

**A STUDY OF
SCIENCE AND TECHNOLOGY MANPOWER
IN INDIA**

(Review, Requirements and Prospects)

Sponsored by

**DEPARTMENT OF SCIENCE AND TECHNOLOGY
MINISTRY OF SCIENCE AND TECHNOLOGY**

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**CENTRE FOR RESEARCH, PLANNING & ACTION
16, Dakshneshwar, 10 Hailey Road, New Delhi-110001**

1989

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"A study of distribution of Benefits from Government Expenditure", Planning Commission, Government of India.

"A Study of Social Sector Outlays in India : 1951-76". the World Bank, Washington.

"A Techno-Economic Study of Hill Areas Development Planning with particular Reference to Manpower Utilisation", Planning Commission, Government of India.

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PREFACE

The Department of Science and Technology, Government of India, commissioned to this Centre a comprehensive study on requirements and supply of technical manpower in India in a long term perspective with horizon years 1990, 1995, and 2000. Such a study is expected to ascertain present availability of different technical skills in the country, their present and future requirements and existing and emerging gaps in their supply and demand so that educational and manpower development planning for the future is placed on a sound footing. The essential purpose of this endeavour is to help plan manpower in a manner that availability of technical manpower at different points of time by educational qualifications and technical skills appropriately matches demand for such manpower. Availability of such information will help minimise, if not eliminate, mis-match between education planning, manpower development and manpower requirements in a long term perspective.

In the current plan of economic development certain skills are being demanded with greater intensity while demand for some other skills is either stationary or even declining. If education and training patterns remain the same and do not change in response to changing manpower requirements, imbalance is sure to arise both in terms of total availability and its composition by qualifications and training. To avoid such imbalance, it is important that planning is done in advance to ensure creation of proper infrastructure both in areas of technical education and technical training where time lag between availability of employable manpower and its entrance in the educational and training stream is very long, sometime varying from 3 to 7 years.

For the conduct of this study considerable secondary information was collected and analysed. In particular study team has taken advantage of various documents and research papers prepared/published by the following organisations / institutions.

1. Registrar General of India
2. Planning Commission
3. Ministry of Industry
4. Ministry of Finance
5. Ministry of Human Resource Development
6. Ministry of Agriculture & Irrigation
7. Ministry of Health & Family Welfare
8. Department of Science and Technology
9. Department of Telecommunications
10. Department of Ocean Development
11. State Planning Institute, Uttar Pradesh
12. Planning Department, Haryana
13. Department of Statistics, Madras
14. Manpower Planning Cell, Jammu and Kashmir
15. Labour & Employment Department, Gujrat
16. Directorate General of Employment & Training
17. Directorate General of Health Services
18. Unversity Grants Commission
19. Council of Scientific and Industrial Research
20. Indian Council of Medical Research

21. Indian Council of Agricultural Research
22. Medical Council of India
23. Institute of Applied Manpower Research
24. Indian Agricultural Research Institute
25. National Institute of Health & Family Welfare
26. National Sample Survey Organisation
27. Central Statistical Organisation
28. World Health Organisation
29. United Nations Conference on Trade and Development.

Further, a field survey was conducted in 1891 establishment covering industrial establishments, medical institutions/hospitals, educational institutions, research and development organisations, etc. The Centre also carried out postal interviews with selected organisations. Valuable information received from them has been utilised in the context of this study.

For the purposes of this study scientific and technical manpower has been divided into 4 distinct disciplines. These are (1) Engineering and Technology Manpower; (2) Agriculture and Veterinary Science Manpower; (3) Health and Medical Manpower; and (4) Manpower in General Science. In addition two sub-studies have been carried out one each on (a) Brain Drain ; and (b) Research and Development manpower.

The final report, thus, consists of six sub-reports as follows :

- I Engineering and Technology Manpower
- II Agriculture and Veterinary Science Manpower
- III Health and Medical Manpower
- IV General Science Manpower
- V S & T Manpower in R & D
- VI Brain Drain.

Study suggests further areas for investigation. More important recommendation that emerges is that such a study is essential for future manpower planning not only at All India level but also at the state level so that manpower balance is maintained both at all-India and regional /state levels.

The present study indicates considerable present and prospective imbalance in specific areas of employment. These relate to Agriculture and Veterinary Scientists ; Engineers and Technologists and Medical and paramedical Manpower.

Agricultural Scientists are already in surplus by about 20 percent. This surplus is expected to rise to about 22 percent by 1990-91. Thereafter it will have a declining trend and by 2000-01 will decline to 12 percent. As against this, shortage of about 1.5 percent of the demand is observed in case of Veterinary Scientists and this shortage is expected to increase to 9 percent by 1995-96 and further to 18 percent by the turn of the century, unless proper corrective steps are taken .

In the field of Engineering and Technology manpower, a surplus by 3 percent is expected by 1990-91 in case of Degree holders. This surplus will increase to 6 percent by 1990-95 and

further to 8 percent by 2000 AD. In case of Diploma holders the surplus will be by 9 percent by 1990-91. Thereafter it will show declining trend and by the turn of the century there will be approximate balance with respect to their demand and supply.

In the field of Medical manpower already there was shortage of doctors by about 18 percent in 1980-81 itself. This shortage is expected to increase to 20 percent by 1990-91. Thereafter it will show somewhat declining trend and by 1995-96, the shortage will decline to 17 percent and by 2000-01 to 12 percent. In case of Nurses shortage is expected to be large. By 1990-91 it will be by 39 percent of the demand and this shortage will further rise to 50 percent by 2000 AD. Substantial shortage is also anticipated in case of Health Educators, Lab-Technicians, Nurses-Midwives, Health Assistants (male) and Health workers (male).

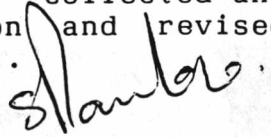
Further, gaps in supply in relation to demand are also expected in some emerging areas. Large number of new installations that are being established in the area of electronics and tele-communications will be in need of properly trained manpower to maintain and keep the industry productive. In the energy sector for new technologies which have been developed to meet the needs of the rural sector, sufficient manpower of good talent is needed to meet the requirements. Also in Food processing, Textile Designing, Printing and Computer Science additional technical manpower of adequate capabilities is required.

The study sponsored by the Department of Science and Technology was carried out by CERPA in coordination with concerned officers of the Department. We are, in particular, grateful to Dr.(Mrs.) A.R. Rajeswari, whose critical and continuous interest in this study has been of abiding value in the conduct of this study and finalization of the Report.

Our special thanks are also due to (Late) Shri R.R. Gulati who spent considerable time in preparation of the study design and also scrutinising and editing various drafts earlier prepared by CERPA. This Report owes much to his contributions.

Our thanks are also due to other officers of the Department of Science and Technology who have cooperated during conduct and completion of this study.

Last and not the least our thanks are due to several respondents, institutional managers, and Government officials who have spared their valuable time to provide the desired information which has constituted a major input to this study. Also to the staff of CERPA which has painstakingly collected and analysed several fragments of relevant information and revised and re-revised various drafts of this study Report.


(S.P. Ahuja)
Project Director
15.12.1989

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1. INTRODUCTION, METHODOLOGY AND SUMMARY

1.1 Introduction

1.1.1 Technological upgradation, modernisation and scientific advances in production processes constitute some of the leading factors in growth of productivity, whether it be in organised industry, agriculture or small industry. In order to keep pace with speedy Technological developments within the country and out side it was realised fairly early by the planners that India needs development of a suitable infrastructure and adequate Scientific and Technical manpower equipped with up-to-date technical knowledge and skills. Accordingly, efforts have been made for expansion in the field of academic instructions and training in Science and Technology ever since the launching of the first Five Year Plan.

1.1.2 As scientific and technical manpower plays a crucial role in developmental process, it is necessary to formulate a data base in regard to availability of scientific and technical manpower according to qualifications, specialisation, age, employment, activity status, nature of Work performed etc. Simultaneously, it is also necessary to know the demand for scientific and technical personnel by qualifications, discipline, specialisation etc. over future years in order to maintain a balance between demand and supply.

1.1.3 The need for collection of data in regard to technical and scientific manpower in different disciplines as well as conditions of work and service obtaining among scientific and technical personnel was felt as early as 1947. In August 1947, Government of India appointed a Scientific Manpower committee to advise on the best methods of utilising and augmenting the scientific manpower resources of the country. On the recommendation of this committee, regarding preparation of a roster of scientific and technical talent available in the country, the Council of Scientific & Industrial Research was asked to compile a National Register of Scientific & Technical personnel. In

this context, the then Prime Minister (Late) Pt. Jawahar Lal Nehru issued frequent appeals to the scientists and technicians of the nation to send complete information about themselves such as age, address, scientific qualifications, research and industrial experience, their present occupation, the nature of research work done, if any etc. However, since the registration was voluntary, the response of the registrants was not satisfactory. With passage of time the registration diminished and it became only a partial reflection of the S & T manpower situation of the country.

1.1.4 Considering the need of the correct update information on S & T manpower, census of technical manpower was conducted in 1961 Census as an ancillary enquiry linked integrally to the Census count in close collaboration with the CSIR. The studies based on the data of S & T personnel collected at the time of 1961 Census proved to be useful in educational and manpower planning. It was, therefore, planned to have a wider coverage during 1971 Census including all degree holders and technical personnel. The studies carried out by CSIR on the above data proved to be useful in the assessment of S & T manpower situation in the country and was considered helpful for Manpower Planning.

1.1.5 The survey of Degree Holders and Technical Personnel (DHTP) was again taken up along with 1981 Census. But, considering the heavy requirement of schedules and difficulty of collecting and handling bio-data for such a huge population, it was decided to collect the data on 20 percent sample in 12 States and complete enumeration in the remaining States and Union Territories. Since Census was not conducted in Assam in 1981, DHTP survey was also not carried out in that State. The post Census non-response survey conducted by CSIR in Delhi and Calcutta revealed that the non-response was as high as 58

percent and 52 percent respectively. The non-response of this order has obviously affected the estimates of various characteristics computed on the basis of survey data and hence could be used only with necessary caution.

1.1.6 Although the total resource of S & T manpower in the country, in relation to the population and magnitude of the task, is rather small as compared to industrially advanced economies yet we have to face twin problems of (1) employment and (ii) emigration. As regards the first problem, this is mainly because of the fact that the economy has not progressed as planned though the outturn of S & T personnel has increased. The current rate of unemployment of S & T personnel is around 9 percent, 6 percent for degree holders and 14.6 percent for Diploma holders in Engineering & Technology and 6 percent for medical doctors. This however, does not imply that there are no shortages of manpower, particularly in specialised areas. Another reason is that S & T has so far not been made an integrated part of the major socio-economic sectors e.g rural development, ecology, production and scientific/industrial research. As regards the second problem, the exodus is generally of better than average persons either because of higher expectations or inadequacy of facilities for research or lack of research environment and this hampers the pace of development. No doubt, efforts to check brain drain have been made, for example by creating a 'Scientists Pool, to provide temporary placement to highly qualified scientists trained in India/Abroad, visit of UPSC selection committee in other countries for recruitment and through Govt. Policy of extending offers to outstanding individual scientists. However, it appears that we have to live with brain drain the main reasons being the differentials in emoluments and the work culture in the developed and developing countries

1.1.7 The manpower system, which is now being developed, has to ensure that no plan project/programme suffers from manpower shortage and there are no surpluses which imply wastage of scarce manpower resources. In spite of macro surpluses, there is a problem of critical manpower shortages which warrant analysis at the disaggregate level, discipline wise and by skill levels. Thereafter, appropriate action, at periodic intervals, may have to be taken to re-organise/restructure the courses to attune these to the new environment.

1.1.8 Keeping the above in view, the Ministry of Science and Technology desired to prepare a Perspective Plan for Science and Technology Manpower in India upto 2000 AD and accordingly the present study was carried out by the Centre for Research, Planning & Action in 1988-89 with a view to prepare the Perspective Plan.

1.1.9 **Main Objectives** of the present Study are as Under:-

- (1) Assessment of the current availability (supply) of S & T Manpower by category (field of specialisation) such as Agriculture and Veterinary science manpower, Engineering & Technology manpower, Medical and para-medical personnel and General Science personnel.
- (2) Discipline wise break-down of supply of each category of manpower alongwith appropriate break down by age/sex/activity status and employment.
- (3) Projection of likely availability (supply) by category/discipline upto the turn of the century which inter alia implies projection of total stock at five yearly intervals.

- (4) The present and projected demand of S & T manpower by category/discipline in relation to Planned/indicative Programmes of development at five yearly intervals upto the end of the century.
- (5) Preparation of Manpower balance and an assessment of the likely shortages/surpluses at disaggregate level upto 2000 AD and various intermediate points so as to take appropriate steps to ensure adequate supply of S & T Manpower as per need and also avoid wastage by avoiding mismatches.
- (6) To estimate the differentials in emoluments, age, qualifications, etc.

1.2 Definition of S & T Manpower

1.2.1 S & T manpower may be taken to refer to the category of manpower which has an add-on effect in terms of either vocationalisation or training. Hence this manpower will be at all levels viz. intermediate, middle or higher level. The categories of manpower included as S & T manpower are all types of degree and diploma holders including Ph.Ds., Post-graduates, Graduates and under graduates in Engineering & Technology and graduates, post-graduates and Ph.Ds. in Science/ Agriculture/ Medicine.

1.2.2 Realising that the above definition is rather vague, S & T manpower has been defined in terms of occupations i.e. type of work performed. Generally degree and diploma holders are covered under Occupation Division Code 0 and 1, of the National Classification of Occupation (NCO). Division Codes 3, 7, 8 and 9, called production related workers are by and large having no formal education/training. Skilled technicians under codes 7 to 9 comprise those who have (a) formal training in trade at the Industrial Training Institute (ITI)

or (b) have formal in-house/in plant training and (c) are occupying technical occupations because of on job training; and (d) have risen to hold these positions by virtue of experience.

1.3 Methodology

1.3.1 Base Line Stock

1.3.1.1 Base line stock of Agricultural and veterinary scientists at the beginning of 1981 for urban areas has been taken from C series tables of 1981 Census. Rural Stock has been estimated on the basis of 1981 B series tables. Stock of employed Agriculture and Veterinary Scientists was estimated from 1981 Census B Series tables.

1.3.1.2 Base line stock of Engineering and Technology manpower at the beginning of 1981 has been built up as the sum total of two components viz (i) employed S & T personnel as per 1981 Census; and (ii) unemployed S & T Personnel estimated on the basis of DHTP(1981) survey and the employment exchange statistics.

1.3.1.3 Stock of Registered Allopathic medical manpower at the end of 1980 has been taken from Medical Council and that of Indian System of Medicine (ISM) Practitioners and Nurses from respective Councils/Examination Boards. Stock of employed Medical and Para-medical personnel has been estimated from Census 1981 B Series tables.

1.3.1.4 Stock of degree holders in Science at the end of 1980 has been generated on the basis of annual outturn of different categories of degree holders from 1950 to 1980 as available from U.G.C reports and corresponding stock of employed degree holders in Science has been estimated from B.Series tables of 1981 Census.

1.3.2 Updated Stock : 1985

1.3.2.1 Updated stock of Agriculture and veterinary scientists at the end of 1985 has been generated with the help of base

line stock, annual enrolment figures in respective disciplines during the intervening years, enrolment / outturn ratio realised in the recent past and attrition rate on account of death, disability etc.

1.3.2.2 Updated Stock of Engineering & Technology manpower for 1985 has been generated from the base year (1981 beginning) stock taking into account the outturn/estimated outturn of degree and diploma holders during the intervening years and attrition rate for depletion.

1.3.2.3 Updated stock of registered Medical and Para-Medical manpower has been taken from respective Medical Councils, Nurses Councils/Examination Boards. Stock of employed manpower has been estimated on the basis of employed stock ratio as observed in 1980.

1.3.2.4 The stock of degree holders in science for the year 1985 has been estimated taking into account base line stock, outturn/estimated outturn of degree holders during the intervening period and attrition rate for depletion.

1.3.3 Projected Stock for future years upto 2000 AD

1.3.3.1 Projected stock of S & T Manpower for future years have been estimated taking into consideration updated stock of 1985 and latest enrolment figures in different disciplines and respective enrolment outturn ratio.

1.3.4 Future Requirements of S & T Manpower upto 2000 AD

1.3.4.1 Requirements of S & T Manpower relating to Agriculture and veterinary Science, Engineering and Technology as also General Science, was estimated at three different scenarios by adopting three different methods viz (a) Output method, (b) Manpower method and (c) Investment method and average of these three estimates was taken as more realistic estimate of requirement.

1.3.4.2 Requirements of Medical and

Para-medical personnel for future years have been estimated on the basis of health needs as per national goal of "Health for All" by 2000 A.D.

1.3.4.3 In order to project future requirements by investment and output methods future Investment/output have been estimated by loglinear method.

1.3.4.4 In order to estimate requirement of medical manpower, future population has been estimated at moderate growth rate expected due to increase in couple protection rates owing to Family Planning Programmes.

1.4 Agriculture Science Manpower

1.4.1 Total stock of degree holders in Agriculture Science at the beginning of 1981 was of order of 1.03 lakh. Around 37.24 percent of them were in Maharashtra and U.P. Another 36.58 percent were in other six major States namely Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh and Tamil Nadu.

1.4.2 78 percent of the stock of degree holders in Agriculture Science manpower were economically active and unemployment rate among them was 11.41 percent. Out of the stock, 2.95 percent were having doctorate degree, 20.57 percent having post-graduate degree and the remaining 76.48 percent having Graduate degree. Among employed, 3.22 percent were Ph.Ds, 20.95 percent were M.Sc.s, and 75.83 percent were B.Sc.s. in Agriculture Science.

1.4.3 Availability of Agriculture Scientists which in 1981 was 6.76 per 10 thousand hectares of cultivated area improved to 9.11 per 10 thousand hectares of cultivated area in 1985.

1.4.4 Future stocks of degree holders in Agriculture Science for 1990, 1995 and 2000 have been estimated as 175.6 thousand, 204.6 thousand and 229.4 thousand respectively showing a growth rate of 3.2 percent per annum by 2000-01.

1.4.5 Requirements of Agriculture Science degree holders have been estimated as 106.6 thousand in 1990-91, 128.9 thousand in 1995-96 and 158.3 thousand in 2000-01 showing a growth rate of 3.9 percent per annum during 1990-95 and 4.2 percent per annum during 1995-2000.

1.4.6 The rate of unemployment, which was of the order of 19.68 percent in 1985-86 and is expected to be of the order of 22.26 percent in 1990-91 will show a declining trend thereafter and by 2000-01 will decline to 11.51 percent only.

1.4.7 Agronomy is the most popular branch of Agriculture Science accounting for 75 percent of the Agriculture Scientists in 1981. Agro-Chemistry, Dairying and Fishing each accounting for around 2 percent of them are relatively less popular.

1.5 Veterinary Science Manpower

1.5.1 Total stock of Veterinary Scientists was 20.9 thousand in 1981. Out of which 83.12 percent were B.VSc., 14.25 percent M.VSc. and remaining 2.63 percent Ph.D degree holders. Out of total stock 30 percent were in the States of Tamil Nadu and Andhra Pradesh alone. Another 41.9 percent were in the States of Bihar, Karnataka, Madhya Pradesh, Maharashtra, Orissa and U.P.

1.5.2 About 87 percent of the total stock of veterinary scientists were economically active and amongst them only 0.02 percent were unemployed.

1.5.3 Updated stock in 1985 was 25.5 thousand. Future stock of veterinary scientists have been estimated as 30.1 thousand in 1990, 34 thousand in 1995 and 37.4 thousand in 2000.

1.5.4 Out of total stock of Veterinary Science degree holders available in 1985, 3.68 percent were Ph.Ds 15.04 percent M.VSc and 81.28 percent B.VScs. By 2000 AD, their respective proportions will be 4.87 percent for Ph.Ds, 16.32 percent for M.VScs. and 78.81 percent B.VSc degree holders in Veterinary Science.

1.5.5 Total estimated requirement of Veterinary Scientists in 1985-86 was 22.5 thousand. Future requirements for the years 1990-91, 1995-96 and 2000-01 have been estimated as 27 thousand, 32.5 thousand and 39.4 thousand respectively showing an overall growth rate of 3.8 percent during 1985-86 to 2000-01.

1.5.6 Already there was a shortage of Veterinary Scientists to the tune of 1.24 percent of the requirement. This shortage is expected to increase further to 2.93 percent by 1990-91, 9.07 percent by 1995-96 and rise as high as 17.5 percent by 2000-01.

1.5.5 There is a need of augmentation of the capacity of teaching in Veterinary Science in all the existing institutions and also opening of new departments/Colleges having such facilities so that economic planning may not suffer due to shortage of manpower.

1.6 Engineering & Technology Manpower

1.6.1 The stock of economically active degree holders in E&T, in 1981 was 311.3 thousand which has increased to 374.5 thousand by 1985. Future stock of E&T degree holders is expected to be 467 thousand in 1990, 573 thousand in 1995 and 693 thousand in 2000. As against this, their requirement is expected to be 453.9 thousand in 1990-91, 606.2 thousand in 1995-96 and 746.9 thousand in 2000-01. Thus, although a surplus of the E&T degree holders is expected in 1990-91 to the tune of about 3 percent of the stock, by 1995-96 a shortage is expected to the tune of 5.5 percent of the requirement and by 2000-01 the shortage will be by over 7 percent. Thus there is a need to augment the enrolment capacity of E&T disciplines to meet their prospective need.

1.6.2 Stock of economically active diploma holders in E&T in 1981 was 527.2 thousand which increased to 637.8 thousand by 1985. Future stock of E&T diploma holders has been estimated as 804 thousand in 1990, 998 thousand in 1995 and 1220 thousand in 2000. Future expected requirement of diploma holders has been estimated as 739.8 thousand in

1990-91, 967.9 thousand in 1995-96 and 1210 thousand in 2000-01. Thus, a surplus of about 8 percent of supply has been estimated for the year 1990-91. This surplus is showing declining trend owing to which by 2000 AD the surplus will decline to 2 thousand against the supply of 1220 thousand which is only marginal.

1.6.3 Gaps in Supply of E & T manpower in relation to demand are also expected to emerge in some frontier areas. Large number of new installations that are being established in the area of electronics and telecommunications will be in need of properly trained manpower to maintain and keep the industry productive. In the energy sector for new technologies which have been developed for rural sector sufficient E & T manpower of good talent is needed to meet the requirement.

