gain persons is showing bright prospect for development of domestic sector.

IT Industry's Future

- The past 10 years saw the IT industry taking a definitive shape and tasting its success. The telecom sector was opened to private sector, resulting in its rapid expansion and dramatic quality improvement
- The 'mobiled population' is likely to explode as "gadget gurus". These may become moving articulate marketing wizards in pushing new items in the market and moving prices rock bottom simultaneously. The talk-time introduced earlier may increase.
- The private telecom firms like Reliance, Hutch, Ideal Cellular, Airtel, Tata Tele-services, TRAI and the state-run companies like BSNL, MTNL will put the brightest minds together.
- The year 2005 turned out to be an exceptional year for the millions of mobile users and the Indian telecom sector. The years 2006 and 2007 were also exciting. The Reliance Info communication introduced a new tariff-regime under the tempting title "one nation, one tariff"-one rupee per minute to anywhere in India. The state -owned BSNL's "one-India" Plan is likely to make similar tempting offers.

Information Technology: e-government software platform

Srikanth Nadhamanic had stayed in the Silicon Valley (California) for 16 years. There he had helped to develop the Sun Microsystems Ultra space & Intel Pentium Chips.

On his return to India, he designed e-government software platform. It (the platform) uses digital mapping which is capable of revolutionizing the administration of India's local government. This mapping system has already sparked a change in Bangalore.

- There is rapid expansion, quality improvement and dramatic innovations in telecom sector in India. At the moment it can compete with the best in the world. The IT service industry has spurted the off-shoring of software services.
- The government has taken special steps to create policy environment and procedures which support the growth of IT services industry. The IT and BPO have shown excellence in their performance and received international recognition as a global software industry.
- The technical education system in the

Globalization, collaboration, competitiveness and connectivity.

A different atmosphere is visible the world over now. A person all over the world collaborates in work and competes with each other. The picture that presents itself is globalization, collaboration, competitiveness and connectivity.

country has risen to meet the demands of the IT service industry.

- During early-1990s, less than one lakh degree and diploma holding engineers passed out of the institutions, and now, their number has gone up to three lakh every year.
- By 2015, the IT industry should be able to generate 4 million jobs.
- For the top companies like Infosys, TCS, Wipro, and Satyam – a rising rupee need not be a threat; it could spur a move towards better innovation and higher efficiency. These four companies account for more than 40 per cent of the receipts from software exports that totaled over $ 29 billion in 2006-07.

5.2.2. Biotechnology

- For the past couple of years, the researchers in biotechnology area have been involved in marine sciences or oceanography research and are busy working on the sea, under the sea and above the sea. They are trying evolving methods of restoring clean environment and help replace fossil fuels with the renewable energy systems. This has the potential of leading to energy independence.

India's Leadership position

"It is talent in all walks of life including biotechnology, science & technology that is going to give India a leadership position", says Dr R A Mashelkar, Former Director General of Council of Scientific and Industrial Research

- The RBD / RBG persons are working on bringing to the earth Helium-3 for the generation of solar power.
- The Council of Scientific and Industrial Research (CSIR) through its various institutions has been able to add several in innovations in the field of biotechnology, including DNA mapping.
- The agricultural scientists are applying biotechnology in farming, with the aim of enhancing food grain production
- Genetic Engineering Approval Committee (GEAC) has permitted the commercial cultivation of BT cotton in India. It supported the suggestion of setting up an independent laboratory to verify the samples and validate the bio-safety of genetically modified crops.

Evergreen Technology

'Achieve Evergreen Revolution & in India' by using agro-biotechnology" says Dr R A Mashelkar former DG, CSIR.

- The 'Red Technology' is helping in designing of antibiotics, gene-therapy for curing diseases, producing synthetics, human insulin for the treatment of diabetics.

5.2.3. Pharmaceuticals

- The Indian Pharmaceuticals Industry has already moved from "imitation to innovation" and is heading towards "venture to innovation".
- A 'Pharma Biotechnology boon' is envisaged in the near future. It has the potential of generating revenues of billions of dollars and creating of millions of professional jobs.
- In Tamil Nadu, a novel joint-venture between Frontier Lifeline Hospital and Tamil Nadu Industrial Development Corporation is on the cards. Copying the Brazilian model and name, Frontier Mediville is to be opened in Elavur in Chennai with following features:

  - It will have a medical science-park for research in basic and applied sciences, a multi-specialty 1000-bed hospital,
  - This centre is likely to be the hub for Medicare and medical research in South Asia. It will fall under the category of 'bio-hospitals' and the cost is likely to be Rs450 crore.
  - The Mediville will have "Sterile Biomedical Corridor" to facilitate manufacturing of pharmaceutical products. It expects to handle outsourcing orders from rest of the world. Its nursing and paramedical training programme will be run in collaboration with Australia's Edward Dunlop Health Foundation.

Box 5.2
Interaction with Dr. G. Bakthavathsalam, Chairman, K.G. Hospital, Coimbatore

- With the help of Indian returnees (RBD/RBG persons), the KG Hospital has commissioned the latest Siemens - developed equipment (which is different from Cathlab andiogram) called "128 Slice Cardiac CT Scan Equipment".
- With this a patent's heart can be scanned within seconds and it provides information on precise location of the blocks of the blood vessel in the heart.
- A major benefit from this 'Technology-Precision Imaging' is preventive cardiology.
- The scanner cab helps in predicting a heart attack and even spots lurking diseases in people whose genetic factors and life - style can bring about heart problems.
- This equipment can scan the brain and neck for tumour or block in blood vessels.

- It will have a herbarium of medical plants and genetically engineered strains of plants. It is planned to be developed in collaboration with Korean Research Institute of Biosciences and Biotechnology and the Asia Pacific Bio-Resources Consortium.

- The Post–graduate Institute of Medical Education and Research (PGIMER), Chandigarh, is a super specialty institute for the implementation of telemedicine programme in the SAARC countries. It involves electronic communication technologies to provide clinical care in the remote areas. Pharmacists need researching on epidemiology of diseases, infectious diseases, nutrition and simplified treatment regimes.
- Bioinformatics is likely to offer opportunities for designing drug molecules, generating new pharma co-genomic data, and creating high-value medical wisdom.
- Biosensor is expected to revolutionize health care delivery system in India. It is a highly useful technological instrument for the management of diabetes, diagnosing of heart diseases, prostrates, etc. and for measuring concentrations of biological molecules in the body saliva and blood.
- Biosensor technology will revolutionize the way quality healthcare is expected to be delivered in India.
- Precise location of the problem zone and spending less time on diagnosis "is the miracle of 'imaging technology'", says Dr G. Bakthavasalam.
- The new diagnostics and therapy approach for disease management has opened avenues for new therapies, gene-regulation, etc. It will require Infotech plus Biotech skills for augmenting.
- India's Stem Cell research applies to kidney, heart, liver, pancreas, etc. problems. The first new TB molecule has been developed by Lupine and other associated institutions. It has supplemented 'Rifamcin' and has practically controlled the TB cases in India.
- Drug researchers are busy in designing new molecules and exploring new mechanisms. The $ 2 billion biotech industry is carving out a niche for itself.

Drugs for the Poor

- Indian drug industry is striving to become a major provider to the developing world - "Drugs for the poor "

- Indian Drug industry is striving to become a major provider to the developing world the "Drugs for the Poor";

5.2.4. Agriculture

- India has achieved many milestones in agriculture during the past three decades; "Green Revolution" is one.
- Dr R.A Mashelkar, the former Director General of Council of Scientific and Industrial has suggested to the Indian farmers to achieve "Evergreen Revolution" in India. He has advocated the use of agri- biotechnology.
- The emphasis is on ushering in an "inclusive growth" in agriculture. It involves acquiring technical expertise in allied fields of agriculture, irrigation, soil management, herbal cultivation, forestry, pastoralism, fisheries, etc.
- The renowned agricultural scientist, Dr M.S Swaminathan says, "Green Revolution" enthusiasm in agricultural scientists has been intellectually gratifying. Let us start another revolution now: "Develop agricultural as part of 'knowledge economy'".

Agriculture as Knowledge Economy

- 'After Green Revolution, let us start another revolution of 'developing agriculture as a part of knowledge economy'..... .....said Dr. M.S. Swaminathan former DG, ICAR

- Reducing poverty and hunger to half by 2015 is the first goal among the UN Millennium Development goals. Adds Swaminathan, "This UN programme represents Global Common Minimum Programme for Sustainable Human Security and Peace".
- Non-resident Indians (NRIs) with farming background have been studying the growth of India's economy in general and commercial farming in particular.
- Earlier, NRIs' remittances home ($21.7 billion in 2005) were to replenish family kitty. Now they find it remunerative to invest in India. The "Farmers' Package Policy" is enticing them to invest in their village farms, introducing biotechnological innovations – experimenting with oilseeds, organic farming, vermi or organic compost, biological pesticides, crop planning, efficient use of water resources, etc.