1.6.4 Some more specific requirements have been mentioned for technical persons for Servo-control system, Cryogenics, bio-technology and application & maintenance engineering.

1.6.5 Keeping in view the future need of technical manpower in these specific areas there is a need for greater linkage between industry and technical education.

1.6.6 Out of total technical manpower engaged in E & T education during 1987-88, only 13.5 percent were female.

1.6.7 The average age of technical personnel engaged in education was 41.3 years. Average age of females is marginally less than that of males. Relatively more females are engaged in the age groups of 31-35 years and 41-45 years.

1.6.8 The average income per month of technical personnel (both male and female combined) in 1987-88 was Rs.3037 that of female being Rs.2964 per month and of male being Rs.3048 per month.

1.6.9 The average age of Technical personnel engaged in Industry in 1987-88 was 37 years. Around 49.6 percent of them were in the lower age group of upto

35 years. The average age of Technical personnel engaged in service sectors was 45 years for Health education, 43 years for Transport & Communication, 42 years each for Electricity, Gas & Water and Education, 41 years for Hospital and. 38 years for R & D.

1.6.10 Average income of Technical Personnel engaged in Industry was Rs. 2395 per month and that of personnel engaged in service sector of different sub-sector was Rs.1732 to Rs.2978 per month.

1.7 Medical & Para-medical manpower

1.7.1 Stock of medical manpower in 1980 consisted of 255.5 thousand Allopathic doctors, 224.9 thousand Ayurvedic doctors, 145.0 thousand Homeopathic Doctors, 26 thousand Unani doctors and 8.4 thousand Dental Surgeons. As against this, employed medical manpower was 207.6 thousand Allopathic doctors, 107.5 thousand Ayurvedic doctors, 50.1 thousand Homeopathic doctors, 6.7 thousand Unani doctors and 8 thousand Dental Surgeons.

1.7.2 Medical manpower per million in 1981 works out as 312 Allopathic doctors, 162 Ayurvedic doctors, 75 Homeopathic doctors, 10 Unani doctors and 12 Dental Surgeons. Stock per million population in Rural area was 113 Allopathic and 132 Non-Allopathic doctors and that in urban areas 932 Allopathic doctors and 333 Non-Allopathic doctors.

1.7.3 Stock of nurses in 1981 was 166.9 thousand and stock of Para-medical staff was 527.7 thousand.

1.7.4 Out of total medical manpower in 1981 female doctors accounted for 10.9 percent. Maximum share (15.7 percent of females) was among Allopathic doctors. For other categories female doctors share was between 4.2 to 5 percent. For Dental Surgeons it was 8.7 percent.

1.7.5 Stock of medical manpower in 1985 consisted of 298.3 thousand Allopathic doctors, 272.2 thousand Ayurvedic doctors, 28.7 thousand Unani doctors and 130 thousand Homeopathic doctors. Accordingly, estimated employed medical personnel in 1985-86 has been

estimated as 242.2 thousand Allopathic doctors, 130.2 thousand Ayurvedic doctors, 7.4 thousand Unani doctors and 50.3 thousand Homeopathic doctors.

1.7.6 Estimated medical manpower per million population for the year 1985-86 has been worked out as 592 of which 341 were of Allopathic, 172 of Ayurvedic, 11 of Unani and 68 of Homeopathic systems. Thus availability of doctors in 1985-86 in relation to population was about 6 percent higher than that of 1980-81.

1.7.7 Stock of economically active Allopathic doctors for future years has been estimated as 309.6 thousand in 1990, 345.8 thousand in 1995 and 378.9 thousand in 2000 AD. Stock of economically active Non-Allopathic doctors would be 160.3 thousand Ayurvedic, 8.0 thousand Unani and 40.7 thousand Homeopathic doctors in 1990 and 177.6 thousand Ayurvedic, 8.6 thousand Unani and 36.9 thousand Homeopathic doctors in 1995 and 193.3 thousand Ayurvedic, 9.2 thousand Unani and 33.5 thousand Homeopathic doctors in 2000. The stock of dental surgeons would be 10.7 thousand in 1990, 11.9 thousand in 1995 and 12.9 thousand in 2000.

1.7.8 Future stock of Nurses is expected to be 242.9 thousand in 1990, 284.9 thousand in 1995 and 322.0 thousand in 2000.

1.7.9 Future requirements of Allopathic doctors have been estimated as 305.4 thousand in 1990-91, 360.3 thousand in 1995-96 and 422.2 thousand in 2000-01. Requirements of Ayurvedic doctors during the corresponding years would be 145.2 thousand, 165.7 thousand and 187.2 thousand respectively. For Unani doctors the requirement would be 9.0 thousand in 1990-91, 10.3 thousand in 1995-96 and 11.7 thousand in 2000-01 and for Homeopathic doctors requirement during corresponding years is expected to be 67.6 thousand, 77.3 thousand and 87.2 thousand respectively.

1.7.10 Future requirements of staff nurses have been estimated as 397.3 thousand in 1990-91, 506.4 thousand in 1995-96 and 645.3 thousand in 2000-01.

1.7.11 Stock of economically active Allopathic doctors is estimated to be marginally surplus in 1990-91. But, present trend of demand supply shows that by 2000-01 shortage to the tune of 43.3 thousand i.e about 10 percent of the requirement is apprehended.

1.7.12 Ayurvedic doctors will be marginally surplus through out the period. But, for Unani doctors there will be shortage throughout the period and by 2000-01, the shortage will be by 21.4 percent of the requirement. Thus there is immediate need for augmenting the enrolment capacity in Unani system of medical education by about 5 percent per annum.

1.7.13 Presently there is a surplus of Homeopathic doctors to the extent of 12 percent of the stock. But the present trend of demand and supply of Homeopathic doctors shows that from 1995-96 onwards there will be shortage and by 2000-01, the shortage will increase to 26 percent of the requirement.

1.7.14 Demand-Supply analysis of Nurses and Para Medical Manpower shows that there would be huge shortage of Nurses by 2000 Ad., Health Educators, Lab-Technicians, Nurse-Midwives, Health Assistants (male) and Health Assistants (female). The existing situation can only be improved significantly if organisational structures responsible for Health Manpower Development are further strengthened with speed.

1.7.15 During 1987-88, in most medical Institutions, females were about one third of the total personnel in all the disciplines excepting nursing where share of females was about 85 percent.

1.7.16 The female medical personnel had a higher share of 53 percent among those below 30 years. This share gradually declined till age group 41-45 years when their share was 18.9 percent but increased again for higher age groups.

1.7.17 The share of women was higher than that of males in the salary slab of

1501-2000. In all other salary slabs their share was lower. The share of women was much less (11.5 percent) for salary slab of above 3500.

1.8 General Science Manpower

1.8.1 Estimated stock of degree holders in science in 1980 was 1268.5 thousand which increased to 1637.9 thousand by 1985. Their projected stock is estimated as 2073.2 thousand in 1990, 2591.7 thousand in 1995 and 3214.3 thousand in 2000. Out of the total stock, 78 percent will be economically active.

1.8.2 The stock of economically active B.Sc degree holders is expected to rise from 1071.9 thousand in 1985 to 2188.1 thousand in 2000 AD. That of M.Sc degree holders will rise from 181.8 thousand to 255.2 thousand and of Ph.D degree holders from 23.8 thousand to 63.8 thousand during the same period.

1.8.3 Estimated requirement of degree holders in Science during 1985-86 was 1012.7 thousand which increased to 1295.5 thousand in 1990-91, 1679.6 thousand in 1995-96 and 2204.7 thousand in 2000-01. Requirement of degree holders in Science by level of degree is expected to rise from 830.7 thousand in 1985-86 to 1897.7 thousand in 2000-01 for B.Sc degree holders, 160.8 thousand in 1985-86 to 243.3 thousand in 2000-01 for M.Sc degree holders and 21.2 thousand in 1985-86 to 65.6 thousand in 2000-01 for Ph.D degree holders.

1.8.4 Analysis of future estimated demand and supply of combined degree holders in Science shows that Unemployment of degree holders which is of the level of around 20 percent of the availability is showing a declining trend and by 2000-01 it will decline to 12 percent. At dis-aggregate level unemployment rate for B.Sc degree holders will decline from 22.5 percent to 13.27 percent, that for M.Sc degree holders will decline from 11.55 percent to 4.62 percent and for Ph.Ds from 10.92 percent to only 0.31 percent during the same period.

1.8.5 In 1980-81, around two-third of employed B.Sc. degree holders were in the lower group of upto 35 years, while amongst M.Sc degree holders about 53 percent were in this age group and amongst Ph.D degree holders only 35.7 percent were in this age group.

1.8.6 Average income of B.Sc degree holders was Rs.2350, that of M.Sc degree holders was Rs. 3454 and that of Ph.D degree holders was Rs. 4097 per month.

1.8.7 About 49 percent of degree holders in Science were engaged in Teaching and R & D and 30 % in Administrative work. In Industry also a sizeable percentage(12.4%)of them were engaged.

1.9 Combined S & T Manpower

1.9.1 With a view to assess the Demand. Supply situation of combined S & T Manpower by 2000 AD, the estimates of economically active S & T manpower and their requirements in regard to different categories of S & T manpower, as presented in chapters 2 to 5 of this report have been consolidated here. Overall situation shows that economically active S & T manpower which was 24.75 lakh in 1980 has increased to 30.32 lakh by 1985 and is expected to increase to 55.8 lakh by year 2000. As against this, the requirements of S & T personnel by 2000-01 would be about 57 lakh. Thus shortage of S & T manpower of the order 1.2 lakh is expected to be experienced by the turn of the century.

1.9.2 The estimated distribution of stock of different categories of S & T manpower for Selected States/UT in 1981 has been presented in table 1.1. The statement reveals that, at the national level, there were 35.87 lakh S & T manpower in 1981. Out of this, medical and para-medical manpower accounted for 37.8 percent, degree holders in Science for 35.3 percent, degree and diploma holders in Engineering & Technology for 23.4 percent and the degree holders in Agriculture and Veterinary Science for 3.5 percent.

1.1 Distribution of S & T Manpower by Discipline in Selected States:1981

(in percent)

Sl. No.	State/UT	Agriculture & Veterinary Science			E & T	General Science	Medical & Para-medical	Total	N ('000)
		Agri.	Vet.	Total					
1.	Andhra Pradesh	2.7	1.3	4.0	29.1	31.7	35.2	100.0	221.6
2.	Bihar	2.2	0.4	2.6	18.2	31.7	47.5	100.0	302.5
3.	Karnataka	2.5	0.7	3.2	26.3	47.9	22.6	100.0	281.6
4.	Kerala	1.4	0.4	1.8	14.0	55.5	28.7	100.0	218.0
5.	Madhya Pradesh	3.3	0.5	3.8	22.7	34.4	39.1	100.0	227.8
6.	Maharashtra	3.9	0.4	4.3	33.7	29.6	32.4	100.0	486.4
7.	Tamil Nadu	1.7	1.0	2.7	21.4	43.4	32.5	100.0	351.4
8.	Uttar Pradesh	5.4	0.3	5.7	12.8	36.2	45.3	100.0	371.6
9.	West Bengal	1.0	0.2	1.2	19.8	40.0	39.0	100.0	344.4
10.	Other States/UTs	3.4	0.7	4.1	26.5	25.6	43.8	100.0	782.0
Total		2.9	0.6	3.5	23.4	35.3	37.8	100.0	3587.3

1.9.3 State-wise distribution of S & T manpower in 1981 have been presented in table 1.1(a). The statement shows that Maharashtra has the maximum share of S & T manpower having 13.6 percent of the total. Other major States in regard to stock of S & T personnel are

Uttar Pradesh, Tamil Nadu, West Bengal, Bihar, Karnataka, Madhya Pradesh, Andhra Pradesh and Kerala in that order. The above nine major States together accounted for 78.2 percent of the total S & T manpower in the country.

1.1 (a) Distribution Of S&T Manpower by States:1981

(in percent)

Sl. No.	State/UT	Agriculture & Veterinary Science			E & T	General Science	Medical & Para-medical	Total
		Agri.	Vet.	Total				
1.	Andhra Pradesh	5.7	13.4	7.0	7.7	5.5	5.8	6.2
2.	Bihar	6.3	6.2	6.3	6.6	7.6	10.6	8.4
3.	Karnataka	6.8	8.6	7.1	8.8	10.6	4.7	7.8
4.	Kerala	2.8	4.3	3.0	3.7	9.5	4.6	6.1
5.	Madhya Pradesh	7.1	5.8	6.9	6.2	6.2	6.6	6.3
6.	Maharashtra	18.2	9.1	16.7	19.4	11.3	11.7	13.6
7.	Tamil Nadu	5.7	16.8	7.5	9.0	12.0	8.4	9.8
8.	Uttar Pradesh	19.1	6.2	16.9	5.7	10.6	12.4	10.4
9.	West Bengal	3.1	3.8	3.3	8.1	10.9	9.9	9.6
10.	Other States/UTs	25.2	25.8	25.3	24.8	15.8	25.3	21.8
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0
(N'000)		(105.0)	(20.9)	(125.9)	(838.5)	(1268.5)	(1354.4)	(3587.3)

1.9.4 Stock & Distribution of economically active S & T manpower having degree and diploma as in 1981 for selected States and for the country as a whole has been presented in table 1.2 & 1.2(a). It would be seen that in 1981 there were 24.75 lakh economically

active S&T manpower having degree or diploma in the country. Out of this 40.0 percent were of General Science, 33.9 percent of E & T, 22.1 percent of medical and nursing and remaining 4.0 percent of Agricultural and Veterinary Science.

1.2 Stock of Economically active S & T Manpower having Degree and Diploma:1981(in'000)

Sl. No.	State/UT	Agriculture & Veterinary Science			E & T	General Science	Medical & Nursing	Total
		Agri.	Vet.	Total				
1.	Andhra Pradesh	4.7	2.4	7.1	64.5	54.8	43.8	170.2
2.	Bihar	5.1	1.1	6.2	55.1	74.8	34.5	170.6
3.	Karnataka	5.5	1.6	7.1	74.1	105.3	28.9	215.4
4.	Kerala	2.3	0.8	3.1	30.6	94.4	36.0	164.1
5.	Madhya Pradesh	5.9	1.1	7.0	51.7	61.2	34.4	154.3
6.	Maharashtra	14.9	1.7	16.6	63.9	112.1	69.3	361.9
7.	Tamil Nadu	4.7	3.0	7.7	75.3	118.8	45.7	247.5
8.	Uttar Pradesh	15.6	1.1	16.7	47.5	104.8	66.1	235.1
9.	West Bengal	2.6	0.7	3.3	68.2	107.3	36.3	215.1
10.	Other States/UTs	20.6	4.7	25.3	207.6	156.0	151.8	540.7
	Total	81.9	18.2	100.1	838.5	989.5	546.8	2474.9

1.9.5 Distribution of S & T personnel by category shows that maximum share was of degree holders in Science in the States of Bihar, Karnataka, Kerala, Madhya Pradesh, Tamil Nadu, Uttar Pradesh and West Bengal. The share of E & T

personnel was maximum in Maharashtra Andhra Pradesh & Others States/UTs. Manpower having degree in Agricultural Science and Veterinary Science was minimum in all the States/UTs ranging from 1.2 to 6.6 percent.

1.2(a) Distribution of Economically Active S & T Manpower Having Degree and Diploma by Discipline : 1981 (in percent)

Sl. No.	State/UT	Agriculture & Veterinary Science			E & T	General Science	Medical & Nursing	Total	N ('000)
		Agri.	Vet.	Total					
1.	Andhra Pradesh	2.8	1.4	4.2	37.9	32.2	25.7	100.0	170.2
2.	Bihar	3.0	0.6	3.6	32.3	43.8	20.3	100.0	170.6
3.	Karnataka	2.6	0.7	3.3	34.4	48.9	13.4	100.0	215.4
4.	Kerala	1.4	0.5	1.9	18.6	57.6	21.9	100.0	164.1
5.	Madhya Pradesh	3.8	0.7	4.5	33.5	39.7	22.3	100.0	154.3
6.	Maharashtra	4.1	0.5	4.6	45.3	31.0	19.1	100.0	361.9
7.	Tamil Nadu	1.9	1.2	3.1	30.4	48.0	18.5	100.0	247.5
8.	Uttar Pradesh	6.6	0.5	7.1	20.2	44.6	28.1	100.0	235.1
9.	West Bengal	1.2	0.3	1.5	31.7	49.9	16.9	100.0	215.1
10.	Other States/UTs	3.9	0.9	4.7	38.4	28.8	28.1	100.0	540.7
	Total	3.3	0.7	4.0	33.9	40.0	22.1	100.0	2474.9

1.9.6 Stock of economically active S & T manpower having degree and diploma in 1985 for the major states and for the country as a whole has been presented in table 1.3. The statement reveals that during 1985-86 there were 30.32 lakh of economically active S & T manpower (having degree & diploma) in the country out of which 42.1 percent were having degree/diploma in general science, 32.5 percent in E & T, 21.0 percent in medical and nursing and the remaining 4.4 percent in Agricultural and Veterinary Science.

1.3 Stock of Economically active S & T manpower having Degree and Diploma:1985

(in '000)

Sl. State/UT No.	Agriculture & Veterinary Science			E & T	General Science	Medical & Nursing	Total
	Agri.	Vet.	Total				
1. Andhra Pradesh	6.0	2.6	8.6	70.5	80.7	46.5	206.3
2. Bihar	5.6	1.4	7.0	71.8	102.4	32.4	213.6
3. Karnataka	7.7	1.9	9.6	84.1	127.7	32.4	253.8
4. Kerala	2.7	0.9	3.6	38.9	119.0	58.9	220.4
5. Madhya Pradesh	7.5	1.4	8.9	67.3	83.7	36.6	196.5
6. Maharashtra	17.9	2.3	20.2	181.4	141.3	78.7	421.6
7. Tamil Nadu	5.9	3.3	9.2	82.0	158.5	60.5	310.2
8. Uttar Pradesh	27.2	1.7	28.9	72.4	134.8	76.4	312.5
9. West Bengal	3.8	1.1	4.9	80.5	133.6	52.8	271.8
10. Other States/UTs	26.5	5.6	32.1	235.7	195.8	161.8	625.4
Total	110.8	22.2	133.0	984.6	1277.5	637.0	3032.1

1.3(a) Distribution of Economically Active S & T Manpower Having Degree and Diploma by Discipline :1985

(in percent)

Sl. State/UT No.	Agriculture & Veterinary Science			E & T	General Science	Medical & Nursing	Total	N ('000)
	Agri.	Vet.	Total					
1. Andhra Pradesh	2.9	1.3	4.2	34.2	39.1	22.5	100.0	206.3
2. Bihar	2.6	0.7	3.3	33.6	47.9	15.2	100.0	213.6
3. Karnataka	3.0	0.8	3.8	33.1	50.3	12.8	100.0	253.8
4. Kerala	1.2	0.4	1.6	17.6	54.0	26.7	100.0	220.4
5. Madhya Pradesh	3.8	0.7	4.5	34.2	42.6	18.7	100.0	196.5
6. Maharashtra	4.2	0.6	4.8	43.0	33.5	18.7	100.0	421.6
7. Tamil Nadu	1.9	1.1	3.0	26.4	51.1	19.5	100.0	310.2
8. Uttar Pradesh	8.7	0.5	9.2	23.2	43.1	24.5	100.0	312.5
9. West Bengal	1.4	0.4	1.8	29.6	49.2	19.4	100.0	271.8
10. Other States/UTs	4.2	0.9	5.1	37.7	31.3	25.9	100.0	625.4
Total	3.7	0.7	4.4	32.5	42.1	21.0	100.0	3032.1

1.9.7 Projected stock of economically active S & T manpower during 1990-2000 at all India level has been presented in table 1.4. The statement shows that total S & T manpower having degree and diploma will be around 38.20 lakh in 1990, 46.44 lakh in 1995 and 55.80 lakh by 2000 AD. The growth rate during 1985-1990, 1990-1995 and 1995-

2000 works out to be 4.67, 3.98 and 3.74 percent respectively.

1.9.8 It is worth mentioning here, that the stock of economically active S & T manpower presented in table 1.2 to 1.4 refers to domestic stock only. Stock of S & T manpower of Indian Origin has not been included here.

1.4 Projected Stock of Economically active Personnel with Degree and Diploma in S & T by Discipline (in '000)

Year	Agriculture & Veterinary Science			E & T	General Science	Medical & Nursing	Total
	Agri.	Vet.	Total				
1990	137.0	26.2	163.2	1271.0	1617.0	769.5	3820.7
1995	159.6	29.6	189.2	1571.0	2021.6	861.9	4643.7
2000	178.9	32.5	211.4	1913.0	2507.1	948.6	5580.1

1.4(a) Distribution of Projected Stock of Economically Active Personnel with Degree and Diploma in S & T by Discipline (in percent)

Year	Agriculture & Veterinary Science			E & T	General Science	Medical & Nursing	Total	N ('000)
	Agri.	Vet.	Total					
1990	3.6	0.7	4.3	33.3	42.3	20.1	100.0	3820.7
1995	3.4	0.7	4.1	33.8	43.5	18.6	100.0	4643.7
2000	3.2	0.6	3.8	34.3	44.9	17.0	100.0	5580.1

1.10 Future Requirements

1.10.1 Estimated requirement of S & T manpower during 1990 to 2000 at all India level has been presented in table 1.5 for different categories. It would be seen from this statement that by 1990-91 requirements of S & T personnel having degree and diploma will be 35.3 lakh, by 1995-96, 45.32 lakh and by 2000-01, 57 lakh showing a growth rate of 5.12 percent during 1990-95 and 4.69 percent during 1995-2000.

1.5 Requirement of S & T Personnel having Degree and Diploma during 1990-91 to 2000-01 (in '000)

Year	Agri-culture	E & T	General Science	Medical and Nursing	Total
1990-91	133.5 (3.8)	1193.7 (33.8)	1295.5 (36.7)	908.0 (25.7)	3530.7 (100.0)
1995-96	161.4 (3.6)	1574.1 (34.7)	1679.6 (37.0)	1117.3 (24.7)	4532.4 (100.0)
2000-01	197.2 (3.5)	1964.6 (34.5)	2204.7 (38.6)	1333.7 (23.4)	5700.2 (100.0)

Note: Figures in brackets are percentage to total.

1.10.2 It is worth mentioning here that the estimated requirement of S & T personnel having degree and diploma, presented in table 1.5 is inclusive of R & D requirements in different sectors of the economy.

1.11 Expected Shortage/Surplus

1.11.1 Expected shortage/surplus of different categories of S & T manpower during 1990-91, 1995-96 and 2000-01 have been presented in table 1.6 from which it will be seen that even in 1990-91 S & T manpower on the whole is expected to be in surplus. However, for medical and nursing shortage is expected to the tune of 138.5 thousand. This shortage is expected to increase to 255.4 thousand by 1995-96 and 385.1 thousand by 2000-01. By 1995 for E & T also there will be marginal shortage which will increase to 51.6 thousand by 2000-01. On totality also the shortage is expected to be around 120.6 thousand.

1.6 Expected Shortage(-)/Surplus(+) of S&T Manpower during 1990-2000(in'000)

Category of Manpower	1990-91	1995-96	2000-01
Agriculture & Veterinary	+ 29.7	+ 27.8	+ 13.7
E & T	+ 77.3	- 3.1	- 51.6
Medical & Nursing	- 138.5	- 255.4	- 385.1
General Sc.	+ 321.5	+ 342.0	+ 302.4
Total	+ 290.0	+ 111.3	- 120.6

1.6(a) Percentage of Shortage(-)/ Surplus(+) of S&T Manpower to Requirement /Stock (in percent)

Category of Manpower	1990-91	1995-96	2000-01
Agriculture & Veterinary	+ 18.2	+ 14.7	+ 6.5
E & T	+ 6.1	- 0.2	- 3.3
Medical & Nursing	- 15.3	- 22.9	- 28.9
General Sc.	+ 19.9	+ 16.9	+ 12.1
Total	+ 7.6	+ 2.4	- 2.1

1.12 Suggestions and Recommendations

1.12.1 Owing to greater emphasis given to S & T since Independence, a massive infrastructure covering a broad spectrum of disciplines and capabilities has been built up in educational and research institutions. However, it has often been felt that S & T has not made the kind of impact it ought to have, possibly because the crucial role that S & T can play in planning for growth was not realised fully. It is thus necessary to integrate more systematically Science and Technology in the process of economic Planning in setting targets.

1.12.2 Agricultural & Veterinary Science

1.12.2.1 Considering that manpower having degree in Agricultural Science is already in surplus by 21.8 thousand in 1985-86 in relation to corresponding demand and this situation will persist in 2000-01 after reaching a peak of surplus by 30.5 thousand during 1990-1995, it is felt that present educational institutions for agriculture will be adequate to meet the demand upto 2000-01. However, more stress in the conversion of intake towards higher education i.e, Post graduates and Ph.Ds in Agricultural Science is to be given to meet the challenges of changing scene towards R & D and Science oriented agriculture in the future. Further adequate employment opportunities are required to be generated where present unemployed manpower is absorbed.

1.12.2.2 Agricultural extension is required to be strengthened in all future plans and decision on the nature and size of the extension organisation would determine the size of the demand for technical manpower at the block and district level from time to time.

1.12.3 Engineering & Technology

1.12.3.1 Technological advancement and expansion of activities in various sectors on the economy have led to manpower shortage in specialised

disciplines, which are bound to increase in future. Due to this reason, the shortage of E & T Degree holders has been apprehended by 33.2 thousand even in 1995-96. By 2000-01, this shortage is expected to increase to 53.6 thousand. In this context, the Seventh Five Year Plan has laid emphasis on the need for giving special attention to technical manpower needs in the new emerging areas like electronics, computer systems, nuclear science, satellite communication, bio-engineering, ocean engineering etc. Further, the increasing pace of development of knowledge all over the world is making the utility of traditional disciplines like civil, mechanical, electrical etc. more and more inadequate. Therefore, we are at a stage when further development is linked to our capability on catching up with the world in emerging areas with special reference to high technology sectors.

1.12.3.2 The educational system in electronics has so far been able to provide good graduates with adequate theoretical background but lacking in hands-on-experience. The primary lacunae in electronics education at the bachelor's level are inadequate laboratory facilities. These are too inadequate in small engineering colleges and private institutes. Also there is a wide gap in the quality of education between bachelor's degree programme and a technician's diploma programme. Post graduate programmes are small or non-existing and educational institutes are unable to attract the best talents in the field who generally go abroad. Since fresh engineers do not have enough hand-on-experience to provide adequate support at the middle level, one finds Ph.Ds sometimes doing trouble shooting repair just to keep system going. There is an urgent need to correct this deficiency in our premier institutions. The system should be modified so that greater stress is laid on practice. The degree should be given only after completion of a project that would take a year.

1.12.3.3 In telecommunication also need for augmentation of resources and

training facilities is called for in the premier institutions. Simultaneously, improvement and upgradation of skills of the existing personnel to improve their performance is also needed.

1.12.3.4 The ocean Science and Technology Board had emphasised the need for increasing the technical manpower particularly for the off shore and deep sea mining, remote sensing, ocean data processing, management of resources etc. In this connection it is necessary to create regular positions in different institutions and organisations instead of research fellowships. Permanent infrastructure could be created in the educational institutions for continuous development of manpower need for the the ocean sector.

1.12.3.5 There is need for development of manpower to design, erect, operate and maintain super-thermal power projects. The initial training of personnel has to be supplemented by in-house training to the employed personnel with a view to upgrading their skills on a continuous basis. There is an urgent need to evolve strategy for development of skilled personnel required in large numbers to man power stations. Trained manpower is required in oil refining and R & D work under the new energy sources programme pertaining to solar energy development, geo-thermal, tidal and wind energy. For atomic energy also heavy demand of skilled manpower is expected for the proposed expansion programme.

1.12.3.6 The vocational education and training courses should have adequate skill component so as to be of help to students in procuring employment in industries. There is a need for diversification into new fields in vocational training in urban and semi-urban areas. In rural areas, it has to be oriented specially to trades which have relevance like agro-based industries, rural based energy system and small industries with rural bias

1.12.4 **Medical & Para-medical**

1.12.4.1 If the existing enrolment capacity for Medical and Nursing teaching is not augmented the programme of "Health for all" by 2000 AD cannot be achieved. It is thus suggested that more stress should be given towards creation of additional capacity of enrolment in medical and nursing in general and nursing in particular.

1.12.4.2 Availability of medical and nursing services in rural areas is not at all adequate, even after creation of CHCs, PHCs and SHCs as Private practitioners are mostly urban biased. It is thus suggested that Medical Practitioners and nurses may be encouraged to set up their practice in rural areas by providing them suitable incentive like proper facilities etc.

1.12.4.3 For Para-medical teaching also, augmentation is necessary to cope up with the need.

1.12.4.4 Indian System of Medicine (ISM) and Homeopathy may be suitably developed and popularised, specially in rural area so that ISM is considered by the people as alternate source of medical facilities.

1.12.5 **General Science**

1.12.5.1 The present growth of education in general science is adequate to meet the demand of this category of personnel upto 2000 AD.

1.12.5.2 Considering the ever increasing tendency of imbalance between States in regard to the manpower need and availability of B.Sc. degree holders there is a need to augment the educational system in various States. In Gujarat, Karnataka and smaller States/UTs enrolment capacity at degree level of science is required to be augmented. In other States more stress is needed to be given to qualitative improvement ensuring properly trained manpower to cope with the technological advancement. Besides, economic planning of the States may be reoriented in such a way that the wastage of train-

ed manpower is avoided.

1.12.5.3 For M.Sc. also enrolment capacity is needed to be increased in Gujarat, Karnataka and smaller States & UTs. Besides, educational system of M.Sc. is required to be reoriented so that demand in specialised disciplines, which is bound to increase in future, is fully met. Such specialised disciplines are Geology, Marine Biology, Genetics and Plant Breeding, Bio-Chemistry, Geophysics, Applied Physics and Applied Mathematics.

1.12.5.4 In regard to Ph.D (Science), Shortage is expected in six major States namely Bihar, Gujarat, Karnataka, Kerala, Madhya Pradesh and Maharashtra as also smaller States/UTs while in Andhra Pradesh, Orissa and Uttar Pradesh surplus of manpower is expected. Considering the above, facilities of Ph.D (science) Research may be augmented in almost all the States excepting Andhra Pradesh, Orissa and Uttar Pradesh.

1.12.6 **Research & Development**

1.12.6.1 Currently India's expenditure on R & D and related S & T activities is about 1 percent of G.N.P. The rapid growth of expenditure in recent past reveals that it may grow to 2 to 3 percent of GNP by 2000-01. Considering a moderately higher growth rate of economy, (5.5 percent in 1995-96 and 6 percent in 2000-01) R & D activity is expected to provide employment to around 68.2 thousand Ph.Ds, 111.0 thousand of post graduates, 81.7 thousand graduates and 31.9 thousand Diploma holders by 2000-01.

1.12.6.2 The growth rate of expenditure on R & D in Private Sector Industries is much lower (one fourth) than that of Public Sector Industries even after providing some incentive like tax incentives in Income Tax Act, and liberalised import policies on import of equipment, Component and raw materials for the use of in house R & D in the industrial units. Although the provisional expenditure in 1986-87 shows much improvement in private sector

investment, no inference can be drawn till final figures on expenditure for 1986-87 is available.

1.12.6.3 In order to promote R & D activity in Private Sector industries, establishment of in-house R & D activity may be made compulsory for units having production valued Rs.2 crores and above and minimum allocation of funds for R & D may be fixed at 0.5 percent of the sales turnover.

1.12.6.4 Incentives may also be provided to those industrial units whose R&D achievement in terms of number of papers published or seminars attended exceeds certain minimum norms to be fixed by the Govt.

1.12.7 **Managing Brain Drain**

1.12.7.1 Since Brain Drain is considered to be a source of national loss, it will be useful to manage it in the best possible manner, both in national and international interest. Brain Drain is also in some quarters described as brain bank because this is one important way by which technologies permeate and percolate into the Indian economy. A number of those, receiving training abroad, set out enterprises in India or help other enterprises in technology transfer etc. Thus a meaningful balance has to be created between need for highly skilled Manpower in India and meeting this need by controlling emigration.

1.12.7.2 The task requires a thorough analysis of emigrants by type of skills they carry with them. Also to monitor skills available with Indians abroad so that selective reverse flows are organised.

1.12.7.3 In selective areas emigration can be restricted as has been done in case of medical personnel.

1.12.7.4 Further, greater indigenisation of professional training system in skills should be attempted so that there is greater scope for use of higher skills within the country.

1.12.7.5 Some useful schemes have been set into motion for reversing Brain Drain. These need to be strengthened. The schemes included are Scientists Pool and the Super-numerary post schemes.

1.12.7.6 A scheme for interviewing scientists abroad for possible absorption into the Indian economy has also been established with the help of UPSC. But its success is yet to be established.

* 1.12.7.7 A tax on foreign exchange release can be devised which can be varied depending upon the nature of training. The tax will be high and prohibitive if similar training is available within the country and low or nil if similar training is not available in India.

* 1.12.7.8 Arrangements can also be made with receiving countries to coordinate with India in regard to their needs for skilled and technical manpower so that sufficient number of such manpower is produced and made available to developing countries for which they can provide a subsidy to selected educational institutions.

1.12.7.9 Some of these transfers of manpower can be organised under an International Labour Compensatory facility or International Fund for Educational Training.

1.12.7.10 But before specific measures are taken in this area, considerable need for further information is felt not only in terms of number of persons emigrating or emigrated but also their qualifications, their intentions and similar other qualitative parameters. These need to be established through a number of studies in the area of skilled manpower.

1.12.7.11 Inflow and outflow of manpower phenomenon is influenced by several factors working in the world system on day to day basis. It is very important to monitor these flows on continuous basis so that necessary realignments between supply and demand are brought about as early as possible.

2. AGRICULTURE & VETERINARY SCIENCE MANPOWER

2.1 Introduction

2.1.1. As part of the study of Scientific and Technology manpower in India, the present as well as future expected situation of technical manpower having qualifications in Agriculture and Veterinary Science i.e. their availability vis-a-vis requirement have been reviewed both at the National as well as Regional levels. Future expected imbalances have also been highlighted and measures needed for correcting the imbalances have been explored. Alongwith this, their distribution by age, sex, pay range, sector and nature of work have also been examined.

2.2 Stock of Agriculture Scientists:1981

2.2.1 Based on 1981 Census data, it is estimated that the total stock of degree holders in Agriculture Science in 1981 was of the order of 1.05 lakh. State level stock for all the major States having at least 2 thousand degree holders has been presented in table 2.1. The statement reveals that majority of them were in the States of Maharashtra and Uttar Pradesh. These two States together accounted for 37.24 percent of the total stock of agricultural graduates in the country. Another 36.58 percent were accounted for by six other major States comprising of Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh and Tamil Nadu.

2.2.2 According to the 32nd Round of National Sample Survey (N.S.S.) the economically active persons' share amongst overall stock of Agriculture Science graduates was 78 percent and unemployment rate among them was 11.41 percent. Distribution of agriculture science degree holders by employment status as at the end of 1980, estimated on the basis of above has been presented in table 2.2. This shows that around 9.3 thousand agriculture science graduates were unemployed even during 1981 Census.

2.1 Stock of Degree Holders in Agriculture Science for Selected States-1981 (in '000)

Sl. No	State	Urban	Rural	Total	Percentage to Total
1.	Andhra Pradesh	3.2	2.8	6.0	5.72
2.	Bihar	1.2	5.4	6.6	6.29
3.	Gujarat	1.9	3.3	5.2	4.95
4.	Haryana	0.4	2.7	3.1	2.95
5.	Karnataka	2.6	4.5	7.1	6.76
6.	Kerala	0.5	2.4	2.9	2.76
7.	M.P.	2.1	5.4	7.5	7.14
8.	Maharashtra	4.3	14.8	19.1	18.19
9.	Orissa	1.0	1.9	2.9	2.76
10.	Punjab	1.2	1.7	2.9	2.76
11.	Rajasthan	0.7	3.4	4.1	3.91
12.	Tamil Nadu	3.3	2.7	6.0	5.72
13.	U.P.	2.0	18.0	20.0	19.05
14.	West Bengal	0.5	2.8	3.3	3.14
15.	Other States/UTs	1.6	6.7	8.3	7.90
	Total	26.5	78.5	105.0	100.00

Source:-

- (1) Urban Stock:1981 Census C.Series table
- (2) Rural Stock has been estimated on the basis of 1981 B.Series table.
- (3) Other States/UTs include Assam also. Estimated Stock based on 1971 Census has been considered for Assam.

2.2 Distribution of Agriculture Science Degree Holders by Employment Status:1981

Sl. No.	Employment Status	Percentage	Nos. (in'000)
1.	Stock	100.0	105.0
2.	Economically active	78.0	81.9
	(i) Unemployed	8.9	9.3
	(ii) Employed	69.1	72.6
3.	Out of labour force (Not seeking employment)	22.0	23.1

2.2.3 Distribution of Stock of agriculture Scientists, as at the beginning of 1980 by level of education, estimated on the basis of estimated stock in each level based on annual outturns of corresponding level of degree holders from 1950 to 1980, annual outturns/expected outturns of next higher level of degree holders from 1952-53 to 1982-83 and depletion of 3 percent of the previous stock due to death, retirement etc. is presented in table 2.3. Of the total agriculture scientists, 76.48 percent were B.Sc. degree holders, 20.57 percent M.Sc. degree holders and only 2.95 percent Ph.D. degree holders. Out of employed Agricultural Scientists in 1980, 75.83 percent were B.Sc. degree holders, 20.95 percent M.Sc. and 3.22 percent Ph.D. degree holders.

2.3 Distribution of Stock of Agriculture Scientists by Level of Education:1981 (in'000)

Level of Education	Stock		Economically Active		Employed	
	Tot- al	Per- centage	Tot- al	Per- centage	Tot- al	Per- centage
Ph.D	3.1	2.95	2.4	2.93	2.34	3.22
M.Sc.	21.6	20.57	16.9	20.63	15.21	20.95
B.Sc.	80.3	76.48	62.6	76.44	55.06	75.83
Total	105.0	100.00	81.9	100.00	72.61	100.0

2.2.4 Distribution of employed agriculture science degree holders by Sectors as on 1981 beginning estimated on the basis of 1981 census, is presented in table 2.4. It would be seen that 27.8 percent of them were directly employed in the agriculture sector. However, the largest share of (46.4 %) employment of Agriculture Scientists is accounted for by other services which included education, R & D and Government developmental work. Another major sector was Trade and Commerce which provided employment to 18.6 percent of the agriculture scientists. Manufacturing sector also provided sizeable employment (5.1 percent) to this category of manpower.

2.4 Distribution of Employed Agriculture Science Degree Holders in Different Sectors-1981

Sl. No.	Sector	Degree Holders (in'000)	Percentage share
1.	Agriculture	20.2	27.8
2.	Mining	0.1	0.1
3.	Manufacturing	3.7	5.1
4.	Construction	0.2	0.3
5.	Trade & Commerce	13.5	18.6
6.	Transport	1.2	1.7
7.	Others	33.7	46.4
	Total	72.6	100.0

2.3 Updated Stock of Agriculture Scientists : 1985

2.3.1 Updated stock of Agriculture Scientists for the year 1985 has been estimated on the basis of base stock in 1981 (beginning), annual expected outturn from 1981 to 1985 and assumed depletion of the rate of 3 percent of previous stock. For example the updated stock of rth year is obtained with the help of following formula -

$$S_r = S_{r-1} - 3\% \text{ of } S_{r-1} + O_r$$

where S_r = estimate of stock of rth year
 S_{r-1} = stock/estimated stock of (r-1)th year
and, O_r = outturn/expected outturn of rth year
Expected outturn of a year is obtained from enrolment/estimated enrolment during the year and enrolment/output ratio realised during recent past.

2.3.2 In Eight leading States which accounted for 77.5 thousand degree holders in Agriculture Science in 1981, updated stock in 1985 increased to 106.1 thousand. Their share in total stock of agriculture science graduates increased from 73.77 percent to 74.67 percent. The share of Uttar Pradesh increased from 19 percent to 24.6 percent while that of Maharashtra decreased from 18.2 percent to 16.2 percent during the same period.

**2.5 Updated Stock of Degree Holders
in Agricultur Science in 1985
for Selected States**

(in'000)

Sl. State No	Base Stock 1981 beginning	Updated Stock 1985	Growth rate(%)
1. Andhra Pradesh	6.0	7.7	5.1
2. Bihar	6.6	7.2	2.1
3. Gujarat	5.2	6.2	3.6
4. Haryana	3.1	4.7	8.7
5. Karnataka	7.1	9.9	6.9
6. Kerala	2.9	3.5	3.8
7. Madhya Pradesh	7.5	9.6	5.1
8. Maharashtra	19.1	23.0	3.8
9. Orissa	2.9	3.9	6.1
10. Punjab	2.9	4.4	8.7
11. Rajasthan	4.1	5.2	4.9
12. Tamil Nadu	6.0	7.6	4.8
13. Uttar Pradesh	20.0	34.9	11.8
14. West Bengal	3.3	4.8	7.8
15. Other States/ Uts	8.3	9.5	2.7
Total	105.0	142.1	6.2

2.3.3 Reviewing the availability of agriculture Scientists as on 1981 in comparison to cultivated area, it is observed that in smaller states and U.Ts, for every ten thousand hectares of cultivated area, 14.25 persons were available. Similarly in the States of Kerala, Uttar Pradesh, and Maharashtra 12.91, 10.86 & 10.02 persons respectively were available per ten thousand hectares. In other States, availability was low, ranging from 2.35 persons in Rajasthan to 8.23 persons in Haryana. In 1985, situation improved in all the States/UTs. During this period at the national level, availability improved from 6.76 persons to 9.11 persons per ten thousand hectares of cultivated area. Maximum improvement in situation was observed in Uttar Pradesh where per ten thousand hectares of cultivated area, availability improved from 10.86 to 18.98 persons. The improvement in Haryana is also worth noting where availability improved from 8.23 to 12.43 agriculture scientists per ten thousand hectares of cultivated area.

**2.6 Availability of Agriculture
Scientists per Ten Thousand Hectares
of Cultivated Area for Selected States
during 1981 and 1985 (in Nos)**

Sl.No.	State	1981	1985
1.	Andhra Pradesh	4.42	5.67
2.	Bihar	6.50	7.48
3.	Gujarat	5.18	5.99
4.	Haryana	8.23	12.43
5.	Karnataka	6.29	8.54
6.	Kerala	12.91	15.67
7.	Madhya Pradesh	3.81	4.77
8.	Maharashtra	10.02	12.08
9.	Orissa	4.37	5.96
10.	Punjab	6.85	10.36
11.	Rajasthan	2.35	2.96
12.	Tamil Nadu	7.98	10.60
13.	Uttar Pradesh	10.86	18.98
14.	West Bengal	5.96	8.27
15.	Other States/UTs	14.25	15.96
	Overall	6.76	9.11

Source: 1) For cultivated Area (Net sown Area + current Fallow) Economic & Statistical Advisor - Ministry of Agriculture.

(2) For Population 1981 Census + GR of population - Registrar General of India.

**2.4 Projected Stock of Agriculture
Scientists upto 2000 AD.**

2.4.1 Projected Stock of Agriculture Scientists by level of degree, upto 2000 AD. has been estimated on the basis of base stock for 1980, annual expected outturns in each level from 1985 to 2000, annual expected outturns in the next higher level from 1987-88 to 2001-2 and assumed depletion rate of 3 percent of the previous stock. The method applied for estimation is the same as that of combined Agriculture Science degree holders. But here, outturn has been adjusted considering the expected outturns in the next higher degree out of them. Projected stock of future years has been presented in table 2.7. It would be seen that the average growth rate of stock of Agriculture Scientists during 1985 to 2000 is expected to be 3.2 percent, while that of Ph.D (Agri.) will be 5.1 percent, M.Sc. (Agri.) 4.5 percent and B.Sc. (Agri.) 2.7 percent.