- The young and energetic Indian farmers are joining hands with NRIs. The NRIs are distributing the seeds they brought from the USA to gourmet vegetables. The Indian farmer is getting consultancy advice from Winrock International -an American NGO in agriculture.

- About 500 farmers across the country are growing these vegetables now. Apple farmers are diversifying into Kiwi growing. More than 20,000 kilograms are produced in a year under the brand name 'Baragarah Estate'.
- The NRI farmers are helping their Indian counter-parts to energize vast untapped production reservoir in agriculture and augment investment therein.

Some Significant Issues

The developing countries should take recourse to refining the traditional methods of soil health-care and pest management and should blend them with modern technology. They should also harvest vast animal wealth; India has over 20 per cent of the world's cattle population Hence, "India should promote crop-livestock integrated farming system", says Dr M.S Swaminthan.

- Novel opportunities for developing nations have opened up avenues for promoting conservation farming and sustainable rural livelihoods. This will help achieve 'evergreen revolution'.
- India has to produce more per unit of land and water because there is diminishing per capita arable land and irrigation water. The situation may be optimized through copying innovative R&D measures followed in agriculturally-developed countries like Israel.
- A good weather code may be kept ready along with drought and flood codes, as per international practices in developed countries.
- Assured and remunerative marketing will stimulate and sustain farmers' interest in producing for the market.
- There is also a need to revitalize the earlier food traditions of rural and tribal consumers.
- Agriculture-across the expanse of India-is heralding the country's second Green Revolution. A progressively larger number of states are amending their Agricultural Produce Marketing Committee (APMC)

Act, along the lines of the Model APMC Act, to allow farmers to directly sell their produce to the consumers.

Box-5.3
Interaction with the Renowned Agricultural Scientist
Dr. M. S. Swaminathan,

1. Pastoralism and nomadic life-style present an interesting picture of rural India.
2. Indian agricultural scientists, especially many returnees from abroad (RBD/RBG persons) are researching on pastoralim in totality so that India is able to harvest vast animal wealth of over 20 per cent of the world's cattle.
3. Many schemes have been introduced to innovate pastoralim in its diversity. The introduction of biotechnology in pastoralism has made considerable impact on animal health and animal reproduction.
4. He advocates **crop-livestock integrated farming system** in India, to overcome mono-cultural farming system that has led some farmers to desperation and many to suicides.
5. India's is the dairy-farming culture! India's 80 million farming households are involved in dairy-related activates and 12 million farmers are spread over 176 districts of the country-participate in dairy cooperative movement, initiated by the National Dairy Development Board (NDDB). It is Amul's replica.
6. India produces 100 million tonnes of milk in a year and is the biggest milk producer in the world. After the Green Revolution, it has been White Revolution architected by Dr Verghese Kurien.
7. While complimenting Dr. Kurien's brain child Amul (previously called as Kara District Cooperative Milk Producers Unicom Limited), Dr Swaminathan, informed that it represents Indian farmers' entrepreneurial spirit. Amul milks massive investment on development of human resources, which has, in turn, given a boost to milk production and pastoralism in the country.
8. Like in Massachusetts, US, Indian scientists too are using biologically active drugs to genetically alter animal breeds. Reproductive physiology in buffaloes is expected to enhance their conception rate and milk production.
9. Biotechnology can help increase the number of calves born per Cow by 12 per cent. The use of BST (somato- tropin) could increase milk production by 12 per cent. It has become possible to produce therapeutic and diagnostic proteins in their milk. Dr M. S. Swaminathan informed that cattle health improvement message has been disseminated through a network of veterinary doctors and veterinary hospitals.
10. The National Bank for Agricultural and Rural Development (NABARD) has launched an ambitious Rs.10,000 million National Milk Scheme to provide farmers with sustained income.

- Significantly, several agricultural sub-sectors like horticulture, herbs, aromatic and medicinal plants, floriculture, seed development, animal husbandry, pisciculture, aqua-culture, vegetables cultivation, mushroom cultivation, and services related to agro and allied sectors have been thrown open to 100 per cent foreign direct investment (FDI) through the automatic route.

5.3. REPLICATE TAMILNADU MODEL IN OTHER STATES

During the course of study, we came across the Tamil Nadu Model in the area of ICT. It is discussed below and we suggest the Tamil Nadu Model should be replicated in other states also.

- ***Tamil Nadu Govt.*** has initiated far-sighted measure to create infrastructure and other facilities besides disseminating the technology to most of the state's districts (having air connectivity), rather than concentrating at the state capital Chennai only.
- It is unlike, neighboring states like ***Karnataka*** (concentrating mostly at Bangalore, Mysore, Mangalore etc.) and, ***Andhra Pradesh*** (Hyderabad, Secundrabad only).
- ***Tamil Nadu Govt.*** is establishing eight well-vibrant-destinations by offering distinct advantages to IT investor's worldwide on the lines of Special Economic Zones (SEZs) with a **host of facilities**[1].

[1] **Host of facilities at vibrant destinations include**: (1) Pro-active Govt. support by pro-active bureaucracy; (2) Highest skilled manpower availability; (3) Rapid Infrastructure Development; (4) Uninterrupted power supply; (5) First in Bandwidth availability; (6) High growth rate of exports; (7) Large Foreign Direct Investments; (8) International Support Connectivity; (9) International Air connectivity; (10) Best Healthcare facilities; (11) Very low attention rate; (12) Good labour relations; (13) The destination of choice for Top ten IT companies

CHAPTER 6

CONCLUSIONS AND SUGGESTIONS

Chapter 6

Conclusions and Suggestions

The present study has led to the following conclusions:

- The process of **Reverse Brain Drain (RBD) / Reverse Brain Gain (RBD)**, i.e. return of highly qualified people form foreign countries to India, had although started during the early-1990s, got momentum only after the turn of the twentieth century.
- On the basis of study conducted for the period 1990-2008, it has been concluded that the maximum number of RBD / RBG persons retuned during the triennium 2005-08. This observation is a pointer to the increasing number of such qualified persons in the subsequent years, i.e. beyond 2008. *Thus, there is a need to conduct such a study for the more recent period.*
- Across the four technological areas selected for the study, viz. Information & Communication Technology (ICT), Biotechnology, Pharmaceuticals and Agriculture, the maximum number of RBD / RBG persons returned are from ICT sector throughout the study period. It is followed by biotechnology, pharmaceutical and lastly agriculture. The number of returnees has increased much faster in ICT than other technological areas. *India, therefore, should develop infrastructural facilities more for ICT sector to utilize this 'Brain Gain'.*
- A remarkable observation in the study is that among returnees, a significant number is of those persons who had gone on long-term assignments or were holders of permanent visas (including citizenship). *It shows the strong magnetic power of India, which it should enhance more vigorously, and also the strong desire of RBD / RBG persons to return home.*
- The age-band of the maximum RBD persons has been found as 30-50 years. It being the most productive age-brand, these RBD / RBG persons have vigour to make significant contributions to the fields of their specialization. *Indian needs to vertically integrate this vigour with the vigour of Indian youth.*

- By investigating the pre-migration and post-migration status of academic qualifications of the RBD / RBG persons, the study has amply demonstrated the big '**knowledge gain**' **to the country**. It is because most of the returnees have come back after acquiring higher qualifications and / or more research / technical experience. *And it is not limited to one technological area, but has been found true in all the four selected technological areas.*
- The study on specialization of RBD persons conducted in terms of natural sciences, applied sciences, social sciences, applied social science, business & management, and humanities & arts has revealed coverage of all these fields. *It shows that the returnees belonging to these areas can contribute to a vast domain of knowledge-building.*
- The study has observed that returnees have come back from as large number of countries as 60, covering all the continents of the world. *They have thus brought with them world-wide experience and could contribute significantly to the "Shinning India'.*
- A notable feature that has emerged from the study is the **high level of satisfaction** expressed by the returnees after coming back to India. Such a high level of satisfaction will provide strength to the RBD / RBG persons to work with more vigour which ultimately will be gain to India.
- '**Scenario after home-coming**' of returnees is an important segment of the study through which, it has concluded that the returnees share higher positions of responsibility in India than they had in foreign countries. *Some of them have even launched or planning to launch their own enterprises.* It is believed that a significant number of these RBD / RBG persons have established small and medium-scale enterprises, but these have not been covered in this study. *A wider investigation covering SMEs is needed to get a better picture about the status of returnees to India.*
- The study has observed a decline in the proportion of RBD / RBG persons associated with R&D sector in India than that was in foreign countries. It is the consequence of lower investment to R&D sector by India than in several foreign countries. *India should enhance its investment to R&D sector to develop its capability to face international competition in today's era of globalization.*