2.7 Projected Stock of Agriculture Scientists by Level of Degree upto 2000
(in '000)

Sl. No.	Level of Degree	Projected Stock at the end of				G.R% 2000
		1985	1990	1995	2000	
1.	Ph.D	4.73	6.32	8.16	9.89	5.1
2.	M.Sc.	31.50	41.65	51.54	61.18	4.5
3.	B.Sc.	105.87	127.63	144.90	158.33	2.7
Total		142.10	175.60	204.60	229.40	3.2

2.8 Projected Stock of Degree Holders in Agriculture Science for the Years 1990,1995,2000 (in'000)

Sl. No.	State	Projected Stock at the end of		
		1990	1995	2000
1.	Andhra Pradesh	9.3	10.7	11.9
2.	Bihar	7.8	8.3	8.7
3.	Gujarat	7.1	7.9	8.6
4.	Haryana	6.2	7.5	8.6
5.	Karnataka	12.5	14.6	16.5
6.	Kerala	4.2	4.8	5.3
7.	Madhya Pradesh	11.3	12.8	14.1
8.	Maharashtra	26.5	29.6	32.2
9.	Orissa	4.7	5.4	6.0
10.	Punjab	5.8	7.1	8.1
11.	Rajasthan	6.3	7.2	8.0
12.	Tamil Nadu	9.1	10.4	11.6
13.	Uttar Pradesh	48.1	59.5	69.3
14.	West Bengal	6.0	7.1	8.0
15.	Other States/UTs	10.7	11.7	12.5
Total		175.6	204.6	229.4
Growth Rate(%/annum)		*4.3	3.1	2.3

* During 1985-90

2.4.2 As against the updated stock of 1.42 lakh of graduates and post graduates in Agriculture Science in 1985 the projected stock estimated on the basis of annual expected outturns upto 2000 and assumed depletion rate of 3 percent of the previous stock for 2000 AD, is expected as 2.29 lakh showing an annual

growth rate of 3.2 percent during 1985 to 2000, the growth rate during 1985-90, 1990-95,1995-2000 being 4.3, 3.1 and 2.3 percent respectively. The main reason for decreasing trend in growth rate is the continuous increase in attrition while outturn remaining constant at that of 1985.

2.5 Estimated Requirement of Agriculture Scientists Upto 2000-01

2.5.0 Baseline data on employment as per 1981 Census has been taken as the requirement for the financial year 1980-81 as no significant addition in employment was expected during the intervening period (which was hardly one month). Moreover, all the statistical data on G.D.P, Investment etc. are available for financial year. Taking the above points into consideration, all future requirements of S&T manpower have been estimated for financial years. As regards stock of Scientific and Technical manpower, baseline stock and future outturns available from UGC fact books related to the end of the respective calendar year. Even the stock as available for 1981 census related to the position as at the end of 1980 as results of Universities/Institutions are normally not published during January and February. In order to have a comparative picture of demand and supply of S&T manpower it is assumed that the requirement of personnel for 1980-81 was to be met by the S&T manpower available during 1980-81 which was the same as available at the end of 1980. For future demand and supply balance also, comparison has accordingly been made for the stock of 1985, 1990, 1995 and 2000 with the requirements of 1985-86, 1990-91, 1995-96 and 2000-01 respectively.

Requirements of Agriculture Scientists for future years upto 2000-01 have been estimated at three scenarios by adopting three different methods viz (i) Output method (ii) Investment method and (iii) Manpower norms.

**2.5.1 Employment at Scenario-I
(by Output Method)**

2.5.1.1 Employment output co-efficients for different sectors of economy for the year 1980-81 have been estimated on the basis of Gross Domestic Product of the year at Factor Cost at

1970-71 prices for each sector and number of Agriculture Scientists engaged in the year in the Corresponding Sector. For subsequent years these norms have been suitably modified taking into account annual growth of per capita income due to expected growth of national income in future and presented in Table 2.9(a).

2.9(a) Employment Output Co-efficients

Sector	Requirement Per one thousand Crore of Output				
	1980-81	1985-86	1990-91	1995-96	2000-01
Agriculture	1.0142773	0.9881743	0.8788702	0.7816524	0.6951921
Mining & Quarrying	0.1645338	0.1593317	0.1558846	0.1526717	0.1428903
Industry	0.4695259	0.4609081	0.412431	0.3676761	0.328658
Construction	0.873363	0.0806776	0.0745156	0.0688231	0.0635727
Trade & Commerce	1.4403913	1.4375484	1.2819619	1.1391191	1.0178465
T & C	0.3537735	0.3501864	0.324939	0.2774092	0.2506938
Others	5.0942028	5.088972	4.5520292	4.0424037	3.603949

2.5.1.2 Applying the employment norms for different sectors during different years on the estimated GDP at factor cost for the corresponding year (as presented in Annexure 2.1), estimated requirements of Agriculture Science degree holders have been worked out and presented in 2.9(b).

2.9(b) Requirement of Agriculture Scientists during 1985-86 to 2000-01 at Scenario-I (in '000)

Sl. Sector No.	Estimated Requirement			
	1985-86	1990-91	1995-96	2000-01
1. Agriculture	24.4	26.2	28.1	30.4
2. Mining & Quarrying	0.1	0.2	0.3	0.4
3. Industry	5.4	7.1	9.3	12.2
4. Construction	0.2	0.2	0.2	0.2
5. Trade & Commerce	16.7	18.4	20.2	22.3
6. T & C	1.6	2.0	2.3	2.8
7. Others	44.9	53.5	63.3	75.2
Total	93.3	107.6	123.7	143.5
Growth Rate	-	2.9	2.8	3.0

**2.5.2 Employment at Scenario-II
(by Investment Method)**

2.5.2.1 Sector wise norms of outlay per standard person year of envisaged employment generation for the country as a whole has been worked out for the year 1985-86 on the basis of total plan outlays and corresponding envisaged employment generation during the plan period. For other years, norms have been suitably modified taking into consideration annual growth in per capita income due to expected growth of national income in future and are presented below in Table 2.10(a).

2.10(a) Sector wise norms of employment Generation during 1980-81 to 2000-01 at Scenario-II

Sector	Norms of Outlay (in Rs. at 1987-88 Constant Prices per Standard person year)				
	1980-81	1985-86	1990-91	1995-96	2000-01
Agriculture	10646	11496	12414	13405	14475
Mining & Manufacturing	115997	125255	135252	146047	157703
Transport	13254	14312	15454	16688	18020
Others	68009	73460	79340	85708	92577

2.5.2.2 Annual addition to total employment in each sector for 1985-86, 1990-91, 1995-96 and 2000-01 has been worked out taking into view (i) total investment/estimated investment during the year, (ii) norms of employment generation, (iii) Success rate realised during 1980-81 to envisaged employment applying the formula.

$$\begin{aligned} & \text{[Estimated Investment for the year]} \\ & \times \text{[Success rate realised envisaged employment during 1980-81]} \end{aligned}$$

Estimated employment for a year = $\frac{\text{Norms of Outlay per standard person year for the year}}{\text{Success rate realised envisaged employment during 1980-81}}$

2.5.2.3 Annual addition to requirement of Agriculture Science degree holders have been estimated from the addition in total employment during the corresponding year and expected share of Agriculture Science degree holders to total employment during the respective year. Average of estimates of investment, based on 5 percent & 8 percent growth rates, have been considered as future estimated investment for this purpose. Future requirement of Agriculture Science degree holders have been estimated from the base year's requirement and addition to requirement during intervening period.

2.5.2.4 Total requirements of Agriculture Scientists worked out by adopting Investment approach during 1985-86, 1990-91 and 1995-96 and 2000-01

are presented in Table 2.10(b).

2.10(b) Requirement of Agriculture Scientists during 1985-86 to 2000-01 at Scenario - II (in '000)

Sl. No.	Sector	Estimated Requirement			
		1985-86	1990-91	1995-96	2000-01
1.	Agriculture	22.6	26.0	31.0	37.9
2.	Mining & Quarrying and Manufacturing	4.6	5.9	7.6	10.1
3.	Transport	1.4	1.7	2.2	2.8
4.	Others	55.7	67.8	85.7	112.0
	Total	84.3	101.4	126.5	162.8
	G.R	x	3.8	4.4	5.2

2.5.3 Employment by Scenario-III. (by Manpower Norms Method)

2.5.3.1 The growth rates of employment for different Sectors as envisaged by the Planning Commission for the Seventh Plan Period, are expected to be realised upto the end of the century. Overall employment for future years have accordingly been estimated first. By relating the overall employment of degree holders in Agriculture Science with the total estimated employment in different Sectors estimated requirements of degree holders in Agriculture Science have been estimated for 2000-01 and are presented in table 2.11.

2.11 Requirement of Agriculture Scientists during 1985-86 to 2000-01 at Scenario - III (in '000)

Sl. No.	Sector	Estimated Requirement			
		1985-86	1990-91	1995-96	2000-01
1.	Agriculture	24.0	28.5	33.8	40.1
2.	Mining & Quarrying	0.1	0.2	0.2	0.3
3.	Manufacturing	4.6	5.8	7.2	9.0
4.	Construction	0.2	0.3	0.4	0.4
5.	Trade & Commerce	16.9	21.2	26.5	33.2
6.	T & C	1.5	1.8	2.3	2.8
7.	Others	42.2	52.8	66.2	82.8
	Total	89.5	110.6	136.6	168.6

2.5.3.2 In order to have a comparative study of the estimated requirements of agricultural Scientists, obtained by three different scenarios, the average estimates of all the three estimates have been presented in table 2.12. It is observed that output method showed higher estimate in 1985-86. In 1990-91 manpower norms showed higher estimate. By 2000-01, the divergence between these estimates is from 143.5 thousand to 168.6 thousand. Considering the above, average of all the three types of estimates are felt as more realistic estimates. Thus, requirement of this category of manpower is expected to increase from 89 thousand in 1985-86 to 158.3 thousand by 2000-01 showing an overall growth of manpower of agriculture scientists by 77.87 percent during this period (i.e at an annual growth of 3.91 percent).

2.12 Requirement of Agriculture Scientists during 1985-86 to 2000-01 at different Scenarios

(in'000)

Sl. Scenario No.	Estimated Requirement			
	1985-86	1990-91	1995-96	2000-01
1. Scenario-I	93.3	107.6	123.7	143.5
2. Scenario-II	84.3	101.4	126.5	162.8
3. Scenario-III	89.5	110.6	136.6	168.6
Average	89.0	106.5	128.9	158.3
Growth rate(%)	x	3.66	3.89	4.19

2.6 Demand Supply Balance

2.6.1 As has already been observed, growth rate of estimated stock is 2.7 percent per annum whereas the growth rate of estimated requirement is 3.2 percent. Consequently the existing rate of unemployment of Agriculture Scientists which is of the order of

19.68 percent in 1985-86 is expected to decline considerably by 2000-01. Table 2.11 presents employment distribution of this category of manpower upto 2000 AD. It would be seen from the table that the magnitude of unemployment which was of the order of 21.8 thousand in 1985-86, will show increasing trend upto 1990-91 but will stabilise during 1990-96. Thereafter unemployment will decline slowly to 20.6 thousand by 2000-01. The rate of unemployment will, however, show an increasing trend upto 1990-91 and thereafter a declining trend. By 2000-01, it will reduce to 11.51 percent.

2.13 Employment Situation of Agricultural Scientists During 1985-86 to 2000-01 (in '000)

Year	Stock	Require-ment	Sur- plus (+) Short- age(-)	Rate of unemp-loyment (%)	
1985-86	142.1	110.8	89.0	(+)21.8	19.68
1990-91	175.6	137.0	106.5	(+)30.5	22.26
1995-96	204.6	159.6	128.9	(+)30.7	19.24
2000-01	229.4	178.9	158.3	(+)20.6	11.51

2.7 Age Structure

2.7.1 Majority of Agriculture Science degree holders were below the age of 40 years. Such graduates accounted for 68.8 percent of all employed graduates comprising of 26.72 percent in age-group of less than 30 years and 42.08 percent in age group of 30 to 40 years. This shows that most of the agriculture science graduates are younger in age. Arising from retirement and attrition in Public sector as well as enhancement in requirement of technical manpower due to speedy growth of economy, there is predominance of younger graduates.

2.14 Distribution of Agriculture Science Degree Holders by Age Group-1981
All India and Selected States (in percent)

Sl. No.	Selected States	Age Group (in years)					Total
		Below 30	30-40	40-50	50-60	60 +	
1.	Andhra Pradesh	24.48	38.47	28.66	7.76	0.63	100.0
2.	Bihar	17.82	42.33	30.11	9.66	0.08	100.0
3.	Gujarat	29.66	47.89	17.05	4.56	0.84	100.0
4.	Haryana	24.46	51.59	18.35	5.00	0.60	100.0
5.	Karnataka	22.77	42.57	26.01	8.43	0.22	100.0
6.	Kerala	28.48	34.51	30.56	6.45	-	100.0
7.	Madhya Pradesh	25.89	41.23	22.45	10.08	0.35	100.0
8.	Maharashtra	28.87	39.92	20.95	8.88	1.38	100.0
9.	Orissa	25.69	51.16	14.55	8.60	-	100.0
10.	Punjab	36.81	47.11	11.39	3.90	0.79	100.0
11.	Rajasthan	28.54	46.02	20.58	3.11	1.75	100.0
12.	Tamil Nadu	31.30	33.03	24.26	7.04	4.37	100.0
13.	Uttar Pradesh	21.45	44.41	22.98	8.49	2.67	100.0
14.	West Bengal	15.43	54.27	20.94	6.61	2.75	100.0
15.	Delhi	19.18	42.01	25.00	12.07	1.74	100.0
16.	Other States/UTs.	31.76	41.14	22.21	4.57	0.32	100.0
	All India	26.72	42.08	23.07	7.58	0.55	100.0

Source: 1981 Census

2.8 Distribution by Main Branches

2.8.1 By main branches about 75.0 percent of agriculture science

graduates were engaged in agronomy and about 6.8 percent in areas like agrochemistry, agroengineering, dairying and fishery and about 18.2 percent in other agriculture branches.

2.15 Distribution of Agriculture Science Degree Holders by Main Branches(Selected States):1981 (in percent)

Sl. No.	States	Share					Total	
		Agro-nomy	Agro-Chemistry	Agro. Engg.	Dairy-ing	Fishery		Others
1.	Andhra Pradesh	78.05	1.52	0.80	1.45	1.38	16.80	100.0
2.	Bihar	73.51	2.55	0.95	1.95	1.20	19.84	100.0
3.	Gujarat	76.00	2.74	0.70	2.06	1.40	17.10	100.0
4.	Karnataka	79.05	2.24	0.81	1.40	1.08	15.42	100.0
5.	Kerala	74.06	2.75	0.66	1.56	1.97	19.00	100.0
6.	Maharashtra	76.05	2.51	0.65	2.01	2.40	16.38	100.0
7.	Orissa	75.04	1.26	0.54	1.96	2.10	19.10	100.0
8.	Rajasthan	75.00	2.64	0.86	1.98	1.00	18.52	100.0
9.	Tamil Nadu	70.05	2.95	0.83	2.00	2.35	21.82	100.0
10.	Uttar Pradesh	72.50	2.66	0.68	1.98	1.20	20.98	100.0
11.	Others States/UTs	76.04	2.53	0.60	1.96	2.38	16.49	100.0
	All India	75.01	2.47	0.73	1.81	1.81	18.17	100.0

Source: DHIP Survey Report, 1981

2.9 **Important Characteristics for Selected States**

2.9.1 Of the total agriculture scientists, share for Ph.Ds. is high at 5.25 percent in Karnataka followed by Kerala (4.20 percent), Orissa and Andhra Pradesh (3.1 percent each) and Maharashtra (2.29 percent). Few had

M.Phil degree. 32.1 percent of agriculture scientists in Orissa had post-graduate degree followed by 23.7 percent in Kerala, 20.1 percent in Maharashtra & Andhra Pradesh each, 19.2 percent in Bihar and 17.5 percent in Karnataka. Graduates accounted for 60 to 75 percent in these states. Under graduate diploma holders were very few, most of agriculture scientists being graduates.

2.16 **Distribution of Agriculture Science Manpower by Level of Education-1981(All India and selected States) (in percent)**

Level of education	A.P	Bihar	Karna-taka	Kerala	Mahara-shtra	Orissa	All-India
Ph.D	3.10	1.26	5.25	4.20	2.29	3.10	3.88
M.Phil	0.00	0.00	0.12	0.30	0.02	0.00	0.11
P.G.Degree	20.12	19.19	17.50	23.72	20.14	32.10	21.75
P.G.Diploma	1.20	0.63	3.00	1.80	0.28	1.91	0.87
Graduate	74.47	71.46	73.25	66.97	74.62	59.71	70.66
Equal to Graduate	0.00	0.50	0.37	0.30	0.30	0.00	0.28
U.G.Diploma	0.30	6.44	0.37	2.10	1.82	2.11	1.95
U.G.Certificate	0.00	0.50	0.00	0.30	0.42	0.60	0.41
Not given	0.81	0.02	0.14	0.31	0.11	0.47	0.09
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: DHIP Survey Report , 1981

2.9.2 As in age distribution of agriculture science manpower, by experience also it was similar with considerable variation. Those having an experience of less than 10 years accounted for over 40 percent of Agriculture Science Manpower in

Kerala and Orissa, between 35 to 40 percent in Maharashtra and Andhra Pradesh and between 28 to 33 percent in Bihar and Karnataka. Those with more than 25 years experience accounted for small proportion of about 4 to 5 percent in most of the States.

2.17 **Distribution of Agriculture Science Manpower by Experience - 1981 (Selected States) (in percent)**

Experience in Years	Andhra Pradesh	Bihar	Karna-taka	Kerala	Mahara-shtra	Orissa	Average
Below 5	16.76	16.66	17.40	23.61	15.07	22.10	17.00
5 - 10	18.54	12.69	15.50	19.10	21.07	18.32	18.20
10 - 15	11.43	10.55	17.56	6.94	15.74	17.36	14.24
15 - 20	9.46	16.97	9.01	12.84	9.02	16.39	11.00
20 - 25	4.73	7.64	5.53	13.19	4.53	3.21	5.60
25 - 30	2.10	4.74	2.21	4.17	1.67	2.57	2.49
30 & above	1.87	1.07	1.74	0.69	1.57	0.96	1.47
Not given	35.11	29.68	31.05	19.46	31.33	19.09	30.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
N	3330	3270	4000	1440	9094	1655	22789

Source: DHIP Survey Report, 1981

2.9.3 The share of employed among Agriculture Science Manpower was high at 93.3 percent in Orissa followed by 84.7 percent in Kerala, 80.9 percent in Bihar, 73.8 percent in Andhra Pradesh, 71.5 percent in Karnataka and 71 percent in Maharashtra. Self employed were more in Karnataka and Maharashtra at about 8 percent. Share of unemployed was high at 16.5 percent in Andhra Pradesh, over 11 percent in Bihar, Maharashtra and Madhya-Pradesh, over 9 percent in Kerala and less than 5 percent in Kerala and Orissa.

**2.18 Distribution of Agriculture Science Manpower
by Present Employment Status (Selected States)
(in percent)**

Present Emplo- ment Status	Andhra Pradesh	Bihar	Karnataka	Kerala	Maharashtra	Orissa	Average
Employed	73.82	80.93	71.50	84.68	71.00	93.30	75.33
Self-employed	2.40	1.64	7.50	1.80	7.93	0.60	5.22
Student	2.80	3.54	3.62	3.30	3.10	3.92	3.33
Trainee	1.05	0.37	0.25	0.60	0.52	0.00	0.50
Apprentice	0.30	0.00	0.12	0.00	0.51	0.00	0.30
Retired	2.10	0.63	5.75	2.40	2.33	0.00	2.50
Unemployed	16.51	11.10	9.25	4.50	11.44	1.81	10.60
Others	0.00	0.00	0.37	0.30	0.32	0.00	0.21
Not Given	1.02	1.79	1.64	2.42	2.85	0.37	2.01
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
N	3330	3270	4000	1440	9094	1655	22789

Source: DHP Survey Report, 1981

2.9.4 By salary status, almost 50 percent were getting less than Rs.1500. Those drawing more than Rs. 2500 were very few in Andhra Pradesh, Bihar, Kerala, and Orissa. In Maharashtra and Karnataka however, their share was about 2 percent.

**2.19 Distribution of Agriculture Science Manpower by Salary Status
(in percent)**

Salary Status (In Rs.)	Andhra Pradesh	Bihar	Karna- taka	Kerala	Mahara- shtra	Orissa	Average
Below 1000	9.95	34.99	13.60	22.22	31.77	35.28	25.51
1000 -1500	40.92	29.35	33.06	29.19	25.64	34.40	30.57
1500 -2000	21.79	13.60	24.20	24.30	9.88	9.74	15.57
2000 -2500	6.50	1.98	6.64	6.60	4.40	4.50	4.90
2500- 3000	0.39	0.00	1.42	0.69	1.12	0.64	0.84
3000 -4000	0.19	0.15	0.60	0.68	0.45	0.08	0.38
4000 -5000	0.19	0.00	0.15	0.00	0.09	0.00	0.09
5000 & above	1.18	0.00	0.15	0.00	0.20	0.00	0.28
Not given	18.89	19.93	20.18	16.32	26.45	15.36	21.86
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
N	3330	3270	4000	1440	9094	1655	22789

Source: DHP Survey Report, 1981

2.10 Veterinary Science Manpower

2.10.1 National level stock of veterinary scientists at the end of 1980, estimated on the basis of year wise outturn of Veterinary Science degree holders since 1950 (as available in the U.G.C. Report), has been presented in table 2.20. It would be seen that at 1980 end, total stock of Veterinary Science degree holders was of the order of 20.9 thousand, out of which 17.38 thousand were having B.VSc. degree, 2.98 thousand M.VSc. degree and only 5.5 hundred Ph.D degree.

2.20 Stock of Degree Holders in Veterinary Science at the end of 1980 by Level of Degree

Sl. No.	Level of Degree	Stock at the end of 1980 (in '00)	Percentage to total
1.	B.VSc.	173.8	83.12
2.	M.VSc.	29.8	14.25
3.	Ph.D	5.5	2.63
Total		209.1	100.00

Note:-

1. Stock had been estimated on the basis of corresponding outturn data from 1950 to 1979 and enrolment data for 1980 as available from U.G.C. report "University Development in India. Part-II" and enrolment figures for 1980.

2. Stock of 1980 end as estimated by U.G.C. was 19755.

3. Planning Commission stock estimated at the beginning of 1980 was 22.3 thousand.

2.10.2 As per 32nd Round NSS data 86.89 percent Veterinary Scientists were economically active and amongst them only 0.02 percent were unemployed. Thus at 1980 end, employment situation of veterinary scientists was as per table 2.21.

2.21 Distribution of Veterinary Science Degree Holders by Employment Status:1980

Employment Status	Degree Holders	
	Percentage	Nos. ('00)
1. Stock	100.00	209.1
2. Economically active	86.89	181.7
3. Employed	86.87	181.7

2.10.3 Stock of veterinary scientists for selected States, as at the end of 1980, estimated from 1981 census data has been presented in table 2.22. The statement reveals that out of 20.9 thousand veterinary scientists, Tamil Nadu and Andhra Pradesh alone accounted for 6.32 thousand, occupying more than 30 percent of the total stock. Other major States were Bihar, Karnataka, Madhya Pradesh, Maharashtra, Orissa and Uttar Pradesh. These six States together accounted for 87.7 thousand, occupying another 41.92 percent of the total degree holders. Statewise distribution shows that there was too much imbalance between States. The share of degree holders varied from as low as 1.34 percent in Haryana to as high as 16.88 percent in Tamil Nadu.

2.22 Stock of Veterinary Science Degree Holders for Selected States:1980 End

Sl. No.	States/UTs.	Stock in (in '00)	Percentage to total
1.	Andhra Pradesh	27.9	13.34
2.	Bihar	13.3	6.36
3.	Gujarat	9.3	4.45
4.	Haryana	2.8	1.34
5.	Jammu & Kashmir	5.2	2.49
6.	Karnataka	18.0	8.61
7.	Kerala	8.9	4.26
8.	Madhya Pradesh	12.4	5.93
9.	Maharashtra	19.1	9.13
10.	Orissa	11.7	5.59
11.	Punjab	8.9	4.26
12.	Rajasthan	5.5	2.63
13.	Tamil Nadu	35.3	16.88
14.	Uttar Pradesh	13.2	6.31
15.	West Bengal	8.4	4.02
16.	Other States/UTs	9.2	4.40
Total		209.1	100.00

Note: State Level Stock has been estimated on the basis of 1981 Census data.

2.10.4 Distribution of employed veterinary scientists by sector as at 1980 end, presented in table 2.23 shows that 17.7 percent of them were employed in Agriculture sector, 2.9 percent in manufacturing sector, 1.1 percent in trade and commerce and the remaining 78.3 percent were in services sector which included veterinary services, teaching, R & D and Government developmental work.

2.23 Distribution of Employed Veterinary Scientists by Sector:1980

Sl. Sector No.	Total Employed ('00)	Percentage to total
1. Agriculture	32.1	17.67
2. Manufacturing	5.2	2.86
3. Trade & Commerce	2.1	1.15
4. Other Services	142.3	78.32
Total	181.7	100.00

2.10.5 It may be seen from table 2.24 that against the stock of 20.91 thousand veterinary doctors in 1981, there were little over 30 thousand Veterinary Asstts.

2.24 Stock of Veterinary Assistants in Major States:1981(Nos)

Sl.No.States/UTs	Veterinary Asstts. Nos.	Percentage to total
1. Andhra Pradesh	1908	6.24
2. Bihar	2131	6.98
3. Gujarat	746	2.44
4. Haryana	903	2.95
5. Karnataka	1193	3.90
6. Kerala	841	2.75
7. Madhya Pradesh	3393	11.11
8. Maharashtra	1971	6.45
9. Orissa	3564	11.66
10. Punjab	1664	5.44
11. Rajasthan	1089	3.56
12. Tamil Nadu	3589	11.74
13. Uttar Pradesh	1571	5.14
14. West Bengal	1333	4.36
15. Other States/UTs	4670	15.28
India	30566	100.00

Source: 1981 Census

2.25 Updated Stock of Degree Holders in Veterinary Science for Selected States : 1985 End

Sl. State No.	Stock (in '00)		Percentage to total
	Base Year 1980	Updated Stock 1985	
1. Andhra Pradesh	27.9	30.2	11.83
2. Bihar	13.3	16.4	6.42
3. Gujarat	9.3	10.4	4.07
4. Haryana	2.8	8.2	3.21
5. Jammu & Kashmir	5.2	4.5	1.76
6. Karnataka	18.0	22.1	8.66
7. Kerala	8.9	10.3	4.03
8. Madhya Pradesh	12.4	15.9	6.23
9. Maharashtra	19.1	26.9	10.54
10. Orissa	11.7	13.2	5.17
11. Punjab	8.9	11.7	4.58
12. Rajasthan	5.5	8.3	3.25
13. Tamil Nadu	35.3	38.0	14.89
14. Uttar Pradesh	13.2	19.7	7.72
15. West Bengal	8.4	11.6	4.55
16. Other States/UTs	9.2	7.9	3.09
Total	209.1	255.3	100.00
G.R(%)		4.1	

Note: Stock has been updated with the help of state wise enrolment data from 1980-81 to 1982-83 as available in UGC report, "University Development in India, Part-I" and enrolment outturn ratio during last five years. As enrolment data from 1983-84 onwards are not available, expected enrolment during these years also have taken as same as that of 1982-83.

2.10.6 Updated stock for 1985 for selected States has been estimated on the basis of base stock as in 1980, enrolment data during 1980-81 to 1982-83 and enrolment outturn ratio realised in the recent past by applying the same method as had been done for Agriculture Science manpower (vide para 2.3.1) and presented in table 2.25. The statement reveals that updated stock at the end of 1985 was 25.53 thousand as against 20.91 thousand of 1980. Overall growth of stock during this period was 22.1 percent. As migration for employment from one State

to another has not been considered (due to non-availability of information), the stock of Jammu & Kashmir and other small States/UTs, appears to have declined due to attrition. The interstate imbalance has shown a tendency of narrowing down.

2.10.7 Projected stock of Veterinary Science degree holders by level of degree has been estimated on the basis of base stock of 1980, estimated outturns from 1980 to 2000, annual expected outturns in the next higher level from 1987-88 to 2001-02 and annual depletion at the rate of 3 percent of the previous stock. The method of estimation was the same as that for projection of future stock of agriculture science degree holders vide para 2.4.1.

2.10.8 As against the updated stock of 25.53 thousand degree holders in Veterinary Science in 1985, the projected stock by 2000 is expected to increase to 37.38 thousand. Corresponding increase in stock of Ph.D, M.VSc. & B.VSc. in Veterinary Science will be from 9.4 hundred to 18.2 hundred, 3.84 thousand to 6.1 thousand and 20.75 thousand to 29.46 thousand respectively.

2.26 Projected Stock of Veterinary Scientists by Level of Education 1985 to 2000

(in '00)

Sl. No.	Level of Education	1985	1990	1995	2000
1.	Ph.D.	9.4	12.8	15.7	18.2
2.	M.VSc.	38.4	47.1	54.6	61.0
3.	B.VSc.	207.5	241.1	269.7	294.6
Total		255.3	301.0	340.0	373.8
G.R(%)		-	3.3	2.5	1.9

2.26(a) Distribution of stock Veterinary Scientists by Level of Education 1985 to 2000

(in percent)

Sl. No.	Level of Education	1985	1990	1995	2000
1.	Ph.D.	3.68	4.25	4.62	4.87
2.	M.VSc.	15.04	15.65	16.06	16.32
3.	B.VSc.	81.28	80.10	79.32	78.81
Total		100.00	100.00	100.00	100.00

2.10.9 Statewise projected stock of degree holders in Veterinary Science presented in table 2.25 shows that by 2000 AD the magnitude of interstate imbalance will further increase.

2.27 Projected Stock of Veterinary Science Degree Holders in Selected States at the end of 1990, 1995, 2000 (in '00)

Sl. No.	State	Projected Stock at the end of		
		1990	1995	2000
1.	Andhra Pradesh	33.9	37.1	39.9
2.	Bihar	19.9	22.9	25.5
3.	Gujarat	11.6	12.7	13.6
4.	Haryana	14.0	19.0	23.3
5.	Jammu & Kashmir	3.9	3.3	2.8
6.	Karnataka	24.8	27.2	29.2
7.	Kerala	11.8	13.0	14.1
8.	Madhya Pradesh	18.4	20.5	22.3
9.	Maharashtra	34.2	40.4	45.8
10.	Orissa	14.6	15.8	16.9
11.	Punjab	15.5	18.8	21.6
12.	Rajasthan	11.2	13.7	15.9
13.	Tamil Nadu	40.4	42.4	44.1
14.	Uttar Pradesh	25.9	31.2	35.7
15.	West Bengal	14.1	15.8	17.3
16.	Other States	6.8	6.2	5.8
Total		301.0	340.0	373.8
G.R(%)		3.3	2.5	1.9

2.10.10 Requirements of degree holders in veterinary science from 1985-86 to 2000-01, have been estimated by three different methods viz (i) Output method, (ii) Investment method and (iii) Manpower method. Detailed procedure for estimating requirement of Veterinary Science manpower by different methods is the same as has been applied for estimating the requirements of Agriculture Science degree holders. Estimated requirements worked out by these methods have been presented in table 2.26(a) to 2.28(c) in that order.

2.28(a) Requirement of Degree Holders in Veterinary Science during 1985-86 to 2000-01 at Scenario-I

(in '00)

Sector	Estimated requirement			
	1985-86	1990-91	1995-96	2000-01
Agriculture	39.1	41.7	45.2	48.6
Manufacturing	7.8	10.4	13.0	17.4
Trade & Commerce	8.7	9.6	10.4	11.3
Other Services	178.0	208.4	244.0	288.3
Total	233.6	270.1	312.6	365.6
G.R(%)	-	2.9	3.0	3.2

2.28(b) Requirement of Degree Holders in Veterinary Science during 1985-86 to 2000-01 at Scenario - II

(in '00)

Sector	Estimated requirement			
	1985-86	1990-91	1995-96	2000-01
Agriculture	35.6	39.9	45.2	51.2
Manufacturing	6.1	7.8	9.5	12.2
Other Services	175.4	214.5	265.7	331.7
Total	217.1	262.2	320.4	395.1
G.R(%)	-	3.8	4.1	4.3

2.28(c) Requirement of Degree Holders in Veterinary Science during 1985-86 to 2000-01 at Scenario- III
(in '00)

Sector	Estimated Requirement			
	1985-86	1990-91	1995-96	2000-01
Agriculture	38.2	45.2	53.8	63.4
Manufacturing	6.1	7.8	10.4	13.0
Trade & Commerce	8.7	11.3	13.9	17.4
Other Services	171.0	212.7	264.8	328.2
Total	224.0	277.0	342.9	422.0
G.R(%)	-	4.3	4.3	4.2

2.10.11 The overall estimated requirements by all the three methods have been presented in table 2.29 alongwith average of three types of estimates. It would be seen that on the whole, all the three types of estimates are close to each other throughout the period excepting for 2000-01 when some divergence has been observed. It is thus, felt that averages of three types of estimates are more realistic estimates. It is seen that total requirement of veterinary scientists will rise from 22.5 thousand in 1985-86 to 39.4 thousand in 2000-01 showing an annual growth rate of 3.8 percent.

2.29 Requirement of Degree Holders in Veterinary Science during 1985-86 to 2000-01 at Different Scenarios
(in '00)

Scenario	Estimated Requirements			
	1985-86	1990-91	1995-96	2000-01
Scenario - I	233.6	270.1	312.6	365.6
Scenario - II	217.1	262.2	320.4	395.1
Scenario - III	224.0	277.0	342.9	422.0
Average	224.9	269.8	325.3	394.2
G.R(%)	X	3.7	3.8	3.9

2.10.12 Table 2.30 presents expected employment situation of veterinary scientists during 1985-86 to 2000-01. The statement reveals that already there is a shortage of manpower in veterinary science to the tune of 2.28 thousand. If the enrolment capacity is not further increased, the shortage will further increase over time and by 2000-01, the estimated shortage of this category of manpower would be of the order of 6.9 thousand i.e 17.5 percent of the total stock of economically active veterinary scientists.

2.30 Employment Situation of Veterinary Science Degree Holders during 1985-86 to 2000-01 (in'00)

Year	Stock	Requi- re- ment	(+) Sur- plus/	Sur- plus/	Perce- ntage of
	eco- nomi- cally Total Active		(-) Short- age	Short- age to Stock	Short- age to Stock
1985-86	255.3	222.1	224.9	(-) 2.8	(-) 1.24
1990-91	301.0	261.9	269.8	(-) 7.9	(-) 2.93
1995-96	340.0	295.8	325.3	(-) 29.5	(-) 9.07
2000-01	373.8	325.2	394.2	(-) 69.0	(-) 17.50

2.10.13 The above findings indicate that there is a need for augmentation of enrolment capacity in veterinary science in all the existing institutions and also opening of new departments/colleges having such facilities so that economic development may not suffer due to shortage of manpower. Simultaneously alongwith augmentation of capacity, qualitative improvement in teaching of veterinary science is needed to be done to keep pace with the technological development.

2.10.14 About 40 percent of those with degree and post-graduate degree in veterinary science are under 35 years and another 42 percent in the age group of 35-45 years. Rest are in the age group of 45 years and above.

2.31 Distribution by Age Group of Graduates and Post-graduates in Veterinary Science : 1981

(in percent)

Age Group	Post- Graduate Degree	Degree	Total
Below 25	3.1	4.3	4.1
25 - 35	36.5	35.8	36.0
35 - 45	39.0	42.9	42.3
45 - 55	16.2	13.1	13.6
55 - 58	2.3	0.6	0.8
Above 58	0.1	0.2	0.2
Not given	2.8	3.1	3.0
Total	100.0	100.0	100.0
N	1508	8674	10182

Source: DHP Survey Report, 1981

2.10.15 By Salary structure, 23.6 percent were getting less than Rs.1000, 52.6 percent between Rs.1000-1500, 18.9 percent in salary range of Rs.1500-2000, 4.0 percent in Rs.2000-3000 and hardly 0.9 percent were drawing above Rs.3000.

2.32 Distribution by Salary Structure of Degree Holders in Veterinary Science : 1981

(in percent)

Salary(Rs.)	Post Graduate Degree	Degree	Total
Below 1000	15.3	25.1	23.6
1000 -1500	41.7	54.6	52.6
1500 -2000	32.2	16.4	18.9
2000 -3000	9.9	3.0	4.0
3000 and above	0.9	0.9	0.9
Total	100.0	100.0	100.0

Source: DHP Survey Report, 1981

2.10.16 Degree holders in Veterinary Science are largely employed by the Government. The share of Government in total employment of Veterinary Science personnel was 97.6 percent. Only 2.4 percent of the degree holders in Veterinary Science were employed in the private sector.

**2.33 Distribution of Degree Holders in
Veterinary Science by Public
and Private Sector:1981**
(in percent)

Sl. No.	Sector	Public Sector	Private Sector	Total
1.	Agriculture	17.01	44.20	17.66
2.	Manufacturing	2.38	29.00	3.02
3.	Financing & Insurance	4.00	-	3.90
4.	Services	74.70	18.20	73.35
	i. General Admn.	8.81	-	8.60
	ii. Education	4.73	-	4.62
	iii. R & D	3.90	15.60	4.18
	iv. Veterinary Service	50.84	-	49.62
	v. Other Services	6.42	2.60	6.33
5.	Other Sectors	1.91	8.60	2.07
	Total	100.00	100.00	100.00
	N	20410	500	20910
		(97.61)	(2.39)	(100.00)

Source: D.G.E.T.

RECOGNITION OF CENTRE

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3. ENGINEERING & TECHNOLOGY MANPOWER

3.1 Introduction

3.1.1 Engineering and Technology (E & T) personnel occupy a pre-eminent position in Scientific and Technical (S & T) manpower not only by virtue of their vital role in economic development in different fields but also by their sheer number and growing demand for sustaining the thrust towards emergence of an industrialized economy. In 1988, as per CERPA Estimates, E&T manpower (Degree & Diploma holders) constitute 29.46 percent of total S & T Manpower. However, in case of S & T Manpower excluding Science graduates, E & T constitutes as high as 63 percent of S & T manpower.

3.1.2 Various important aspects of all the three categories of E & T manpower, viz; degree holders, diploma holders and skilled technicians (ITI trained/others) are summarized in this section.

3.1.3 Degree holders include graduates, post-graduates, doctorates as well as those with diploma equal to degree or post-graduate degree in E & T. Diploma holders are those who come out of a Polytechnic Institute after three to four years training beyond Secondary Education. Skilled Technicians are those who are trained at the Industrial Training Institutes (ITIs) in Engineering Trades for a period of one to two years depending upon the trade with minimum qualification of 8th class pass for some trades, such as, welder, moulder, machanic and matriculation or 10th class pass under 10+2 system, for some other trades, such as fitter, turner, machinist, draughtsman etc. In addition, those with on-the-job training or professional experience without any formal training are also covered under this category of E & T Manpower.

3.2 Stock : 1981

3.2.1 According to 1981 census data there were 37.57 lakh skilled and technical persons in engineering and technology (E & T). Of these 3.11 lakh were degree holders, 5.27 lakh diploma holders (DHS) and 29.19 lakh otherwise

skilled technical persons.

3.1 Estimated Stock of Engineering & Technology Manpower by Qualifications:1981

Sl. No.	Qualifications	Nos. ('00)	Percentage share
1.	Degree Holders	3113	8.0
2.	Diploma Holders	5272	14.0
3.	Skilled Technicians	29190	77.7
	Total	37575	100.0

Source: Census, 1981

3.2.2 Of the total degree holders in 1981, Maharashtra alone accounted for 20.8 percent. Tamil Nadu accounted for 9.1 percent, Karnataka for 8.9 percent, West Bengal for 8.2 percent and Andhra Pradesh for 7.5 percent. Thus, these five States together accounted for 54.5 percent of total degree holders.

3.2.3 As for diploma holders also Maharashtra accounted for a high share at 18.8 percent followed by Tamil Nadu (8.9 percent), Karnataka (8.8 percent), West Bengal (8.1 percent) & Andhra Pradesh (7.8 percent). These five States accounted for 52.4 percent of total Diploma holders as compared to 54.5 percent of degree holders.

3.2 Distribution of Degree & Diploma Holders in Major States:1981(Percent)

Sl. No.	States	Degree Holders	Diploma Holders	Total
1.	Andhra Pradesh	7.5	7.8	7.7
2.	Bihar	6.7	6.5	6.6
3.	Karnataka	8.9	8.8	8.8
4.	Kerala	2.2	4.5	3.7
5.	Madhya Pradesh	6.1	6.2	6.2
6.	Maharashtra	20.8	18.8	19.4
7.	Tamil Nadu	9.1	8.9	9.0
8.	Uttar Pradesh	5.6	5.7	5.7
9.	West Bengal	8.2	8.1	8.1
10.	Other States and UTs	24.9	24.7	24.8
	Total N('00)	100.0	100.0	100.0
		3113	5272	8385

Source: Census, 1981

3.2.4. In case of skilled technicians also, the same trend as for Degree holders and DHs was noticed with Maharashtra claiming the highest share of 19.63 percent, followed by Tamil Nadu with 11.62 percent, West Bengal 9.72 percent, Andhra Pradesh 8.85 percent and Karnataka 6.39 percent. These five States together accounted for 56.21 percent of total skilled Technicians relative to 54.5 percent of Degree Holders and 52.4 percent of DHs.

3.2.5 Of the degree holders accounting for 3.11 lakh persons in 1981, about 25.1 percent were civil engineers, 22.7 percent electrical engineers and 26.1 percent mechanical engineers. Out of the rest 26.1 percent, 3.2 percent were chemical engineers, 2.3 percent Architectural engineers, 2.2 percent Industrial engineers and 1.2 percent mining engineers. Other E & T disciplines accounted for 17.2 percent of degree holders.

3.3 Stock of Degree Holders by Branches:1981

(in percent)

Sl.No.	Branches	Stock
1.	Mechanical	26.1
2.	Civil	25.1
3.	Electrical/Electronic	22.7
4.	Chemical	3.2
5.	Architecture	2.3
6.	Industrial	2.2
7.	Mining	1.2
8.	Other branches	17.2
	Total	100.0
	N ('00)	3113

3.2.6 Of 5.27 lakh DHs in 1981, 21.8 percent belonged to civil, 15.5 percent to electrical and 14.0 percent mechanical disciplines. 20.1 percent were draughtsmen. The most popular discipline for DHs was civil followed by draughtsmen. There were very few DHs in the area of mining though surveyors accounted for about 13 percent of all DHs.

3.4 Distribution of Stock of Diploma Holders in Different Branches:1981 (in percent)

Sl.No.	Branches	Stock
1.	Civil	21.8
2.	Draughtsman	20.1
3.	Electrical/Electronic	15.5
4.	Mechanical	14.0
5.	Surveyors	13.0
6.	Chemical	3.4
7.	Mining	0.6
8.	Other Branches	11.6
	Total	100.0
	N ('00)	5272

3.2.7 Those holding Ph.D degree were largely in teaching (63.4 percent) and R & D (20.5 percent). Teaching and R & D accounted for about 47.1 percent of post-graduates also. Graduates and DHs were largely in production, operation and maintenance constituting 33.7 percent graduates and 39.8 percent DHs followed by construction comprising 23.5 percent graduates and 30.7 percent DHs. R & D also employed substantial number of graduates and DHs with 18.3 percent graduates and 12.8 percent DHs.

3.5 Distribution of Engineering & Technology Personnel According to Nature of Work by Qualification:1981 (in percent)

Sl. No.	Nature of work	Ph.D	Post Graduate	Diploma	Graduate-Holders
1.	Teaching	63.4	17.3	3.4	3.0
2.	R & D	20.5	29.8	18.3	12.8
3.	Production, Operation & Maintenance	3.0	17.3	33.7	39.8
4.	Marketing and Sale	4.6	9.4	8.0	2.9
5.	Construction	0.8	10.6	23.5	30.7
6.	Administration	1.8	3.9	3.2	-
7.	Others	5.9	11.7	9.9	10.8
	Total	100.0	100.0	100.0	100.0
	N	2593	296	41	4500

Source:Table-3.3, 3.4, 3.5 DHTP survey,1981

3.2.8 In 1981, of those holding degree, 79.4 percent were employed and 14.8 percent self employed. Another 5.8 percent were estimated to be unemployed. Among DHS 74.8 percent were employed and 10.6 percent self employed.

3.6 Distribution of E & T Manpower by Activity Status :1981

Sl. Activity No.	Degree Holders ('000 Nos)	Percentage (%)	Diploma Holders ('000 Nos)	Percentage (%)
1. Employed	247	79.4	394	74.8
2. Self-employed	46	14.8	56	10.6
3. Unemployed	18	5.8	77	14.6
Total	311	100.0	527	100.0

Source: CERPA Estimates based on proportions worked out from DHTP Survey, 1981.