- The achievements of RBD / RBG persons being India's gains, the study has amply brought out the gains of India in terms of knowledge-enhancement, innovations in S&T, entrepreneurship development, business development capacity enhancement, quality assurance and quality control, and management and evolution of congenial environment. *It is based on the achievements of RBD / RBG persons in the development or innovation of new processes, new products, novel projects, new designs, business development in terms of new clients, new markets, production cost reduction, creation of new branding, organizational changes and imparting of tacit knowledge to the staff, efficiency enhancement, MIS development, etc.*
- On the basis of feedback received from the respondents, the *study has concluded that a number of changes will have to be made in policies related to sectors of education, research and industry to attract more professional people from abroad to India.*
- Regarding the spread of RBD persons in India, the study has concluded that the respondents have selected 14 states / union territories of the country. *The biggest congregation of RBD persons has been reported in Andhra Pradesh.*
- The study has elaborated one more strength of India, i.e. the lower R&D cost in India in comparison to advanced countries. *This positive strength has already attracted several MNCs for establishing their R&D centres in India and will attract more companies in future. This would mean more employment and income generation for the Indian professionals.*
- On the basis of employment opportunities in the "Knowledge Process Outsourcing" (KPO) sector, *the study has projected the need of 2,55,000 professionals by the year 2010-11, indicating higher potential in employment and income in India.*
- To enthusiaze more RBD / RBG persons, the study has outlined the success stories of some returnees covering all the chosen technological areas. *These include those of Mr Rajiv C Mody (CEO, Sanskeen Communication Technologies Ltd.), Dr Villo Morawala Patell (Founder and MD of Avesthahen--India's leading fully integrated biotechnology and bioinformatics company), Dr Gopalan Sampathkumar (Establishng his laboratory at National Institue of Immunology), Mr Varaprasad Reddy (Founder of Shanta Biotech, producer of Heptitis B vaccine in India), Dr Maheshwari Kalyanpur (rare pediatric*

cardiologist), Mr Arjun Kalyanpur (Tele-radiologist), and Mr Suresj Sharma (Inventor of herbal treatment for diabetes).

- *The study has suggested replicating Tamil Nadu Model in different states to give a boost to ICT or any other sector by attracting RBD / RBG persons.*

Some Suggestions

The more success of RBD / RBG persons means more gains to India. These gains will lead to the generation of more employment and income opportunities in the country and will make India stronger in facing the international competition in the era of globalization.

The following suggestions are made in this direction:

- *India needs to understand the pattern of RBG thoroughly and various waves of RBG from time to time.* There is an urgent need to conduct research over the subject. This talented pool of Indians, with plenty of capital and investment capabilities, can provide immense opportunities for creativity and innovation. *Their presence and contribution need to be highlighted.*
- The *sector-specific infrastructural requirements need to be identified* and created so that RBD / RBG professionals feel comfortable back home.
- Though the country is developing sector-specific parks (e.g. IT parks, Bio-tech parks, Food-parks, etc.), *there is a need for developing common infrastructural facilities under public-private partnership (PPP),* which will provide prompt and quality services.
- In order to streamline the procedural constraints, the Govt. of India needs to devise *single-window clearance-system* for NRIs willing to initiate any venture or settle down in India. The Ministry of External Affairs (MEA) and the Ministry of Overseas Indian Affairs (MOIA), Govt. of India, should synergize procedural formalities along with other Ministries / Departments. In view of the 'Dual Citizenship' status being granted to NRIs, the Govt. of India needs to streamline the registration procedure for NRIs, in order to keep track of their arrival and duration in India.
  - For examples in Mumbai, FRRO (Foreigners Regional Registration Office) had reported 30% registration work last year and projected an increase by 40% this year.
  - FRRO, Mumbai has estimated the number of expatriates to India at 4,000 for the present, which is likely to go over 15,000 by 2012.

Suggested Changes in Policies on Education, Research and Industries

The participants in this study are of the opinion, that in order to ensure the return of more 'knowledge-human capital' to the country, i.e. for the RBD / RBG to continue and their numbers to increase, some changes will have to be introduced in the existing policies on Education / Research / Industries. These have been summarized below:

Education

- Primary education should be broad based and of very high quality and should not be ignored under the pretext of it being a state subject.
- Compulsory free education for all till class 12.
- Good higher education is the need of the hour; good support should be made available to students for higher education.
- Infrastructure in educational institutions needs to be improved.
- Costs of education need to be looked into and corruption in the system should be removed.
- New study areas / disciplines should be introduced.
- Education should focus more on creative thinking and value addition in the form of knowledge and skill building rather than just mugging.
- Teachers at all levels of education are extremely important and to attract motivated people to teaching profession, there is a need to improve the existing scales of pay and promotional avenues.
- The existing large number of educational institutions are creating specialists with no where to go. There is not enough University-industry integration. Hence, industrial linkage in the final year of under-graduation should be made compulsory.
- The 200+ universities in India need thorough overhauling. Selection for the top positions and promotions should be based on quantifiable indices.
- Removal of reservation in education system.

Research

- Salaries for academic scientists in India need to be at par with or at least close to those in the Industry, as it is one of the major factors being considered when scientists return home.
- Freedom in research will improve work environment. Researches should be motivated to publish in Indian journals, so that with good research papers, Indian journals will achieve International standards and recognition.
- Many more research-intensive educational institutions need to be established. Today our system is more theory based and the focus of the students should be to learn 'how' to do things. Hence, there is need for practical learning where the focus is on' why' rather than 'how'.

- In order to transform the outcome of research into products, policies should encourage interaction between research establishments and industries.
- Funding for research should be increased. Bureaucratic procedures must be dispensed with to ensure that basic resources are easily available in labs. Grants must be given judiciously based on accountability of principal investigators.
- Most of the students go in for research to get better jobs. Many a times they never make use of their special training, resulting in loss to the society. Hence, adequacy of well-paid jobs where the training can be fully utilized is to be ensured.
- Students must be encouraged to take up research in basic sciences and the emerging fields like biotechnology, environmental science, etc.

Industry

- Policies should be modified to increase industry-funded research.
- Policies should be modified to support medium level enterprise to benefit. A cue can be taken from the Chinese model so that we can build on our strengths and are able to compete globally.
- Subsidies need to be provided to industries, particularly new ones.
- Concessions should be given to innovative industries.

Final out come

- *The study team is of the view that* this Primary / Pilot Study have given an important empirical evidence to show that Reverse Brain Drain (RBD) / Reverse Brain Gain (RBG) lead to a tangible contribution. But these are suggestive evidences.

- Therefore, there is a need to undertake further detailed study on selected firms that would provide a more informed understanding of the contribution made by the returnees. From primary statistics it is difficult to reveal how their contributions were embedded within their organizations.

- The focus could be on SMEs (small and medium enterprises), as study shows a substantial impact*) like having attracted individuals from abroad and embedded them within their domain.*

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APPENDICES

- Appendix-I: Technological Areas where RBG is happening
- Appendix-II: Formats / Questionnaires for Professionals
  - Format for Industries for obtaining Information about Professionals of Indian Origin working in the Industry
  - Format for Institutes / Departments for obtaining Information about Professionals of Indian Origin working in the Institutes / Departments
  - Format for Professionals from the Four Identified Technological Areas

Appendix-I

Technological Areas where RBG is happening

"India's Reverse Brain Gain (RBG) in Liberalized Era"-

Technological Areas where RBG Is happening

Presented by:
Natural Resources India Foundation (NRIF)

Predominant Technological Areas

- ICT;
- BT;
- Pharma;
- Agril.
- Health Tourism
- General Health Care
- Surgery
- Endo-Surgery
- Gynecology
- Ophthalmology
- Urology
- Other Health areas
- Petro-Chemicals
- Space
- Oceanography
- Social Development viz. Poverty alleviation, Population study....

- *The **emphasis in this study has been on identifying those S&T disciplines in which Reverse Brain Gain has taken place**. The various facets of the study are connected to natural resources such as Agriculture; Forestry; Water Management; Oceanography; Space; Environment; General Health Care; Surgery; Endo-surgery; Gynecology; Ophthalmology; Urology; Rural livelihood; and other technological areas like Information & Communication Technology (I&CT), Biotechnology, Pharmaceuticals, etc.*

Major Technological Areas where RBD is happening

- **Four Predominant areas being covered under the study viz.**

– **Information and Communication Technology (ICT),**

– **Biotechnology (BT)**

– **Drugs & Pharma (D & P)**

– **Agriculture (Agril.)**

Indian ICT, BT, PHARMA, AGRIL., Where Economic Opportunities are Unlimited

Indian Economy Opportunities

- 15 Years
- ONE DIRECTION
- 8% GDP growth

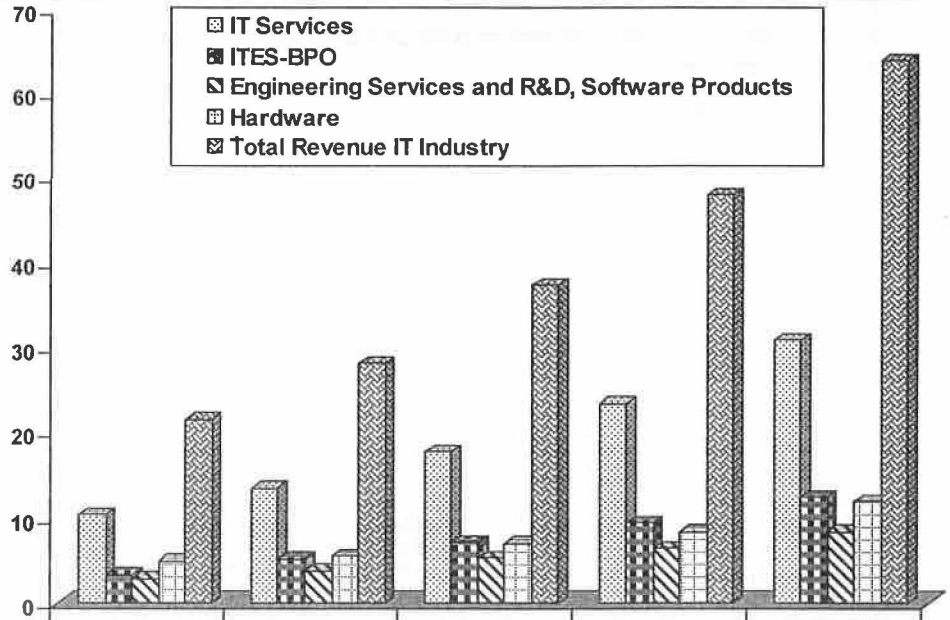
	GDP Growth	Forex	FII Flow	FDI	Per Capita	Inflation
1990	4.9 percent	< USD 1 billion	USD 1 million (1993)	USD 97 million	USD 390	9 percent
2008*	9.0 percent	USD 310.7 billion as on June 13, 2008	USD 16.1 billion in 2007–08	USD 25 billion in 2007–08	USD 740	11.91 percent as on July 17, 2008

Sources: Times of India, , RBI, RBI, DIPP, Indian Budget, Rediff, The Economic Times

Trend

- **The Table clearly depicts that there has been a consistent growth in: GDP, Flow of Foreign exchange, Foreign Institutional Investors, Foreign Direct Investment, Per capita Income and the Inflation despite the global recession and melt-down.**

IT-BPO Industry - Sector-wise revenue break up



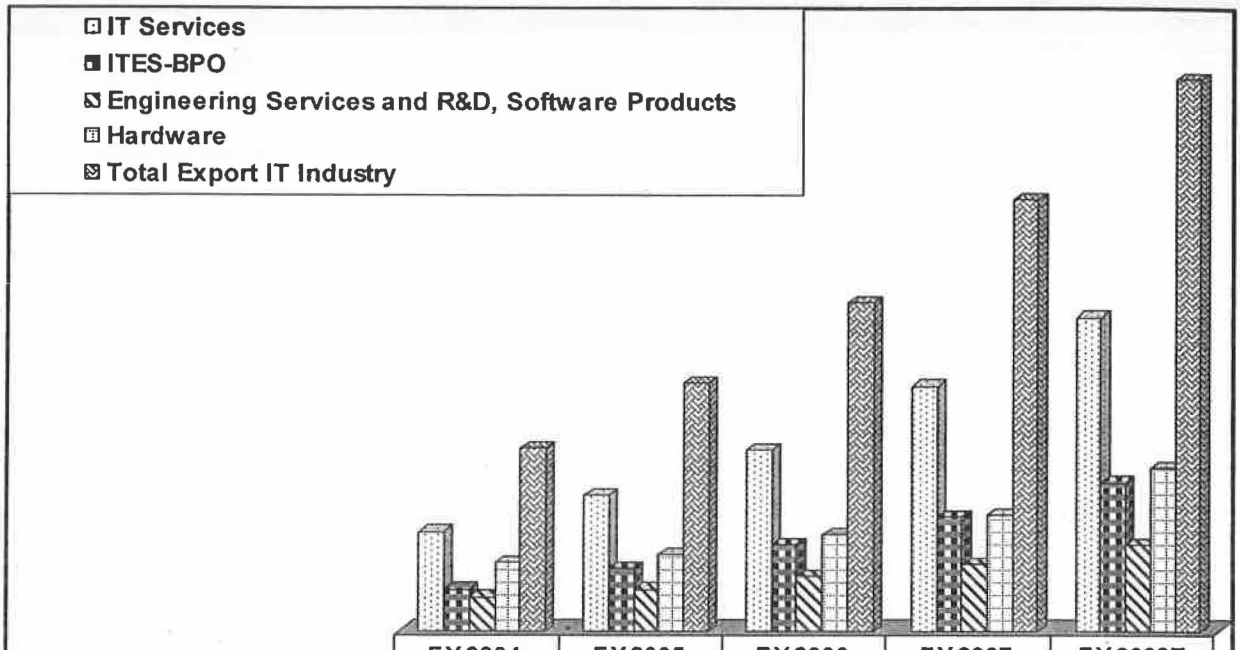
	F.Y.2004	F.Y.2005	F.Y.2006	F.Y.2007	F.Y.2008E
IT Services	10.4	13.5	17.8	23.5	31
ITES-BPO	3.4	5.2	7.2	9.5	12.5
Engineering Services and R&D, Software Products	2.9	3.8	5.3	6.5	8.5
Hardware	5	5.6	7.1	8.5	12
Total Revenue IT Industry	21.6	28.2	37.4	48	64

Note: Figures may not add up due to rounding off. **Source: *NASSCOM.***

- **Trend**

- **There has been consistent growth in the Total Revenue of IT sector during last 5 years on:**
  - **Overall IT services,**
  - **Business Process Outsourcing,**
  - **Engineering services, R&D, Software Products;**
  - **Hardware, and**
  - **Total Revenue of the IT Industry**

IT-BPO Industry - Sector-wise Export break-up



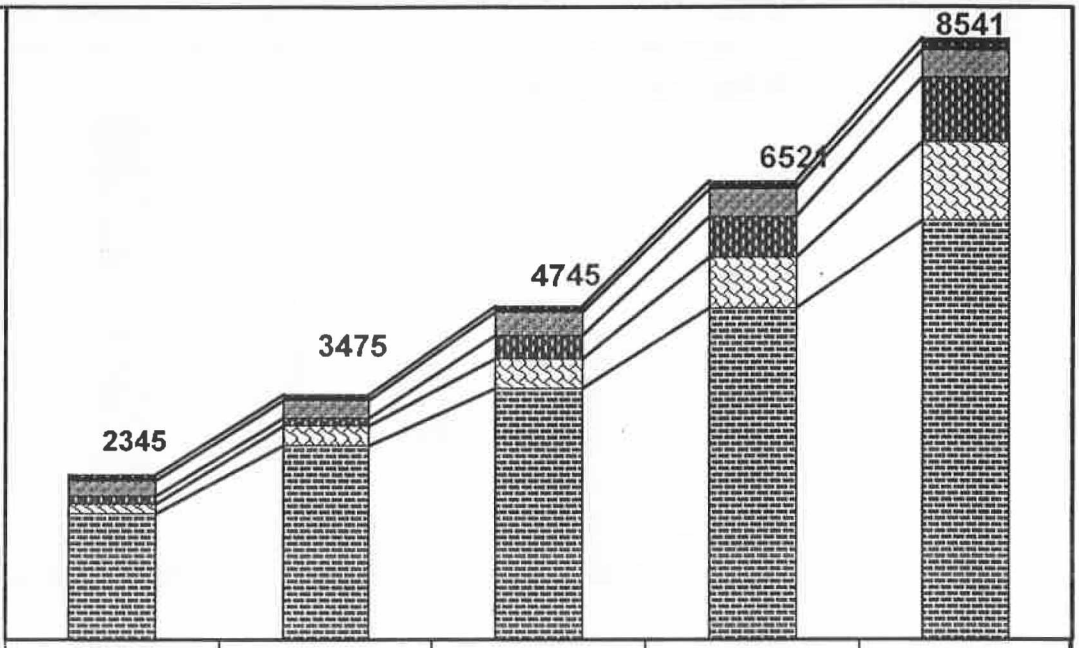
	F.Y.2004	F.Y.2005	F.Y.2006	F.Y.2007	F.Y.2008E
IT Services	7.3	10	13.3	18	23.1
ITES-BPO	3.1	4.6	6.3	8.4	10.9
Engineering Services and R&D, Software Products	2.5	3.1	4	4.9	6.3
Hardware	5	5.6	7.1	8.5	12
Total Export IT Industry	13.4	18.2	24.2	31.8	40.8

Note: Figures may not add up due to rounding off. **Source: *NASSCOM***

- **Trend**

- **There has been consistent growth in the Total Export of IT sector during last 5 years on:**
  - **Overall IT services,**
  - **Business Process Outsourcing,**
  - **Engineering services, R&D, Software Products,**
  - **Hardware, and**
  - **Total Revenue of the IT Industry.**