3.2.9 By sectors there was close relationship between employment of degree holders and DHS in the manufacturing sector; their respective share being 36.2 percent and 33.4 percent in 1981. Similar relationship was also observed in the electricity, gas and water sector where 13.6 percent were degree holders and 15.2 percent DHS. The share of DHS in construction sector was far higher at 27.4 percent as against the share of engineers at 12.3 percent. This explains the popularity of draughtsmen and civil engineering among DHS. There were very few DHS in the education sector but more in the trading sector. Similarly, DHS were fewer in services sector as compared to degree holders. In case of Skilled Technicians, they were mostly employed in Manufacturing sector accounting for 82.8 percent followed by Electricity, Gas and Water with 6.5 percent and construction sector 4 percent. The rest 6.9 percent were accounted for mining & quarrying, Transport & Communication and services sectors.

3.7 Distribution of Employed and Self-employed E & T Manpower in Different Sectors: 1981

(in percent)

Sl. Sector No.	Degree Holders (%)	Diploma Holders (%)	Skilled Technicians (%)
1. Manufacturing	36.2	33.4	82.8
2. E G & W	13.6	15.2	6.5
3. Construction	12.3	27.4	4.0
4. Administration	5.7	6.2	-
5. Education	5.0	2.8	-
6. T & C	4.8	4.9	3.2
7. Trade	2.2	3.3	-
8. Others including Services	20.2	6.8	3.5
Total	100.0	100.0	100.0
N (in '00 Nos)	2930	4500	29190

Source: CERPA estimates based on proportion worked out from DHTP Survey, 1981.

3.2.10 Age structure shows that both degree holders and DHS are evenly distributed in terms of age. There is much concentration in the younger age group (about half are below 35 years) apparently because several new institutions have been established and their output is being absorbed in the economic system more recently.

3.8 Distribution of Employed E & T Manpower by Age Group (in percent)

Age-Group (Years)	Degree Holders (%)	Diploma Holders (%)
Below 30	24.0	31.4
30 - 34	25.3	21.7
35 - 39	20.5	18.7
40 - 49	22.2	20.7
50 - 59	7.0	5.9
60 +	1.0	1.6
Total	100.0	100.0
N (in '00)	2930	4500

Source : 1981 Census

3.3 Updated Stock : 1985

3.3.1 From the base stock of 1981 the updated stock of 1985, as estimated by taking into account outturns of degree holders and diploma holders during the intervening period and attrition rate for depletion, was 3.74 lakh of degree holders and 6.38 lakh of diploma holders. Total employed E & T personnel in 1985 consisted of 3.44 lakh of degree holders and 5.83 lakh of diploma holders.

3.9 Estimated Stock of Degree Holders and Diploma Holders by Major States:1985 (in ,000)

Sl. State No.	Degree Holders	Diploma Holders
1. Andhra Pradesh	25.1	46.6
2. Bihar	29.6	45.3
3. Karnataka	33.0	52.9
4. Kerala	10.8	30.1
5. Madhya Pradesh	25.0	45.3
6. Maharashtra	75.6	108.4
7. Tamil Nadu	30.3	52.9
8. Uttar Pradesh	24.1	53.6
9. West Bengal	31.1	51.6
10. Other States/UTs	89.9	151.1
Total	374.5	637.8
Percentage Shares	37	63

3.3.2 State-wise shares both of degree holders and Diploma holders have undergone changes because of shift in economic activities as between States. Maharashtra which accounted for 20.8 percent of degree holders in 1981 had a lower share of 20.2 percent by 1985. The share of Bihar had somewhat increased from 6.7 percent to 7.9 percent and that of Andhra Pradesh declined from 7.5 percent to 6.7 percent. The share of Tamil Nadu also declined whereas that of Uttar Pradesh improved.

3.3.3 Among DHs, share of Andhra Pradesh, Karnataka, Maharashtra and Tamil Nadu declined in 1985 as compared to 1981. As against this the share of Bihar, Madhya Pradesh and Uttar Pradesh improved.

3.9(a) Distribution of Degree Holderse and Diploma Holders in Major States : 1985

(Percent)

Sl. State No.	Degree Holders	Diploma Holders
1. Andhra Pradesh	6.7	7.3
2. Bihar	7.9	7.1
3. Karnataka	8.8	8.3
4. Kerala	2.9	4.7
5. Madhya Pradesh	6.7	7.1
6. Maharashtra	20.2	17.0
7. Tamil Nadu	8.1	8.3
8. Uttar Pradesh	6.4	8.4
9. West Bengal	8.3	8.1
10. Other States & UTs	24.0	23.7
Total	100.0	100.0
N ('00)	3745	6378

Source: CERPA estimates

3.3.4 Breakup of these estimated employment by major economic sectors as also by Public Sector and Private Sector was worked out from DGET data on occupational/educational pattern, Public & Private Sectors. In 1985 about 69 % of degree holders and 79.9 percent of Diploma holders in E & T were employed in the public sector and rest in private sector. In all it is estimated that there were 3.44 lakh degree holders. As against this there were 5.83 lakh DHs. While in Manufacturing, Public Sector accounted for 19.6 percent of Degree Holders and 12.9% of DHS, the same for Private Sector was very high at 85.1 and 80.1 percent respectively. In case of Degree holders in Public Sector, Construction activities had the highest share of 25.1 percent closely followed by services with 23.2 percent. Most of the DHs, accounting for 37.7 percent were also found to be employed in construction activities in Public Sector.

3.10 Estimated Stock of Employed Engineering & Technology Manpower by Public and Private Sector:1985 (in '00)

Sl. Sector No.	Degree Holders			Diploma Holders		
	Pub-lic	Pri-vate	Total	Pub-lic	Pri-vate	Total
	Sec-tor	Sec-tor		Sec-tor	Sec-tor	
1.Manufacturing	465	906	1371	601	939	1540
2.E G & W	339	43	381	755	54	809
3.Construction	595	33	628	1756	40	1796
4.Mining & Quarrying	192	11	203	289	6	395
5.T & C	140	22	162	195	23	218
6.Services	550	22	572	801	91	892
7.Other Sec. (Trade,Fin. etc.)	90	28	118	261	19	280
Total	2370	1065	3435	4658	1172	5830
Percentage	69.0	31.0	100.0	79.9	20.1	100.0

3.10(a) Distribution of Stock of Employed Engineering & Technology Manpower by Public and Private Sector:1987 (percent)

Sl. Sector No.	Degree Holders			Diploma Holders		
	Pub-lic	Pri-vate	Total	Pub-lic	Pri-vate	Total
	Sec-tor	Sec-tor		Sec-tor	Sec-tor	
1.Manufacturing	19.6	85.1	39.9	12.9	80.1	26.4
2.E G & W	14.3	4.0	11.1	16.2	4.6	13.9
3.Construction	25.1	3.1	18.3	37.7	3.4	30.8
4.Mining & Quarrying	8.1	1.0	5.9	6.2	0.5	5.1
5.T & C	5.9	2.1	4.7	4.2	2.0	3.7
6.Services	23.2	2.1	16.7	17.2	7.8	15.3
7.Other Sec. (Trade,Fin. etc.)	3.8	2.6	3.4	5.6	1.6	4.8
Total	100.0	100.0	100.0	100.0	100.0	100.0
N	2370	1065	3435	4658	1172	5830

Source: CERPA Estimates based on Proportions worked out from DGET data on occupational Educational pattern, Public & Private Sectors.

3.4 Projected Stock upto 2000 AD

3.4.1 Future stocks of E & T degree/diploma holders for a year has been estimated with the help of corresponding updated stock of 1985, estimated annual outturn of each category of E & T manpower during intervening period and attrition rates of 1.5 percent of stock (as communicated by Planning Commission to the states in connection with 7th Plan exercise). It is estimated that by 2000 AD, stock of E & T Manpower consisting of degree holders and DHs will increase to 19.13 lakh as against 10.12 lakh in 1985 and 8.38 lakh in 1981. This manpower is estimated at 12.71 lakh in 1990 and 15.71 lakh in 1995.

3.11 Projected Stock of E & T Manpower:1990 to 2000

(in '000)

Category	Base Stock	Updated Stock	Projected Stock		
	1981	1985	1990	1995	2000
Degree Holders	311	374	467	573	693
Diploma Holders	527	638	804	998	1220
Total	838	1012	1271	1571	1913

3.4.2 The share of DHs in total E & T Degree and Diploma holders worked out from the estimated stock shows that it would slightly increase to 63.8 percent by 2000 from 62.9 percent in 1981. This share is estimated at 63 percent in 1985, 63.3 percent in 1990 and 63.5 percent in 1995.

3.12 Projected Share of Degree holders and DHs in Manpower 1990,1995,2000 (in percent)

Category Manpower	Base Stock	Updated Stock	Projected Stock		
	1981	1985	1990	1995	2000
Degree Holders	37.1	37.0	36.7	36.5	36.2
Diploma Holders	62.9	63.0	63.3	63.5	63.8
Total	100.0	100.0	100.0	100.0	100.0

3.4.3 The increase in share of DHs in total E & T manpower is due to slightly higher annual rate of growth that DHs will experience over the period under reference as compared to Degree holders. This rate of growth for DHs is estimated at 3.9 percent over 1981-1985 as against 3.8 percent of Degree holders. The rate of growth for DHs is estimated at 4.7 percent over the period 1985-90, 4.4 percent over the period 1990-95 and 4.1 percent over the period 1995-2000. The comparative rate of growth for degree holders will be 4.5 percent over 1985-90, 4.2 percent over 1990-95 and 3.8 percent over 1995-2000.

3.13 Rate of Growth of Engineering & Technology Personnel

(in percent)

Category	Annual Rate of Growth			
	1985 over 1981	1990 over 1985	1995 over 1990	2000 over 1995
Degree Holders	3.8	4.5	4.2	3.8
Diploma Holders	3.9	4.7	4.4	4.1
Combined	3.8	4.7	4.3	4.0

3.5 Employment Output Ratio

3.5.1 For projecting the demand for E & T manpower Employment-Output Co-efficients by Industry/Sectors have been used. For the manufacturing sector as a whole, it is estimated that for every Rs.1 crore of output 1.44 degree holders are required. As against this, requirement of DHs is 2.04 and that of skilled technicians 32.06 per Rs.1 crore of output.

3.14 Employment-Output Co-efficients (Per Rs.One Crore of Output:1981-82)

Sl. No.	Industry	No.of Engineering Personnel employed Per Rs. One Crore of Output		
		Degree Holders	Diploma Holders	Skilled Techns.
1.	Food Products	0.424	0.703	5.480
2.	Textiles	1.233	0.894	9.864
3.	Rubber, Petroleum	0.481	0.949	38.762
4.	Chemicals	1.261	2.058	13.645
5.	Non-metallic Mineral Products	1.889	2.374	60.562
6.	Basic Metal	1.212	1.990	48.469
7.	Non-Elect.Engg. Products	3.805	6.975	78.910
8.	Elect.Engg. Products	3.063	6.023	71.975
9.	Transport equipment	3.443	3.678	81.820
Manufacturing Sec.		1.437	2.041	32.061

Source: CERPA estimates based on estimated employment and Corresponding output in each industry during 1981-82.

3.5.2 The employment-output co-efficients vary for different industry groups and are higher for industries such as non-electrical engineering products, electrical engineering products and transport equipment ranging from 3.06 to 3.81 in case of degree holders and 3.68 to 6.98 for DHs. In relation to this, food products and rubber and petroleum products industries require fewer degree holders (0.42 &

0.48) and DHs (0.70 & 0.95) though the requirements of skilled technicians is fairly high in case of rubber and petroleum industries (38.76) and non-metallic mineral products (60.56) as compared to smaller requirement of degree holders (0.48 & 1.89) and DHs (0.95 & 2.37) in these industries.

3.5.3 For sectors other than manufacturing, employment GDP Co-efficients have been estimated to yield sectoral co-efficients for degree holders, DHs and skilled technicians. Here it is observed that the needs for degree holders, DHs and skilled technicians is high in electricity, gas and water sector followed by construction and mining & quarrying sectors. The need for E & T skilled personnel is observed to be limited in sectors such as trade & finance.

3.15 Employment-GDP Co-efficients (Per Rs.One Crore of G.D.P 1981-82)

Sl. Sector No.	No. of Engineering Personnel Employed Per Rs. One Cror GDP		
	Degree Holders	Diploma Holders	Skilled Techns.
1. E G & W	17.264	29.851	51.573
2. Construction	7.657	19.725	30.211
3. Mining & Quarrying	7.003	6.309	16.211
4. T & C	1.857	2.917	12.200
5. Community & Social Services	3.956	4.551	3.245
6. Other Services (Trade, Finance)	0.412	0.432	-

Source: CERPA estimates based on estimated employment and GDP in each sector during 1981-82.

3.5.4 Keeping in view the projected sectoral growth rates at factor cost over the period 1984-85 to 2000-01 demand for E & T personnel has been estimated for the year 1990-91 and beyond.

3.6 Perspective to 2000 : Scenario-I

3.6.1 Demand for Engineering

Personnel was worked out by applying Employment-Output/GDP Co-efficients to projected gross value of output/GDP for the future years upto 2000 AD. It is observed that in the manufacturing sector, the demand for engineers i.e. degree holders will increase from 1.79 lakh in 1990-91 to 2.24 lakh in 1995-96 and 2.83 lakh in the year 2000-01. In all sectors together, the demand for degree holders will increase from 4.48 lakh in 1990-91 to 6.01 lakh in 1995-96 and 7.4 lakh in the year 2000-01. On this basis the total need for additional degree holders over the period 1990-91 to 2000-01 is estimated at 2.92 lakh of which 1.04 lakh will be absorbed by the Manufacturing Sector, 0.65 lakh by Electricity, Gas and Water (E, G & W), 0.44 lakh by construction, 0.57 lakh by services and the rest by transport, communication and other sectors.

3.16 Projected Demand for Engineers (Degree Holders) by Major Industry Groups/Sectors, 1990-91 to 2000-01 at Scenario - I (in '000)

Sl. Major Indus- No. try/Sectors	1990-91	1995-96	2000-01	Increase in 2000-01 over 1990-91
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Manufacturing Sector

1. Textiles	19.5	22.4	26.7	7.2
2. Chemicals	23.9	26.6	29.6	5.7
3. Basic Metals	17.2	21.8	27.8	10.6
4. Non-Elec. Engg. Prod.	26.0	34.8	46.3	20.3
5. Elec. Engg. Products	22.2	29.9	40.4	18.2
6. Transport equipment	22.0	29.0	38.3	16.3
Total(1-6)	130.8	164.5	209.1	78.3

I. Manufacturing Sector

(including 1-6 above)	179.1	224.4	282.6	103.5
II. E G & W	61.7	98.8	126.3	64.6
III Construction	73.1	100.5	117.5	44.4
IV. Services	71.0	102.8	128.3	57.3
V. T & C	21.6	26.0	30.3	8.7
VI. Other Sec.	41.7	48.5	55.2	13.5
All Sectors	448.2	601.0	740.2	292.0

3.6.2 The average growth rate in demand for degree holders based on output Method (Scenario-I) is estimated at 6.0 percent over the period 1990-91 to 1995-96 and 4.3 percent over the period 1995-96 to 2000-01.

3.17 Growth rate of Demand for Degree Holders, 1990-91 to 2000-01 at Scenario-I (Percentage per annum)

Sl. No. Major Industry/ Sector	1995-96	2000-01
	1990-91	1995-96
Manufacturing Sector		
1. Chemicals	2.2	2.2
2. Textiles	2.8	3.6
3. Basic Metals	4.9	5.0
4. Non-Elec. Engg. Products	6.0	5.9
5. Elec. Engg. Products	6.1	6.2
6. Transport Equipment	5.6	5.7
I. Manufacturing Sector	4.6	4.7
II. E G & W	9.9	5.0
III. Construction	6.6	3.2
IV. Services	7.7	4.5
V. T & C	3.8	3.1
VI. Other Sectors	3.1	2.6
All Sectors	6.0	4.3

3.6.3 As against additional demand for 2.92 lakh engineers over the period 1990-91 to 2000-01 the additional demand for DHs is estimated at 4.96 lakh during this period. The overall demand for DHs is estimated at 7.36 lakh in 1990-91 and expected to increase to 9.64 lakh in 1995-96 and to 12.33 lakh in 2000-01.

3.18 Projected Demand for Diploma Holders by Major Industry Groups/Sectors, 1990-91 to 2000-01 at Scenario-I

Sl. No. Major Industry/ Sector	1990-91	1995-96	2000-01	Increase in 2000-01 over 1990-91
1. Textiles	13.0	16.3	19.5	6.5
2. Chemicals	39.0	43.5	48.3	9.3

3. Basic Metals	28.2	35.8	45.5	17.3
4. Non-Elec., Engg. Products	47.6	63.8	84.8	37.2
5. Electrical Engg. Prod.	43.6	58.9	79.5	35.9
6. Transport & Equipment	23.5	31.0	40.9	17.4
Total(1-6)	194.9	249.3	318.5	123.6

I. Manufactu- ring Sec. (including (1-6)above)	251.1	319.0	404.6	153.5
II. E G & W	113.6	180.8	248.0	134.4
III. Construc- tion	196.1	243.1	312.7	116.6
IV. Services	101.8	133.7	165.6	63.8
V. T & C	25.5	30.7	35.8	10.3
VI. Other Sectors	48.1	56.4	65.8	17.7
All Sectors	736.2	963.7	1232.5	496.3

3.19 Distribution of Projected Demand for Diploma Holders by Major Industry Group/Sectors 1990-2001 (Based on Output Method)

Sl. Major Industry No. Groups/Sectors	Percentage to total Demand		
	1990-91	1995-96	2000-01
1. Textiles	1.76	1.69	1.58
2. Chemicals	5.30	4.51	3.92
3. Basic Metals	3.83	3.71	3.69
4. Non-Electrical Engg. Products	6.47	6.62	6.88
5. Elec. Engg. Products	5.92	6.11	6.45
6. Transport equipment	3.19	3.22	3.32
Total(1-6)	26.47	25.86	25.84
I. Manufacturing Sector (Including 1-6 above)	34.11	33.10	32.83
II. E G & W	15.43	18.76	20.12
III. Construction	26.64	25.23	25.37
IV. Services	13.83	13.87	13.44
V. T & C	3.46	3.19	2.90
VI. Other Sectors	6.53	5.85	5.34
Total N('000)	100.00	100.00	100.00
	736.2	963.7	1232.5

3.6.4 Of the additional demand for 4.96 lakh of DHs, 1.53 lakh shall be absorbed by the manufacturing sector, 1.34 lakh by E,G & W sector, 1.17 lakh by the construction sector, 0.64 lakh by services sector and 0.28 lakh by other sectors.

3.6.5 On this basis, the share of manufacturing sector among all DHs will decline from 34.1 percent in 1990-91 to 32.8 percent in 2000-01. As against this the share of EG & W will increase from 15.4 percent to 20.1 percent. The share of other sectors will change marginally.

3.6.6 The overall rate of growth in demand for DHs(Scenario-I) is estimated at 5.5 percent per annum over the period 1990-91 to 1995-96 and 5.0 percent per annum over the period 1995-96 to 2000-01. During 1990-91 the increase in demand is likely to be highest at 9.8 percent per annum in the E G & W sector followed by 6.2 percent in Electrical engineering Products Industry and 6.0 percent in Non-electrical engineering products industry. These growth rates over the period 1995-96 to 2000-01 will be 6.5 percent for E G & W, 6.2 percent for Elec. Engg. Products and 5.9 percent for Non.Elec. Engg.products. Other industries/sectors which will experience a decline in the growth rates are Textiles , Chemicals , Non-electrical engineering products and services. The demand for DHs in construction sector is expected to go up.

3.6.7 Demand for skilled technicians was worked out by applying employment. Output coefficients as given in table 3.15 to projected gross value of output/GDP for the future years and presented in table 3.21. The demand is expected to increase by 28.84 lakh over the period 1990-91 to 2000-01. The actual demand of skilled technicians is expected to be 47.05 lakh in 1990-91, 59.91 lakh in 1995-96 and 75.89 lakh in the year 2000-01.

3.20 Growth Rate of Demand for Diploma Holders:1990-91 to 2000-01 at Scenario-I (Percent per annum)

Sl. Major Industry No. Groups/Sectors	1995-96 over 1990-91	2000-01 over 1995-96
1. Textiles	4.6	3.6
2. Chemicals	2.2	2.1
3. Basic metals	4.9	4.9
4. Non-electrical Engineering Products	6.0	5.9
5. Electrical Engineering Products	6.2	6.2
6. Transport equipment	5.7	5.7
I. Manufacturing Sector	4.9	4.9
II. E G & W	9.8	6.5
III. Construction	4.4	5.2
IV. Services	5.6	4.4
V. T & C	3.8	3.1
VI. Other Sectors	3.2	3.1
All Sectors	5.5	5.0

3.21 Projected Demand for Skilled Technicians by Major Industry Groups/Sectors : 1990-91 to 2000-01 at Scenario-I (in '000)

Sl. Major Industry No. Group/Sectors	1990-91	1995-96	2000-01	Increase in 2000-01 over 1990-91
1. Rubber, Petroleum	515	637	793	278
2. Chemicals	259	288	320	61
3. Basic Metals	688	872	1107	419
4. Non-Elect. Engg. Products	539	722	960	421
5. Elect. Engg. Products	522	703	950	428
6. Transport equipment	523	689	909	386
Total(1-6)	3046	3911	5039	1993
I. Mfg. Sec.	3929	4990	6359	2430
II. E G & W	196	295	376	180
III. Construction	300	372	464	164
IV. Services	72	88	105	33
V. T & C	142	170	199	57
VI. Other Sectors	66	76	86	20
All Sectors	4705	5991	7589	2884

3.6.8 Distribution of projected demand for Skilled Technicians by Industry and sectors based on table 3.21 shows that of the total demand for skilled technicians in 2001, 83.79 percent shall be in the manufacturing sector and the rest in other sectors such as EG & W, construction, transport and communication etc.