Biotech industry 2002-06



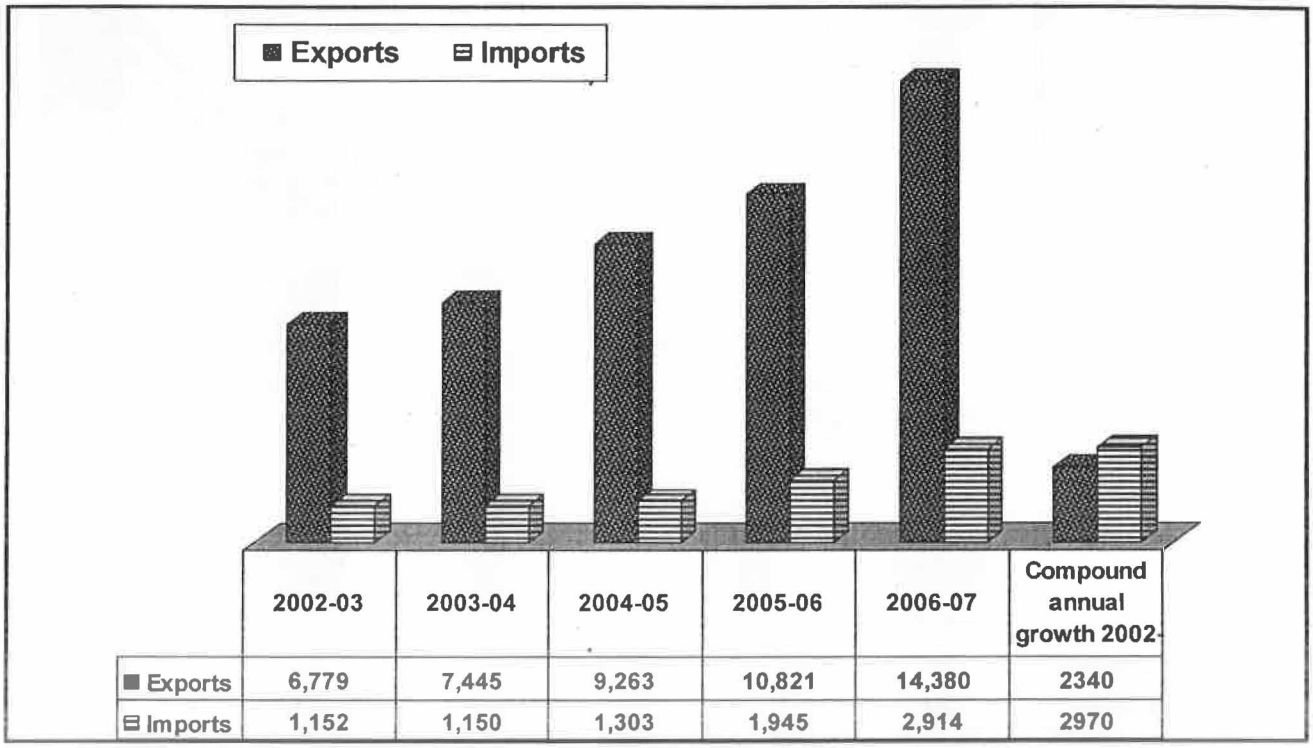
	2002-03	2003-04	2004-05	2005-06	2006-07
Bioinformatics	75	80	100	120	145
BioIndustrial	235	238	320	375	395
Bio-Agri	110	130	330	598	926
BioServices	135	275	425	720	1102
Bio-Pharma	1790	2752	3570	4708	5973

Source: Bio Spectrum

- **Trend**

- **There has been consistent growth in the Total Revenue in the Biotechnology Sector during last 5 years on:**
  - **Bioinformatics,**
  - **Bio-Industrial Services,**
  - **Bio-Agriculture Services,**
  - **Bio-Services,**
  - **Bio-Pharmaceuticals Services,**

Drugs, pharmaceuticals exports and imports (Rs. Crore) 2002-07



	2002-03	2003-04	2004-05	2005-06	2006-07	Compound annual growth 2002-
Exports	6,779	7,445	9,263	10,821	14,380	2340
Imports	1,152	1,150	1,303	1,945	2,914	2970

Source: Ministry of Chemicals & Fertilizers.

- Trend

- There has been consistent growth in the Exports and Imports during last 5 years in :
  - Drugs, and
  - Pharmaceuticals Services,

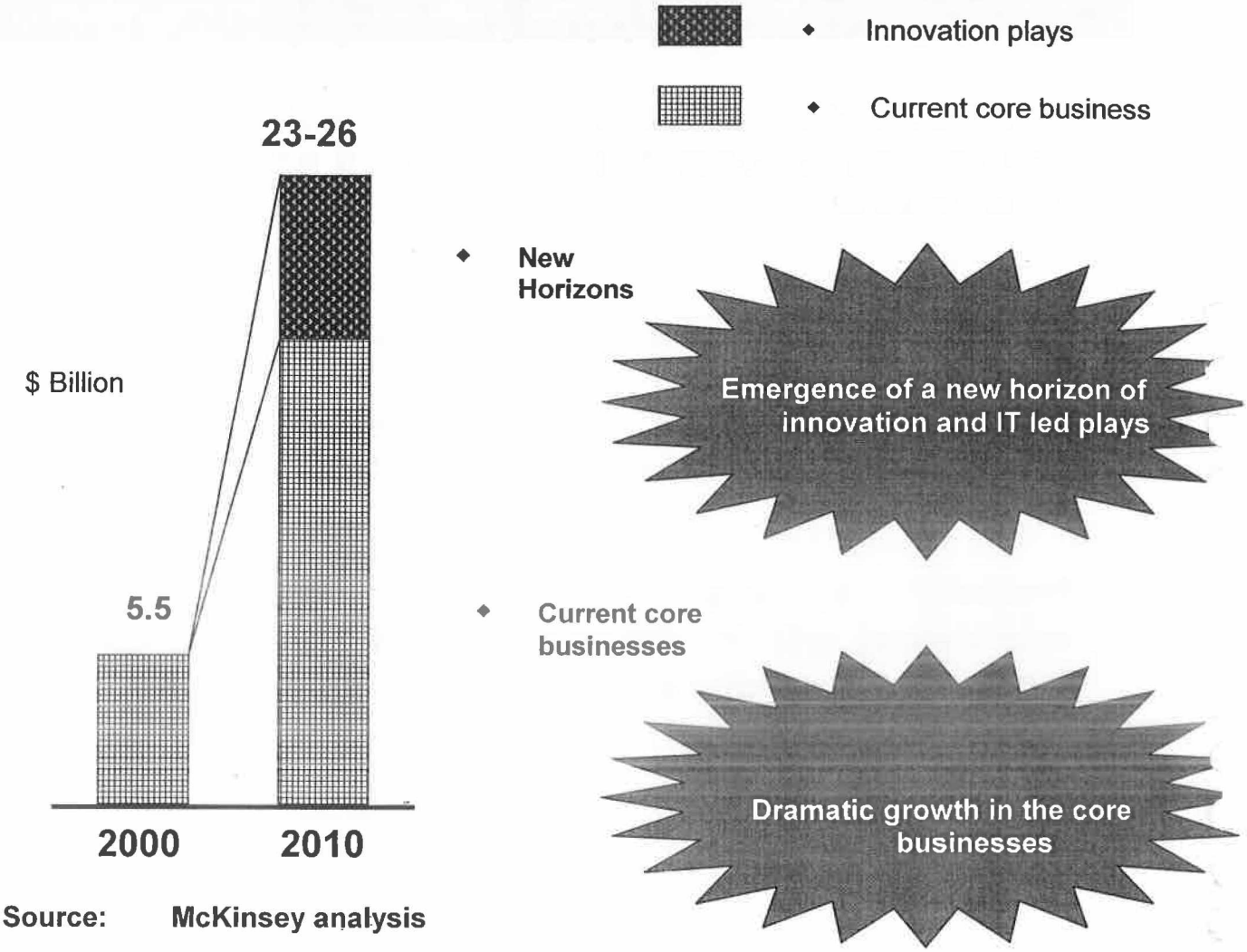
VISION 2010 FOR THE PHARMACEUTICAL INDUSTRY IN INDIA AND IMPLICATIONS FOR IT ENTREPRENEURS

- **Pharmaceutical and allied sector in India have a unique and exciting opportunity to grow from $ 5.5 bn in 2000 to $ 25 bn in 2010**

- **Of this, $1.5-2.0 billion could accrue from IT-related new horizon plays including bioinformatics, genomics/proteomics, data management for contract research, and remote sales and marketing**

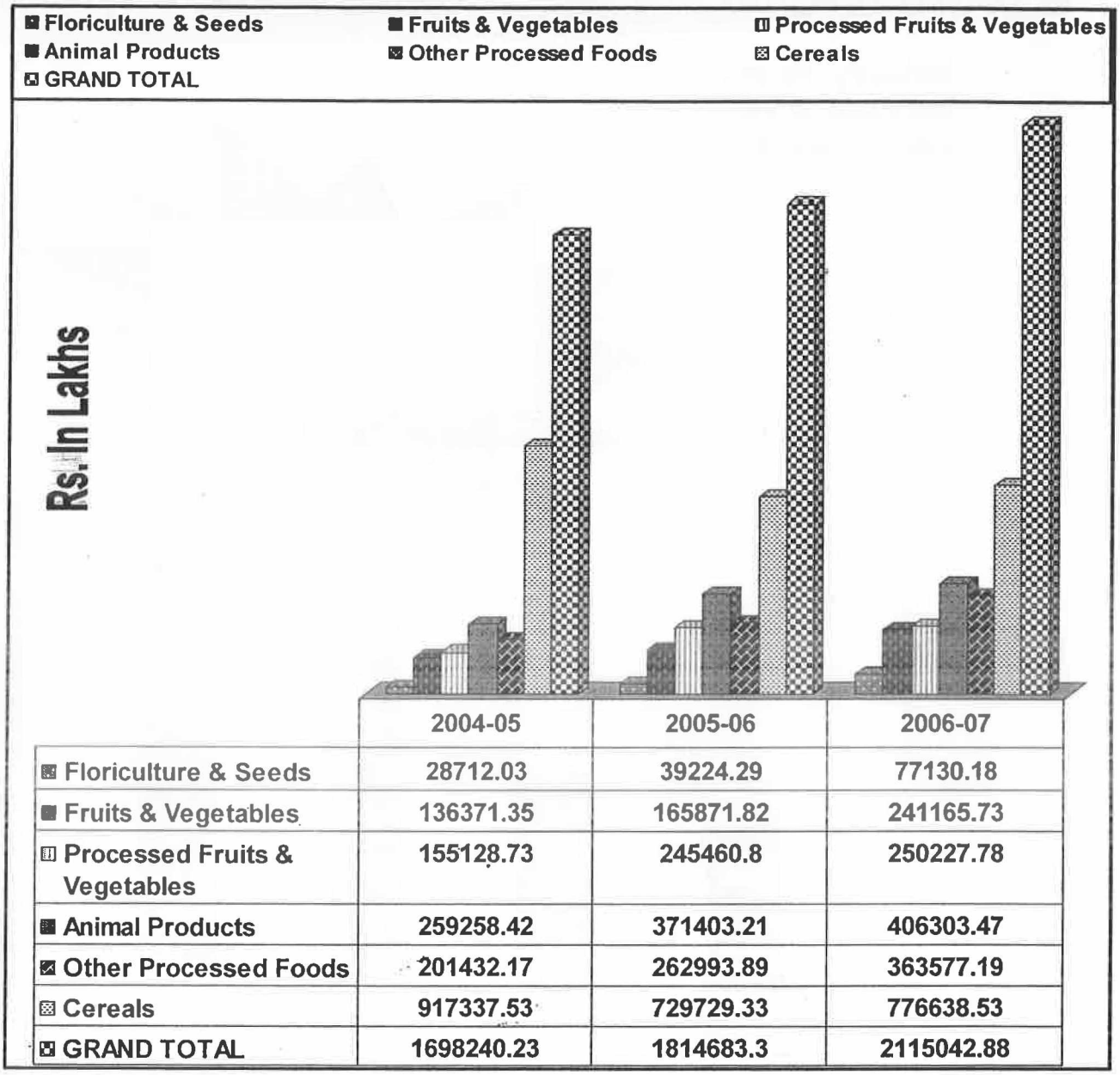
- **However, success in IT-related plays (especially informatics) will be difficult and will require a focus on biological knowledge and innovation – not just cost**

THE INDIAN PHARMA MARKET IS SET TO WITNESS SUBSTANTIAL GROWTH WITH A LARGE PORTION DRIVEN BY INNOVATION LED "NEW HORIZON" PLAYS



Source: McKinsey analysis

Agricultural and processed food products Export Statement (2004-2005 to 2006-2007)



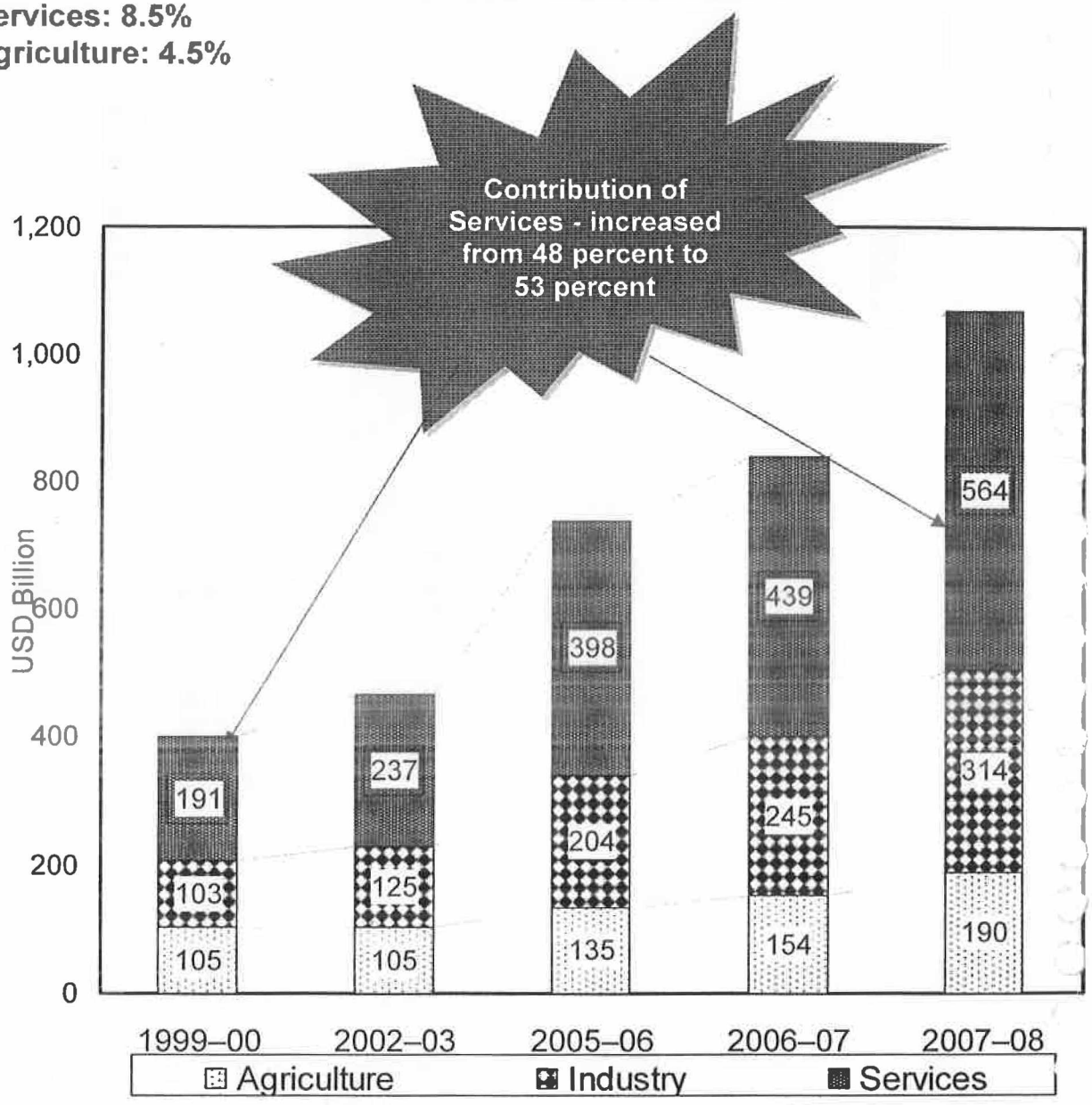
	2004-05	2005-06	2006-07
Floriculture & Seeds	28712.03	39224.29	77130.18
Fruits & Vegetables	136371.35	165871.82	241165.73
Processed Fruits & Vegetables	155128.73	245460.8	250227.78
Animal Products	259258.42	371403.21	406303.47
Other Processed Foods	201432.17	262993.89	363577.19
Cereals	917337.53	729729.33	776638.53
GRAND TOTAL	1698240.23	1814683.3	2115042.88

- **Trend**
  - **There has been consistent growth in the Agricultural and processed food products exports during last 3 years.**

Source: DGCIS Annual Report

Growth in sectors at Constant Prices (2007–08):

Industry: 10.8%
Services: 8.5%
Agriculture: 4.5%



Source: MOSPI Statistics, RBI

Why India? – Quote Unquote

"India is now truly a land of opportunity".

John Redwood Economic Competitiveness

"India has evolved into one of the world's leading technology centers".

Craig Barrett Intel Corporation

"I have never seen India so dynamic, vibrant and full of business opportunities".

Peter Loescher President and Chief Executive Siemens

"We came to India for the costs, stayed for the quality and are now

- Dan Scheinman, Cisco System Inc. as told to Business Week, August 2005

By 2032, India will be among the three largest economies in the world.

BRIC Report, Goldman Sachs

"The Indian market has two core advantages - an increasing presence of multinationals and an upswing in the IT exports".

Travyn Rhall, ACNielsen

"India is a developed country as far as intellectual capital is concerned".