3.22 Distribution of Projected Demand for Skilled Technicians by Major Industry Groups:1990-91 to 2000-01 at Scenario-I

Sl. Major Industry No Groups/Sectors	Percentage to total Demand		
	1990-91	1995-96	2000-01
1. Rubber, Petroleum	10.95	10.63	10.45
2. Chemicals	5.50	4.81	4.22
3. Basic Metals	14.62	14.55	14.59
4. Non-Elect. Engg. Products	11.46	12.06	12.65
5. Elect. Engg. Products	11.09	11.73	12.52
6. Transport Equipment	11.12	11.50	11.98
Total (1-6)	64.74	65.28	66.41
I. Mfg. Sec.(Total including 1-6 above)	83.51	83.29	83.79
II. E G & W	4.17	4.92	4.95
III. Construction	6.38	6.21	6.11
IV. Services	1.53	1.47	1.38
V. T & C	3.02	2.84	2.62
VI. Other Sectors	1.40	1.27	1.13
Total N('000)	100.00	100.00	100.00
	4705	5991	7589

3.6.9 The rate of growth of skilled technicians is estimated at 4.9 percent per annum over the period 1990-91 to 1995-96 which will decline marginally to 4.8 percent per annum over the period 1995-96 to 2000-01. The rate of decline in growth rate of demand for skilled technicians shall be high in EG & W sector. The industries which may demand relatively more skilled technicians in 1995-96 to 2000-01 as against 1990-91 to 1995-96 shall be rubber & petroleum and electrical engineering products industries.

3.23 Growth Rate of Demand for Skilled Technicians:1990-91 to 2000-01 at Scenario-I
(Percent per annum)

Sl. Major Industry No. Groups/Sectors	1995-96 over 1990-91	2000-01 over 1995-96
1. Rubber, Petroleum	4.3	4.5
2. Chemicals	2.1	2.1
3. Basic Metals	4.9	4.9
4. Non-elect. Engg. Products	6.0	5.9
5. Elect. Engg. Products	6.1	6.2
6. Transport equipment	5.7	5.7
I. Manufacturing Sector	4.9	5.0
II. E G & W	8.5	5.0
III. Construction	4.4	4.5
IV. Services	4.1	3.6
V. T & C	3.7	3.2
VI. Other Sectors	2.9	2.5
All Sectors	4.9	4.8

3.6.10 Total E & T personnel demand works out to 58.89 lakh in 1990-91, 75.56 lakh in 1995-96 and 95.62 lakh in 2000-01 indicating a growth rate of 5.1 percent during 1990-91 to 1995-96 and 4.8 percent during 1995-96 to 2000-01.

3.24 Demand for Engineering & Technology Personnel: 1990-91 to 2000-01 at Scenario-I
(in '000)

Sl. Sector No.	1990-91	1995-96	2000-01
1. Manufacturing	4359.2	5533.4	7046.2
2. E G & W	371.3	574.6	750.3
3. Construction	569.2	715.6	894.2
4. Mining & Quarrying	120.4	138.7	157.1
5. T & C	189.1	226.7	265.1
6. Services	244.8	324.5	398.9
7. Other Sectors (Trade, Finance)	35.4	42.2	49.9
Total	5889.4	7555.7	9561.7

3.7 Perspective to 2000:Scenario-II

3.7.1 For estimation of E & T manpower over future years an alternative method was also tried. In this method demand for E & T personnel was worked out based on manpower norm i.e the number of E & T persons required per thousand employees in different industries/economic sectors.

3.7.2 Following this procedure it is observed that on average for every one thousand workforce in different industry/sectors, the manufacturing sector requires 13.6 degree holders, 19.3 DHs and 310.9 skilled technicians (STs). As against this, the need of the construction sector is 12.9 degree holders, 33.2 DHs and 50.8 STs per thousand employees. For electricity gas & water, the requirements of degree holders, DHs and STs respectively are estimated at 33.8, 58.5 and 101 per thousand employees, Mining and quarrying requires 17.4 degree holders, 15.6 DHs and 39.9 STs. The number of skilled technicians per thousand workers in transport and communication and services sector is much less. On an average for every one thousand employees, the non- agriculture economy requires 5.6 degree holders, 8.6 DHs and 56 other technical persons.

3.25 Norms for Engineering Manpower:1981

Sl. No. Major Indus-try Groups/Sectors	No.of Engg.Personnel employed per one thousand workforce		
	Degree Holders	Diploma Holders	Skilled Techns.
1. Food Products	3.1	5.2	40.7
2. Textiles	7.5	5.4	60.2
3. Rubber, Petroleum	5.9	11.7	571.9
4. Chemicals	28.2	45.9	305.5
5. Basic Metals	14.2	22.7	567.1
6. Non-elect. Engg. Products	25.1	46.0	520.9
7. Electrical Engg. Products	29.3	50.3	687.8
8. Transport Equipment	20.9	19.6	497.1

I. Manufacturing Sector	13.6	19.3	310.9
II. Construction	12.9	33.2	50.8
III. E G & W	33.8	58.5	101.0
IV. Mining & Quarrying	17.4	15.6	39.9
V. T & C	2.3	3.6	15.0
VI. Other Services	2.8	3.3	2.8
All Sectors	5.6	8.6	56.0

3.7.3 It is observed from estimated demand based on Manpower Norms that in manufacturing sector the demand for engineers i.e. degree holders will increase from 1.88 lakh in 1990-91 to 2.30 lakh and 2.90 lakh in 1995-96 and 2000-01 respectively. In all sectors together the demand for degree holders will increase from 4.60 lakh in 1990-91 to 6.11 lakh in 1995-96 and 7.53 lakh in the year 2000-01. On this basis the total need for additional degree holders over the period 1990-91 to 2000-01 is estimated at 2.93 lakh of which 1.02 lakh will be absorbed by the manufacturing, 0.59 lakh by electricity, gas and water (EG & W), 0.53 lakh by construction, 0.51 lakh by services and the rest by transport, communication and other sectors.

3.26 Projected demand for Degree Holders in E & T: 1990-91 to 2000-01 at Scenario - II

Sl. Sectors No.	Projected demand for Degree Holders in E & T: 1990-91 to 2000-01 at Scenario - II (in '000)		
	1990-91	1995-96	2000-01
1. Manufacturing	188.4	230.4	290.3
2. E G & W	62.2	95.2	120.9
3. Construction	75.2	112.2	127.7
4. Mining and Quarrying	31.1	35.3	40.4
5. T & C	22.0	27.5	34.4
6. Services	65.3	92.5	115.8
7. Other Sectors (Trade, Finance)	15.5	18.2	23.4
All Sectors	459.7	611.3	752.9

3.7.4 As against additional demand for 2.93 lakh engineers over the period 1990-91 to 2000-01, the additional demand for DHs is estimated at 4.6 lakh during this period. The overall demand for DHs is estimated at 7.43 lakh in 1990-91 and expected to increase to 9.72 lakh in 1995-96 and to 12.03 lakh in 2000-01. Of the additional demand of 4.6 lakh of DHs, 1.27 lakh shall be absorbed by the manufacturing sector, 1.44 lakh by EG & W sector, 1.1 lakh by the construction sector, 0.44 lakh by the services sector and 0.35 lakh by other sectors.

3.27 Projected Demand for Diploma Holders in E & T : 1990-91 to 2000-01 at Scenario - II

(in '000)

Sl. Sectors No.	1990-91	1995-96	2000-01
1. Manufacturing Sec.	245.1	309.1	371.9
2. E G & W	107.1	183.3	250.7
3. Construction	193.5	247.3	303.3
4. Mining and Quarrying	28.0	31.8	36.4
5. T & C	34.5	43.2	54.1
6. Services	109.6	128.1	153.7
7. Other Sectors (Trade, Finance)	25.6	29.2	33.3
Total	743.4	972.0	1203.4

3.7.5 On this basis the share of manufacturing sector among all DHs will decline from 33.0 percent in 1990-91 to 30.9 percent in 2000-01. As against this, the share of EG & W will increase from 14.4 percent to 20.8 percent. The share of other sectors will change marginally.

3.28 Distribution of Demand of DHs by Sectors: 1990-91 to 2000-01

(in percent)

Sl. Sector No.	1990-91	1995-96	2000-01
1. Manufacturing	33.0	31.8	30.9
2. E G & W	14.4	18.9	20.8
3. Construction	26.0	25.4	25.2
4. Mining & Quarrying	3.8	3.3	3.0
5. T & C	4.6	4.4	4.5
6. Services	14.7	13.2	12.8
7. Other Sector	3.5	3.0	2.8
All Sectors	100.0	100.0	100.0
(N'000)	(743.4)	(972.0)	(1203.4)

3.7.6 Demand for skilled Technicians is expected to increase by 28.94 lakh over the period 1990-91 to 2000-01. The actual demand is expected to be 47.54 lakh in 1990-91, 60.29 lakh in 1995-96 and 76.48 lakh in 2000-01.

3.29 Projected Demand for Skilled Technicians: 1990-91 to 2000-01 at Scenario- II

(in'000)

Sl. Sectors No.	1990-91	1995-96	2000-01
1. Manufacturing	3978	5062	6434
2. E G & W	185	232	295
3. Construction	296	370	475
4. Mining & Quarrying	71	84	93
5. T & C	144	181	226
6. Services	80	100	125
7. Other Sectors	Neg.	Neg.	Neg.
All Sectors	4754	6029	7648

3.7.7 Thus, total demand of E & T Personnel during 1990-91, 1995-96 and 2000-01 will be as shown in table 3.30, 3.31, and 3.32. Total Engineering & Technology personnel demand works out to 59.57 lakh in 1990-91, 76.12 lakh in 1995-96 and 96.04 lakh in 2000-01 indicating a growth rate of 5.0 percent during 1990-91 to 1995-96 and 4.8 percent during 1995-96 to 2000-01.

3.30 Demand for Engineering & Technology Personnel 1990-91 at Scenario - II

(Figures in '000)

Sl. Sector	Degree Holders	Diploma Holders	Ski- lled Techns.	Total
1. Manufacturing	188.4	245.1	3978	4411.5
2. E G & W	62.2	107.1	185	354.3
3. Construction	75.2	193.5	296	564.7
4. Mining and Quarrying	31.1	28.0	71	130.1
5. T & C	22.0	34.5	144	200.5
6. Services	65.3	109.6	80	254.9
7. Other Sectors	15.5	25.6	Neg.	41.1
All Sectors	459.7	743.4	4754.0	5957.1

3.31 Demand for E & T Personnel 1995-96 at Scenario - II

(in '000)

Sl. Sector	Degree Holders	Diploma Holders	Ski- lled Techns.	Total
1. Manufacturing	230.4	309.1	5062	5601.5
2. E G & W	95.2	183.3	232	510.5
3. Construction	112.2	247.3	370	729.5
4. Mining and Quarrying	35.3	31.8	84	151.1
5. T & C	27.5	43.2	181	251.7
6. Services	92.5	128.1	100	320.6
7. Other Sectors (Trade, Finance)	18.2	29.2	Neg.	47.4
All Sectors	611.3	972.0	6029	7612.3

3.32 Demand for E & T Personnel 2000-01 at Scenario - II

(in '000)

Sl. Sector	Degree Holders	Diploma Holders	Ski- lled Techns.	Total
1. Manufacturing	290.3	371.9	6434	7096.2
2. E G & W	120.9	250.7	295	666.6
3. Construction	127.7	303.3	475	906.0
4. Mining and Quarrying	40.4	36.4	93	169.8
5. T & C	34.4	54.1	226	314.5
6. Services	115.8	153.7	125	394.5
7. Other sectors	23.4	33.3	Neg.	56.7
All Sectors	752.9	1203.4	7648	9604.3

3.7.8 The average growth rate in demand for degree holders is estimated at 5.9 percent over the period 1990-91 to 1995-96 and 4.3 percent over the period 1995-96 to 2000-01. The overall rate of growth in demand for DHs is estimated at 5.5 percent and 4.4 percent per annum over the periods 1990-91 to 1995-96 and 1995-96 to 2000-01 respectively. The growth rate for Skilled Technicians will be 4.9 percent during entire period of 1990-91 to 2000-01.

3.33 Growth Rate of Demand, 1990-91 to 2000-01 at Scenario - II

(Percent per annum)

Sl. Category	1995-96 over 1990-91	2000-01 over 1995-96
1. Degree Holders	5.9	4.3
2. Diploma Holders	5.5	4.4
3. Skilled Technicians	4.9	4.9
Over all	5.0	4.8

3.8 Supply-Demand Balance

3.8.1 It is interesting to note that projected demand and its respective shares by industries/sectors as worked out by two different methods, by and

large, correspond. Most probably this happens because sector-output which has been adopted as the first criterion (Scenario-I) for estimation of manpower requirement itself is a function of number of persons employed in each sector which has been adopted as the second criterion (Scenario-II). Thus, a degree of relationship between turnover/production, number of persons employed and number of technical persons required is expected.

3.8.2 Using the estimates derived by these two different methods described as scenario-I and scenario-II, a balance between supply and demand has been derived. For this purpose, the demand has been estimated as the average demand as worked out from Scenario-I and Scenario-II already explained. Supply has been worked out independently on the basis of existing stock and estimated additions to stock through the educational facilities already established.

3.8.3 Taking this into account, for degree holders in 1990-91 a surplus of 13.1 thousand persons has been arrived at. This shows that there is a surplus capacity of about 3 percent which will explain the level of unemployment at any point of time. This apparently is not too high and is desirable keeping in view the frictional unemployment and need of movement of persons from one area to another and from one trade to another. This level of surplus is also necessary to provide the employers with some degree of choice and also for some degree of competition as between those seeking technical work.

3.8.4 By 1995-96 the position is expected to get worse with a shortage of 33.2 thousand persons as compared to availability. This shortage will have to be provided for through expansion of the educational system for which planning must start straightway. By 2000-01 the shortage of degree holders is expected to increase to 53.6 thousand which can create a crisis in the market for degree holders. Therefore, there is a need to set up additional institutions to

provide for this prospective need for degree holders in the country.

3.34 Manpower Balance-Degree Holders (in '000)

Year	Demand			Supply	Surplus (+)/ Shortage (-)
	Scena-rio-I	Scena-rio-II	Aver-age		
1990-91	448.2	459.7	453.9	467	(+)13.1
1995-96	601.0	611.3	606.2	573	(-)33.2
2000-01	740.2	752.9	746.6	693	(-)53.6

3.8.5 Apparently enough capacity has been created to provide for diploma holders at present and future. A surplus of 64.2 thousand among DHs which works out as 7.99 percent of supply has been estimated for the year 1990-91. This surplus will reduce to 2 thousand by the year 2000-01. This will happen after taking into account the possible increase in supply from the educational system as it stands at present and its likely development over future years without any specific intervention on the basis of this study.

3.35 Manpower Balance -Diploma Holders (in '000)

Year	Demand			Supply	Surplus (+) Shortage (-)
	Scena-rio-I	Scena-rio-II	Aver-age		
1990-91	736.2	743.4	739.8	804	(+)64.2
1995-96	963.7	972.0	967.9	998	(+)30.1
2000-01	1232.5	1203.4	1218.0	1220	(+) 2.0

3.8.6 It has not been possible to work out supply level for Skilled Technicians because in this case supply becomes open ended i.e while part (roughly one-third of the supply) of

these personnel is from ITIs, major portion of requirement is met through other sources including on-the-job training and experience in handling the job. Each Institution normally generates its own supply and one need not seriously plan in this direction except that a basic level of education and training should be maintained and younger generation should be increasingly made vocation oriented at pre-school and pre-university levels. This means that curricular should increasingly focus on scientific and technical culture so that persons coming out of the educational system should have appropriate aptitude to take up and quickly adopt themselves to technical work.

3.9 Specific Industry Needs

3.9.1 The industry has been experiencing shortages in specific subject sectors which need immediate and urgent attention. The sectors which have been specifically mentioned in the context of shortages of E & T personnel are electronics industry and telecommunications.

3.9.2 The difficulties largely mentioned in these sectors are that the products of educational institutions are not able to maintain and repair some of the equipments and systems put into operation in these sectors because these persons do not have enough on-the-job training/experience. This suggests that there is an over emphasis on theoretical training as compared to practical training. The industry has desired shift in training package of fresh graduates so that a large number of new installations/systems that are being established in the area of electronics and tele-communications with respect to industrial needs are properly maintained and kept productive rather than be allowed to go into disuse soon after huge investments have been made for want of trained/experience technical personnel.

3.9.3 Another area is the manpower needs of the ocean sector. Some of the

areas of research in ocean technology are frontier areas of new technologies but have large prospects. There is a need to set up specialised institutions to take care of these sectors.

3.9.4 Energy sector is another important area requiring attention as regards the supply of technical manpower. Here again new technologies have been developed to meet needs of the extensive rural sector but sufficient manpower of adequate capabilities is not available to meet the requirements. In this context the installation and maintenance work is done by technologists who do not have sufficient experience and understanding of what they are doing. As a result considerable damage is done not only to the specific investments but also to the system at large.

3.9.5 A few other selected sectors mentioned by the industry experiencing shortages include food processing industry particularly food and dairy technologists, textile design and printing technologists, rubber technologists, computer scientists and electrical engineers, mechanical and automobile engineers, tool designing and quality control engineers and electronic engineers.

3.9.6 Some more specific requirements have been mentioned for technical persons for servo control system, cryogenics, microwave engg., computer science, bio-technology, application and maintenance engg.

3.9.7 Keeping in view the need for providing technical manpower in these specific areas and capabilities of our technical institutions as already exist, it appears that some of these shortages can be resolved through greater linkages between industry and technical education. This seems possible if the following steps are taken in right earnest: (i) Providing industrial assignments to educational faculties, (ii) Providing vocational training for students with the industry, (iii) Re-orientation of under-graduate projects with more practical approach in keeping

with industry needs which can be easily identified closely to the institution to which these under-graduates belong; (iv) Continuing education facilities for working engineers with possibilities for sabbatical leave leading to updating of knowledge, (v) Annual lecture series and research reviews in which teachers, students and practitioners are able to participate and; (vi) Setting up programmes of industrial associates in which members of the teaching faculties are drawn by the industry to work on their specific problems.

**3.10. Technical Education:
Some field Observations**

3.10.1 During field survey some interviews were carried out in educational institutions like engineering colleges and technical institutes. In all 142 technical/engineering colleges were interviewed through personal contacts and 8 through postal contacts. Besides, bio-data details 675 employees were also collected.

3.10.2 Data reveal that out of the total technical manpower engaged in technical and engineering education in 1987-88, the share of females engaged in technical education was 13.5 percent.

3.10.3 The average age of technical persons engaged in education sector was observed at 41.3 years. The distribution by age groups is given in table 3.36(a).

3.36(a) Distribution of Technical S & T personnel in education Sector by Age (in percent)

Age (in years)	Share
Upto 25	2.4
26 - 30	11.2
31 - 35	13.4
36 - 40	15.8
41 - 45	20.0
46 - 50	18.0
Above 50	19.2
Total	100.0
N	675
Average Age (in years)	41.3

Source: CERPA Field Survey

3.10.4 Relatively there were more females in the age group of 31 - 35 years and 41 to 45 years as compared to other age groups.

3.36(b) Distribution of Technical Personnel by Sex/Age

(in percent)

Age (in years)	Male	Female	Total	N
Upto 25	87.5	12.5	100.0	16
26 - 30	86.7	13.3	100.0	76
31 - 35	83.3	16.7	100.0	90
36 - 40	87.7	12.3	100.0	107
41 - 45	82.7	17.3	100.0	135
46 - 50	90.9	9.1	100.0	121
Above 50	87.7	12.3	100.0	130
Total	86.7	13.3	100.0	675
Average age (in years)	41.5	40.8		

Source: CERPA Field Survey

3.10.5 The average remuneration in the education sector was observed at Rs.3033 which was relatively higher than for average R & D manpower. The distribution by income slabs is shown in Table 3.36(c)

3.36(c) Distribution of Technical Personnel in Education Sector by Income

Income (in Rs. per month)	share
Upto 1500	6.7
1501 - 2000	9.8
2001 - 2500	14.9
2501 - 3000	13.3
3001 - 3500	14.7
3501 - 4000	25.2
4001 - 4500	15.4
Total	100.0
N	675
Average income (in Rs per month)	3037

Source : CERPA Field Survey.

3.10.6 Interestingly there were relatively higher percentage of female technical personnel in the income range of Rs.3501 to Rs.4000 and also in lower income range of Rs.1501 to Rs.2000.

3.36(d) Distribution of Technical Personnel by Sex/Income (in percent)

Income per month (in Rs.)	Male	Female	Total	N
Upto 1500	84.4	15.6	100.0	45
1501 - 2000	83.3	16.7	100.0	66
2001 - 2500	85.2	14.8	100.0	101
2501 - 3000	91.1	8.9	100.0	90
3001 - 3500	87.9	12.1	100.0	99
3501 - 4000	82.9	17.1	100.0	170
4001 - 4500	91.4	8.6	100.0	104
Total	86.5	13.5	100.0	675
Average Income (in Rs./month)	3048	2964	3037	

Source: CERPA Field Survey

3.10.7 The average income as in 1987 - 1988 was observed to consistently increase as technical persons go up the age group. The average income was seen to increase from Rs. 2162 for age group upto 25 years to Rs. 3606 for the age group above 50 years.

3.10.8 The share in intake by level of technical course and also share in out-turn is shown in table 3.37. This table shows that about 4/5th of intake was for

Bachelor of Engineering degree consisting of more popular subjects of Civil, Mechanical, Electrical, Chemical, Electronics, Metallurgy and Mining. Intake in the computer sector is 2.9 percent, in the Architecture 1.4 percent and a lesser proportion was in other branches.

3.10.9 Table 3.37 also shows that out-turn in some of the conventional branches was somewhat higher than in the non-conventional branches such as M.Tech (Hydraulics), Computer technology etc. Because of this reason, for those who joined the S & T labour market relatively larger proportion was of those with conventional training and education. Whereas pass percentage in B.E Mechanical and B.E civil was respectively 80 to 93 percent, pass percentage in M.Tech (Structure), M.Tech (Hydraulics), Urban Planning, Industrial Management and similar other non-conventional subjects was much less. This table also shows approximately one-third wastage in over-all S & T Technical manpower and relatively higher wastage level in non-conventional subjects indicating need for greater strictness in admission to these courses and greater care in quality of training.