Jack Welch General Electric

"India is a very exciting market and the luxury car segment is growing exponentially here".

Mr Paul de Voijs Managing Director Volvo Car India

Source: IBEF Report

Appendix-II

Formats / Questionnaires for Professionals

- Format for Industries for obtaining Information about Professionals of Indian Origin working in the Industry
- Format for Institutes / Departments for obtaining Information about Professionals of Indian Origin working in the Institutes / Departments
- Format for Professionals from the Four Identified Technological Areas

Soliciting Brief Information about the your Organization on the following aspects: -

1. **Name and address of your Organization:** _____

Telephone	Fax No.	E-mail id	Website	Contact persons, Tel. / Fax/ E-mail / Source of Information	Partnership Company, if any (Pl. specify) & Equity Partnership

2. **Financial Details:** (Amount in Re Lakhs/ Crores) (Kindly use extra sheets as per need)

Main Economic Activity	Subsidiary activity	Area of R&D	Planned Investment	Investment in R&D
1.				
2.				
3.				
4.				
5.				

3. **Specific Target Areas in which Firm is operating:** (Kindly use extra sheets as per need)

If In-house R&D Centre, New products developed	New type of Services being provided	Types of certifications obtained	Future Plans for R&D	Patents Obtained
1.				
2.				
3.				
4.				
5.				

Any other information related to R&D (Kindly use extra sheets as per need)

Additional information related to R&D	Partner Organization, if any (Pl give details)	Nature of Collaboration	Outcome of collaboration	Remarks, if any
1.				
1.				
2.				
3.				
4.				
5.				

From: NATURAL RESOURCES INDIA FOUNDATION (NRIF)
Regd. Office: 93, GH –9, Pocket, Sunder Vihar, New Delhi-110087; Tel.: +91-11-25253185; Tel./ Fax: +91-11-25289265;
E-Mail: rpmattoo@eth.net & nrif@rediffmail.com; rpm.nrif@gmail.com; **Web:** http://nrif.tripod.com/

4. Turnover during last three years: (Amount in Re Lakhs/ Crores) **Turn over of two main sectors**

Main Economic Activity			Subsidiary activity			Export Turn over			Main Sectors (Specify)			Main Sectors (Specify)		
'03-'04	'04-'05	'05-'06	'03-'04	'04-'05	'05-'06	'03-'04	'04-'05	'05-'06	'03-'04	'04-'05	'05-'06	'03-'04	'04-'05	'05-'06

(Kindly use extra sheets as per need)

5. RBG Professional of Indian origin having returned to India (either on short / long term or permanently) in your R&D Centre / organization, their current employment status, technology areas1 and the factors governing their return to India, who could be invited to attend a 2-day orientation Seminar / Workshop being organized in due course of time to deliberate on the various facets of the study for future deployment in the main stream to strengthening the S&T in the country.

S. No.	Name	Designation	Address	Telephone	Fax No.	E-mail id

(Kindly use extra sheets as per need)

6. Any Success story (ies) in your R&D Centre who fulfills RBG criteria in your organization, (Pl. specify):

Authorized Signatory (Name & Designation)

[1] (In selected *technology areas such as* ***Information and Communication Technology-ICT, Biotechnology, Pharmaceuticals, Agriculture*** *etc.*)

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Regd. Office: 93, GH –9, Pocket, Sunder Vihar, New Delhi-110087; Tel.: +91-11-25253185; Tel./ Fax: +91-11-25289265;
E-Mail: rpmattoo@eth.net & nrif@rediffmail.com; rpm.nrif@gmail.com; **Web:** http://nrif.tripod.com/

Soliciting Brief Information about Professionals of Indian Origin who are working in your Organization/ Department

(Kindly use extra sheets as per need)

1. **Name of University / Institute / Organization / Department:** _____

2. **Information of Head/Person filling this Performa**

Name	Telephone	Fax No.	E-mail id	Website	Contact persons Telephone / Fax/ E-mail

3. **Organization Details**

Main Economic Activity	Subsidiary activity	Area of R&D	Investment in R&D	Planned Investment

4. **Specific Target Areas in which Organization / Department is operating**

If In-house R&D Centre, New products developed	New type of Services being provided	Types of certifications obtained	Patents Obtained/Applied	Future Plans for R&D
1.				
2.				
3.				
4.				
5.				

5. **Collaboration/Joint Venture/Other Types of Linkages**

Partner Organization, if any (PI give details)	Nature of Collaboration	Outcome of collaboration	Remarks, if any

PS: (*Kindly use extra sheets as per need*)

From: NATURAL RESOURCES INDIA FOUNDATION (NRIF)
Regd. Office: 93, GH –9, Pocket, Sunder Vihar, New Delhi-110087; Tel./ Fax: +91-11-25289265; Tel.: +91-11-25253185;
E-Mail: rpmattoo@eth.net & nrif@rediffmail.com; rpm.nrif@gmail.com; **Web:** http://nrif.tripod.com/

6. Professional of Indian origin having joined your organization (either on short / long term or permanently)

S. No.	Name	Designation	Address	Telephone, Fax and e-mail id	Specific area in which involved	Major constraint if any

7. Constraint or other issues that you would like to elaborate for RBG professionals

8. Success story (ies) in your R&D Centre that involved RBG professional

PS: (*Kindly use extra sheets as per need*)

Authorized Signatory (Name & Designation)

From: NATURAL RESOURCES INDIA FOUNDATION (NRIF)
Regd. Office: 93, GH –9, Pocket, Sunder Vihar, New Delhi-110087; Tel./ Fax: +91-11-25289265; Tel.: +91-11-25253185;
E-Mail: rpmattoo@eth.net & nrif@rediffmail.com; rpm.nrif@gmail.com; **Web:** http://nrif.tripod.com/

NATURAL RESOURCES INDIA FOUNDATION

Registered Office: 93, GH 9, Pocket, Sunder Vihar, New Delhi–110087
Tele: +91-11-25253185; **Telefax:** +91-11-25289265; **Mob.:** 091-9810243385
E-Mail: rpmattoo@eth.net • nrif@rediffmail.com **Website:** <http://www.nrif.org.in>

NGO under Societies Registration Act XXI of 1860
Regd. No. S-43105, Registrar of Societies, Govt. of NCT of Delhi
Registered with MHA, GoI: FCRA No. 231660367, under Section 6 (1) (a): Social

MOST IMMEDIATE / URGENT

Ref.: No. NRIF: P (RPM): DST(NSTMIS): RBG:LPAC: 200708: **2556** Dated : 22nd February 2008

Om Shanti

Working on the issues related to research, Consultancy & Turnkey jobs in the fields of : natural resources: Agriculture; forestry; environment; water management; rural livelihood; development finance; economic security; and women empowerment .... programs in India & Abroad

"Let noble thoughts come to us from every side"

Dear Respondent,

Sub: Study on: "India's Reverse Brain Gain (RBG) in the Liberalized Era"

You will be pleased to know that we are implementing the above-cited study for an on behalf of Union Ministry of Science & Technology, Govt. of India. (Letter of Introduction issued by: NSTMIS, MoS&T, GoI, is enclosed at the back of this letter, for your kind information and ready reference).

The objectives of this study are as follows:

1. Identification of technological areas such as: biotechnology, pharmaceuticals, agriculture, information and communication technology, etc where reverse brain drain leading to gain appears to have occurred.
2. The extent to which the Reverse Brain Gain (RBG) occurred in each of the above areas and its spread in India.
3. The underlying factors that governed the RBG in various areas.
4. Related policy issues, suggestions and recommendations based on the findings of the above.

The outcome of the study shall be of great help to the Government / Industry / Academic institutions, policy makers and planners in understanding the contribution of RBG professionals. It would also help in stimulating necessary policy interventions towards creating a more conducive environment for RBG professionals to participate in the economic and social development of the country.

The preliminary findings of the study would be discussed at a 2-day Seminar / Orientation workshop in North (preferably at Delhi / Gurgaon) and South (preferably at Bangalore / Hyderabad), where the respondents would be invited to deliberate on the various facets of the study and understand case studies of RBG professionals in the main stream in strengthening the economic and social development of the country. We solicit your e-mail for further contact.

We solicit the Professionals of Indian origin having returned to India as a respondent-'resource person'- to spare some time to go through the **enclosed Questionnaire*** and return the filled-in questionnaire at the earliest. The information provided by the respondent would be kept strictly confidential and used only for academic, research and policy analysis purpose.

* The questionnaire can also be down-loaded from our website: **http://www.nrif.org.in:**

Thanking you in anticipation for your kindly cooperation
With best regards, faith and good-will.
Yours faithfully,
For **NATURAL RESOURCES INDIA FOUNDATION (NRIF)**

R P MATTOO
PRESIDENT
Encl. : As stated above

NRIF
DoB : (18 / 01 / 2000)
PAN : AAATN5485E
ITO Ward 25(3)

Dr. Laxman Prrasad,
Advisor & Head (NSTMIS)
Tel / Fax: 011-26510686
E-Mail: laxman@nic.in

भारत सरकार
विज्ञान और प्रौद्योगिकी मंत्रालय
विज्ञान और प्रौद्योगिकी विभाग
टेक्नोलॉजी भवन, नया महरोली मार्ग, नई दिल्ली – 110 016
GOVERNMENT OF INDIA
MINISTRY OF SCIENCE AND TECHNOLOGY
Department of Science and Technology
Technology Bhavan, New Mehrauli Road, New Delhi-110 016

DO No. DST File No. DST/NSTMIS/05/87/2006-07 13th March, 2007

TO WHOM-SO-EVER IT MAY CONCERN

Subject : Study on 'India's Reverse Brain Gain (RBG) in Liberalized Era'

The National Science and Technology Management Information System NSTMIS), Department of Science & Technology (DST), Ministry of Science & Technology, Government of India, New Delhi, has sponsored the above-cited research study to the Natural Resources India Foundation (NRIF), Sunder Vihar, New Delhi-110087.

The present study aims to identify Professionals of Indian origin returning to India (either on short / long term or permanently) to know about their current employment status, technology areas and the factors governing their return.

NRIF, New Delhi is conducting the study in select *technological areas such as biotechnology, pharmaceuticals, agriculture, information and communication technology, etc* and shall cover : -

- Indian firms / MNCs; R&D Centres in India;
- Institutes of National Importance like: IITs, Universities / Institutes with potential of excellence as identified by UGC;
- Major Universities and their faculty;
- CSIR Institutes;
- NASSCOM, Chamber of Trade and Commerce of selected States;
- Major clients served by executives back to India;
- Agents facilitating job opportunities abroad as well as in India; and,
- Other related Institutes

The outcome of the study would help in identifying the success stories of the RBG, and would inter alia help the Government and policy makers to devise policies and measures for their effective deployment in the main stream to strengthen the S&T in the country.

I request all the institutions to facilitate the NRIF Survey Team by providing ***prompt response*** for the success and the timely completion of the study.

Looking forward to your sincere cooperation.

Prasad 13.3.2007.

(DR. LAXMAN PRASAD)

Study on:
"India's Reverse Brain Gain (RBG) in Liberalized Era"

Study being implemented by

NATURAL RESOURCES INDIA FOUNDATION (NRIF)*

QUESTIONNAIRE FOR PROFESSIONALS

- *Dear Respondents,*

- **Professional Category:**

- The Professionals of Indian origin returning to India are classified under the following categories. *Kindly identify your category -*

(√ whichever applicable)

- *a) Short term (less than 6 months); .....* ☐
- *b) Medium term (up to 2 years) or .....* ☐
- *c) Long term (more than 2 years) or .....* ☐
- *d) Permanently) or .....* ☐
- *e) Joint Industrial visit or.....* ☐
- *f) Joint research programme / pursue research with Indian counterpart.* ☐
- *g) Consultancy or .....* ☐
- *h) Any other (Please specify):_____*

NRIF Registered office:
93, GH –9, Pocket, Sunder Vihar, New Delhi-110087; Tel.: +91-11-25253185; Tel. / Fax: +91-11-25289265
E-Mail: nrifoundation7@gmail.com & nrif@rediffmail.com; Web: http://www.nrif.org.in;

PS: Questionnaire can also be down loaded from our website and sent through e-mail

Sponsored and Catalyzed by
UNION MINISTRY OF SCIENCE & TECHNOLOGY, GOVT. OF INDIA (NSTMIS)

Study on: "India's Reverse Brain Gain (RBG) in Liberalized Era"

A. PERSONAL DETAILS:

1. Name. _____

2. Age (in completed years): ☐☐

3. Sex (Male-1, Female-2): ☐

4. Marital Status (Married-1, Unmarried-2, Widow/er-3, Divorcee-4): ☐

   If married, number of children M ☐ F ☐ If yes, age range of Children: _____

5. Institute presently working: _____

   _____

6. Academic Qualification & Discipline at the time of leaving India: _____

7. Present Academic Qualification ☐

   Graduation-1, Post-Graduation-2, Ph.D.-3, Post Doctoral Research-4
   Any other (please specify) _____

7. Specialization: _____ _____
   For example:
   a. Natural sciences: _____; b. Applied sciences (including engineering, medicine):_____;
   c. Business or Management: _____; d. Applied social sciences (law, economics): _____
   e. Social sciences: ___; f. Humanities and fine arts (including education, history):_____
   g. Other: (Please specify) _____

8. Name the qualification received abroad:

	Qualification	Country
(a)		
(b)		
(c)		

9. Professional training (*if any, specify*):

	Type	from India	from Abroad
(a)			
(b)			
(c)			

10. Membership of Academies / Societies (*if any, specify*):_____
    (a)
    (b)
    (c)

11. Family Background (*Please, specify*): _____
    i) Income group: a) High income group (Rs.50,000 pm & above);
    b) Middle income group (Rs.25,000 to Rs.50,000 pm;
    c) Low income group (up to Rs.25,000 pm);
    ii) Occupational group: a) Professional; b) Business background; c) Business / Trader; d) Industry;
    e) Household Industry; f) Farming; g) Any other
    (*Please, specify*_____)

12. Institution last worked overseas (*with period*) _____
    Responsibility: *Technical Managerial / Any other please specify)* held: _____
    (*If more than one company / research institute kindly name all*)

13. Year of return to India (*please specify*): _____

14. Name the Country where you last worked: _____
15. Category of visa held abroad (*choose any one*):
    *a) Citizen; b) Permanent resident ; c) Temporary visa status; d) Student visa; e) Other type specify*_____
16. Responsibilities in the present Institution: _____

_____

_____

_____

(*Responsibility: Technical Managerial / Any other please specify*). ***Kindly use extra sheets, as per need***.....)

B. MOTIVATION FOR GOING ABROAD / HOME COMING OR REVERSE BRAIN GAIN

17. Reasons for going abroad: (***Rank top 5 from 1 to 5 in order of priority / importance***)

- ♦ Poor Academic environment in India: _____ ♦ Low /unattractive salary in India: _____
- ♦ Lack of recognition of merit: _____ ♦ Lack of freedom for research: _____
- ♦ Lack of resources for research: _____ ♦ Lack of career progression/stagnation: _____
- ♦ Perception that conditions are not going to improve: _____
- ♦ Shortage of skilled professionals abroad: _____
- ♦ Better basic living conditions in developed economies: _____
- ♦ Any other (*please specify*): _____

18. Reasons for Home coming or Reverse Brain Gain:
    (***Rank top 5 from 1 to 5 in order of priority / importance***)

- ♦ **Professional**
- ♦ Study / Training / Research: _____
- ♦ To pass on the benefits of knowledge acquired to the homeland: _____
- ♦ Availability of better options / choice: _____
- ♦ Improvement in infrastructure: _____
- ♦ Changes in work culture: _____
- ♦ Medical treatment is now cheaper in India: _____;
- ♦ Any other, please specify: _____

- ♦ **Personal** *(Rank top 5 from 1 to 5 in order of priority / importance)*
- ♦ Concern about children's environment: _____
- ♦ Family ties / home sickness: _____
- ♦ Strength of family ties: _____
- ♦ Gone abroad to acquire more knowledge and gain experience: _____
- ♦ Discrimination abroad: _____
- ♦ Any other, please specify: _____

19. The Hope and the Reality:
    Are you satisfied with your decision of returning to India? *(√ whichever applicable)*
    - Fully satisfied: _____
    - Partially satisfied: _____ (kindly specify, reasons, if any)
    - Not Satisfied: _____ (kindly specify, reasons, if any)

C. YOUR CONTRIBUTION AFTER RETURN

20. Please list the major achievements in your professional domain in India after return, namely: -
    a) Technological capability: *Such as: a) Starting a novel project; b) Process that has been developed; c) New product that has been developed; d) Any other information that needs mention;*.....

1.

2.

3.

4

b) Non-Technological capability: *Such as: a)Explored a New Client; b) Devised Market access; c) Suggested organizational change; d) Helped the company in creating new branding; e) Instrumental in imparting the tacit knowledge to the other staff of the company: f) Any other information that needs mention*

1.

2.

3.

4

21. Please give in brief your **Tangible contribution**, related to: -

a) Technological contribution: *Such as: a) Number of Patents; b) New design developed; c) Quality assurance; d) Any other information that needs mention:*

1.

2.

3.

4

b) Non-Technological contribution: *Such as: a) Creating 'just-in-time' inventory system; b) Accounting system in concordance with internal accounting practice; c) MIS (Management Information System); d) Any other information that needs mention:*

1.

2.

3.

4

D. OBSERVATIONS & SUGGESTIONS:

22. Your views on factors that govern Reverse Brain Gain (RBG)?

1.

2.

3.

4.

23. Do existing policies in education / research / industries need modifications? If yes, please specify:

1.

2.

3.

4.

19. We welcome any information, you deem fit to help the purpose of study:

Date_____ Signature: _____

Place: _____ Name & address: _____

: _____