3.10.10 Projected growth rates for selected E & T disciplines during 1985-2000 is presented in table 3.38.

3.36(e) Distribution of S & T Personnel by Age/Income (in percent)

Age (in years)	Income in Rs. per month							
	Upto 1500	1501 2000	2001 2500	2501 3000	3001 3500	3501 4000	4001 4500	Average Income
Upto 25	8.9	9.2	2.0	-	2.0	0.6	1.0	2162
26 - 30	39.9	26.2	18.8	9.1	10.1	1.2	1.0	2164
31 - 35	13.2	20.0	19.8	12.5	17.2	9.4	6.7	2677
36 - 40	11.1	20.0	17.8	18.2	16.2	17.1	8.6	2801
41 - 45	6.7	10.8	17.8	27.3	22.2	25.9	14.4	3164
46 - 50	8.9	4.6	14.8	25.0	21.2	18.8	23.1	3289
Above 50	11.3	9.2	9.0	7.9	11.1	27.0	45.2	3606
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-
N	45	66	101	90	99	170	104	
Av. Age (in yrs)	34.9	35.4	38.4	41.4	40.6	44.3	46.7	

Source : CERPA Field Survey.

3.37 Course-wise Intake-Outturn
in 1987-1988
(in percent)

Sl. No.	Sub-Name	In-take	Out-turn	Outturn as percent of the intake
1.	B.E (Civil)	21.6	30.4	93.07
2.	B.E (Mech.)	19.2	23.3	80.24
3.	B.E (Elect.)	16.0	15.6	64.45
4.	B.E (Chem.)	6.6	4.6	47.08
5.	B.E.- (Electronics)	11.5	10.6	60.57
6.	B.E(Metallurgy)	3.5	3.8	71.22
7.	B.E (Mining)	4.1	2.8	45.00
8.	B.E (Computer)	2.9	0.8	17.24
9.	B.E (Arch)	1.4	1.5	72.73
10.	M.Tec.(Environ.)	0.7	0.4	40.74
11.	M.Tech.(Int. power system)	0.5	0.4	47.62
12.	M.Tech.(Ferro- Alloy Tech.)	0.2	0.2	100.00
13.	M.Tech. (Electronics)	0.6	0.8	84.61
14.	M.Tech. (Structure)	1.3	1.0	51.92
15.	M.Tech. (Hydraulics)	0.4	0.2	29.41
16.	M.Tech.(Urban Planning)	1.2	0.6	34.04
17.	M.Tech. (Production)	1.1	0.6	38.09
18.	M.Tech.(Heat, Power Engg)	0.5	0.7	85.71
19.	P.G.Dipl(Ind. Management)	1.5	0.2	10.00
20.	Dipl(Mech.)	1.3	0.4	22.00
21.	Dipl(Elect.)	1.3	0.5	26.00
22.	Dipl(elec- tronics)	1.3	0.3	18.00
23.	Dipl(Chem.)	1.3	0.3	18.00
Total		100.0	100.0	
N		1972	1307	66.3

Source: CERPA Field Survey

3.38 Projected Growth Rates for Selected
Engineering and Technology Disciplines (%)

Degree/Subject of Specialisation	Growth Rate During 1985-2000
1. Civil Engg.	2.45
2. Mechanical	1.32
3. Electrical	0.67
4. Electronics	3.51
5. Chemical Engg.	3.20
6. Mathematics	0.86
7. Chemistry	-0.27
8. Physics	Nil
9. Applied Mechanics	2.65
10. Metallurgy	-0.25
11. Humanities	0.64
12. Training Placement Dept.	9.68
13. Computer Engg.	7.60
14. Architecture	0.40
15. Production	5.81
16. Mining	2.48
17. Urban Planning	4.73
18. Structure	4.73
Total	1.71

Source: CERPA Field Survey

3.10.11 Table 3.39 gives the general pattern of staff by educational qualifications in the manufacturing sector as far as scientific and technical staff is concerned. This shows that structural engineers who at the moment constitute about 0.45 percent of total tech. staff shall increase their share to 0.72 percent. Similar increase in share of tech. persons in the selected sectors such as urban planning, production engg., computer engg., training placement and applied mechanics will take place. Also the share of chem. engg. in total manpower is expected to go up from 6.67 percent as at present to 8.29 percent in the year 2000. The share of electronics engineers will also increase from 9.15 percent as at present to about 11.9 percent by the year 2000. As against this, the share of selected disciplines will decline. This will include mechanical, electrical engg., metallurgy & architecture and training in pure mathematics, chemistry & physics.

3.39 Distribution of Technical Staff by Subject in Selected Manufacturing Establishments

(in percent)

Degree/sub. of Specialisation	Actual Staff			Expected Staff	
	1985-86	86-87	90-91	95-96	2000-01
Civil Engineering	16.00	15.44	17.56	18.15	17.79
Mechanical Engg.	18.60	18.79	17.83	17.89	17.55
Electrical Engg.	16.27	14.86	13.67	14.21	13.94
Electronics	9.15	12.67	12.47	11.52	11.90
Chem. Engineering	6.67	7.14	7.24	7.60	8.29
Metallurgy	8.53	6.41	6.30	6.49	6.37
Comp. Engineering	0.62	0.86	0.94	0.99	0.96
Architecture	2.48	2.33	2.28	2.08	2.04
Production (industrial)	0.47	0.44	0.54	0.61	0.84
Mining	2.79	3.50	3.22	3.19	3.14
Urban Planning	0.31	0.44	0.40	0.49	0.48
Structural	0.45	0.57	0.67	0.61	0.72
Others	17.66	16.55	16.88	16.17	15.98
Total	100.00	100.00	100.00	100.00	100.00
N	645	686	746	816	832

Source: Based on CERPA Postal Interviews among selected Manufacturing establishments.

3.11 Some structural details : Industry Sector

& Beverages and Textile, the number of persons required per Rs. one lakh of turnover was only 0.15 and 0.14 persons respectively.

3.11.1 In the course of field survey, 1621 industrial units were contacted out of which majority i.e 905 units (55.83 percent) belonged to Metal products industry. In percentage, the next in ranking were Paper & Leather industry (17.83 percent), Textile industry (14.25 percent), Transport industry (6.66 percent), Food and Beverage industry (2.78 percent) and others (1.23 percent). The industrial units covered in Electricity, gas & steam were less than one percent each and only 2 units were covered in Water Sector.

3.11.2 Number of personnel required per Rs. one lakh of turnover was highest in Electricity (2.97 persons) followed by Transport (2.77 persons) and Paper & Leather industry (1.58 persons). In Food

3.11.3 Distribution of technical personnel by age as in 1987-88 presented in table 3.40(a) shows that, for all industrial sectors together, 12.72 percent were below 25 years of age and another 36.91 percent were of 25-35 years age group. In more than 55 years of age group there were only 4.2 percent of them. At disaggregate level distribution varied widely. While 97.5 percent of the personnel in Iron ore industry were below the age of 25 years, in Electricity, Gas & water no one was in this age group. Similarly, in the age group of above 55 years no one was working in Iron ore industry, although a high percentage of those working in water and other industries were of this age group.

3.40(a) **Distribution of Technical personnel by age group in major Industry - groups**

(in percent)

Industry	Age groups (years)					Total	Average age
	Less than 25	25-35	35-45	45-55	Above 55		
Iron ore	97.52	-	1.65	0.83	-	100.0	23
Food & Beverage	9.75	34.15	28.05	25.61	2.44	100.0	38
Textile	9.41	36.86	32.55	17.26	3.92	100.0	38
Paper & Leather	5.63	42.89	33.09	14.47	3.92	100.0	37
Metal Products	9.76	43.80	32.29	12.14	2.01	100.0	36
Transport	6.98	52.71	30.23	8.53	1.55	100.0	35
Electricity	-	50.00	50.00	-	-	100.0	36
Water	-	19.05	66.67	4.76	9.52	100.0	41
Other	2.50	19.28	40.00	23.93	14.29	100.0	43
All Sector	12.72	36.91	31.82	14.35	4.20	100.0	37

Source : CERPA Field Survey.

3.11.4 Female technical personnel as proportion to male was high (at 16.67 percent)in Electricity Industry. In Food & Beverages the proportion was 3.66 percent, in Paper & Leather 2.7 percent and in Transport and Metal products, around 1.6 percent. In all sectors combined there were 4.96 female personnel for every 100 male personnel.

3.11.5 Distribution of Engineering and Technical personnel in Major Service Industry groups presented in(table 3.40-(b) shows that the share of younger age

below 25 years was somewhat less i.e. 3 percent and that also restricted to Education, Hospital and R & D Sectors.

3.11.6 By income, it was observed that in 1987-88, 8.36 percent of the total S & T personnel, were in the income bracket of less than Rs. 1000 per month, 38.5 percent in the income bracket of Rs. 1001-2000, 23.4 percent in the income bracket of Rs. 2001-3000, 16.7 percent in the income bracket of Rs. 3001-4000 and 12.9 percent in the income bracket of more than Rs.4000 per month.

3.40 (b) **Technical Personnel by Age group in Major Service Sector**

(in percent)

Service Sector	Age groups (years)					Total	Average
	Less than 25	25-35	35-45	45-55	Above 55		
Electricity, Gas & Water	-	15.85	62.19	13.42	8.54	100.0	42
Transport & Communication	-	16.28	50.00	29.07	4.65	100.0	43
Education	2.38	24.55	35.56	33.04	4.47	100.0	42
Hospital	2.60	26.46	40.13	24.30	6.51	100.0	41
Health Education	-	16.39	34.43	34.42	14.76	100.0	45
R & D	9.31	31.38	34.14	25.17	-	100.0	38

Source: CERPA Field Survey

**3.40(c) Distribution of Technical personnel in
Major Industry groups by Income Slab** (in percent)

Industry	Income Slab (Rs.)					Total	Average Income
	Upto 1000	1001 2000	2001 3000	3001 4000	Above 4000		
Iron ore	35.84	35.82	20.00	5.84	2.50	100.0	1623
Food & Beverages	3.66	32.93	32.93	13.41	17.07	100.0	2582
Textile	1.82	37.46	24.36	17.81	18.55	100.0	2643
Paper & Leather	6.91	37.46	20.10	16.03	19.56	100.0	2559
Metal Products	7.80	37.04	22.15	17.08	15.03	100.0	2339
Transport	7.15	41.83	30.38	11.91	8.73	100.0	2264
Electricity	-	44.45	33.33	22.22	-	100.0	2278
Water	36.36	36.36	13.64	13.64	-	100.0	1637
Others	6.84	34.53	25.73	22.80	10.10	100.0	2465
Total	8.36	38.53	23.44	16.72	12.95	100.0	2395

Source: CERPA Field Survey

3.11.7 This distribution by income differs for each industry group. In Iron ore industry and water sector about 36 percent of workers were in the income bracket of less than Rs. 1000 per month, whereas in other industry groups, personnel in the income group of less than Rs. 1000 were very much less (1.82 percent to 7.8 percent). Similarly for Food & Beverages, Textile, Paper & Leather and Metal products, percentage of personnel with monthly salary higher than Rs.4000 was relatively higher (between 15 to 20 percent) than Iron ore and Transport industries where respectively

2.5 and 8.73 percent of personnel were with monthly salary above Rs. 4000.

3.11.8 Share of female technical personnel were relatively higher in lower income groups. In the income group of less than Rs.1000, 24.34 percent share was occupied by females whereas in the income group of Rs.3000 to Rs.4000 only 1.4 percent share was occupied by them.

3.11.9 Distribution of technical personnel by income slabs for Services Sector, as in 1987-1988, was as under.

**3.40(d) Distribution of Technical personnel in Service Sector
by Income Slab & Sector** (in percent)

Amenities	Income Slab in Rs.					Total	Average
	Upto 1000	1001 2000	2001 3000	3001 4000	Above 4000		
Electricity, gas & water	-	85.92	9.86	4.22	-	100.0	1732
Transport & Communication	4.65	43.03	36.04	16.28	-	100.0	2331
Education	5.03	11.41	28.29	29.86	25.41	100.0	3004
Hospital	12.65	19.41	33.53	34.41	-	100.0	2428
Health Ed.	-	15.39	26.92	57.69	-	100.0	2923
R & D	-	17.95	25.64	47.01	9.40	100.0	2978

Source: CERPA Field Survey

3.11.10 Distribution of S & T personnel 1987-1988 is presented in table 3.40 (e) by sex for different industries, as in below.

3.40(e) Distribution of Technical Personnel in Major Industry groups by Sex (in percent)

Industry	Male	Female	Total	N
Iron ore	100.0	-	100.0	1623
Food & Beverages	96.34	3.66	100.0	2582
Textile	99.64	0.36	100.0	2643
Paper & Leather	97.30	2.70	100.0	2559
Metal Products	98.35	1.65	100.0	2339
Transport	98.41	1.59	100.0	2264
Electricity	83.33	16.67	100.0	2278
Water	100.00	-	100.0	1637
Others	48.21	51.79	100.0	2465
Average	91.10	8.90	100.0	20390

Source: CERPA Field Survey

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OBJECTS :

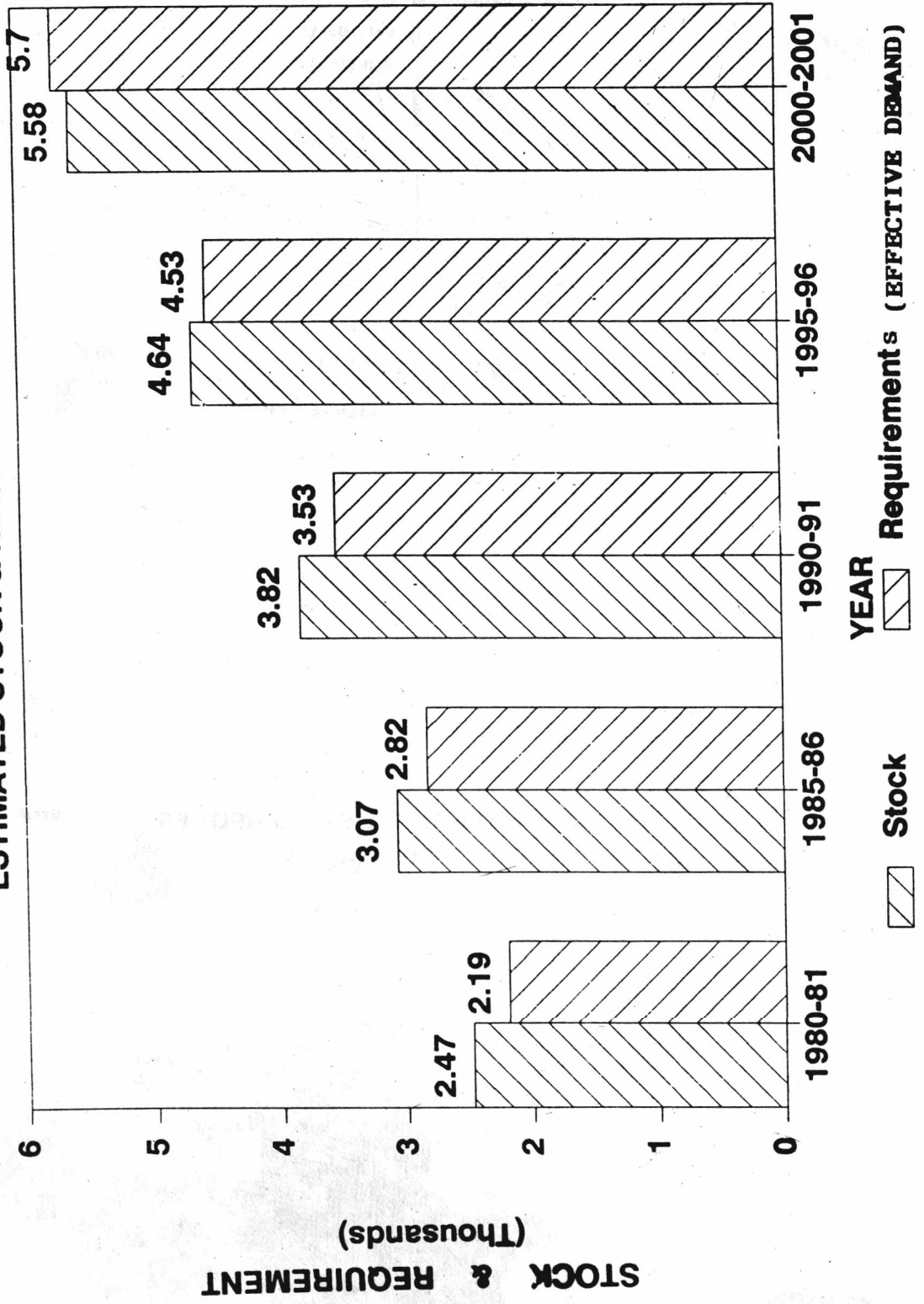
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(i) To undertake charitable activity for the relief of the poor; education, medical relief and other acts of general public utility, without any profit motive, and in particular (ii) To organise research planning and action to promote social and economic independence among the poor, to enable them to secure an increasing share in the fruits of national development. (iii) To promote use of appropriate technology in indigenous and need based industry (iv) To provide facilities to meet the credit needs of the poor, to protect them from usury, in any shape or form. (v) To undertake education and training activity to assist in the effective implementation of national laws and policies intended or framed to help the poor. (vi) To provide medical relief wherever feasible (vii) To undertake other activities of general public utility like research, planning and action relating to : (a) Problems in the domain of Finance Currency, Industry, Commerce, Economics, Science and Sociology or (b) The changing patterns of Agriculture, Irrigation, Industry, National Income, Population, Transport, Power, etc., (c) Economic and Social problems-environmental, sanitation, beneficial utilisation of natural resources and to propose workable solutions to assist national planning and development, on area basis.

Graph-1

ECONOMICALLY ACTIVE S&T MANPOWER

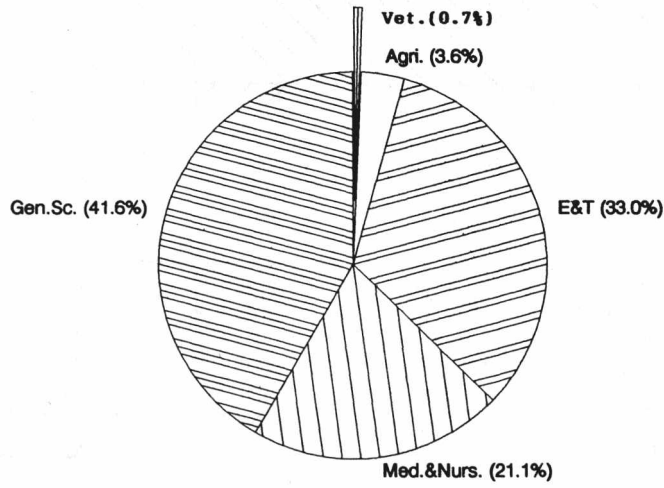
ESTIMATED STOCK & REQUIREMENT



Graph-2 (a)

ECONOMICALLY ACTIVE S&T MANPOWER

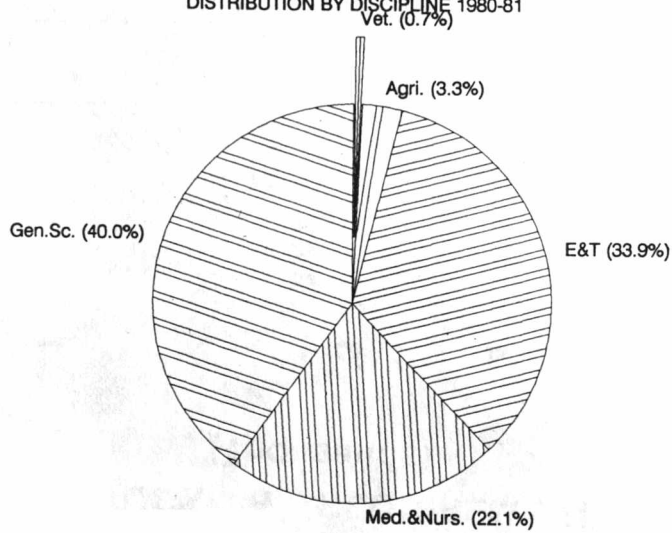
DISTRIBUTION BY DISCIPLINE 1985-86



Graph-2 (b)

ECONOMICALLY ACTIVE S&T MANPOWER

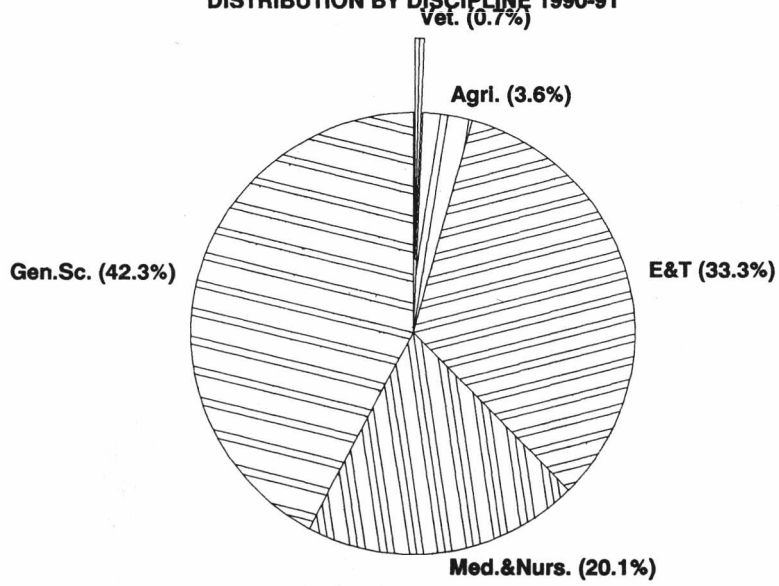
DISTRIBUTION BY DISCIPLINE 1980-81



Graph-2(c)

ECONOMICALLY ACTIVE S&T MANPOWER

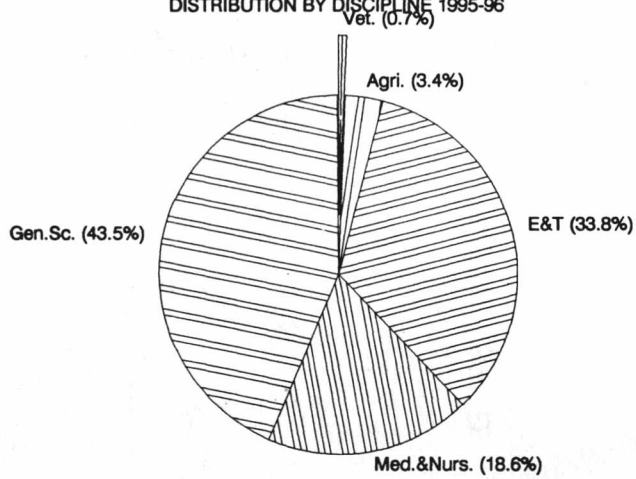
DISTRIBUTION BY DISCIPLINE 1990-91



Graph-2(d)

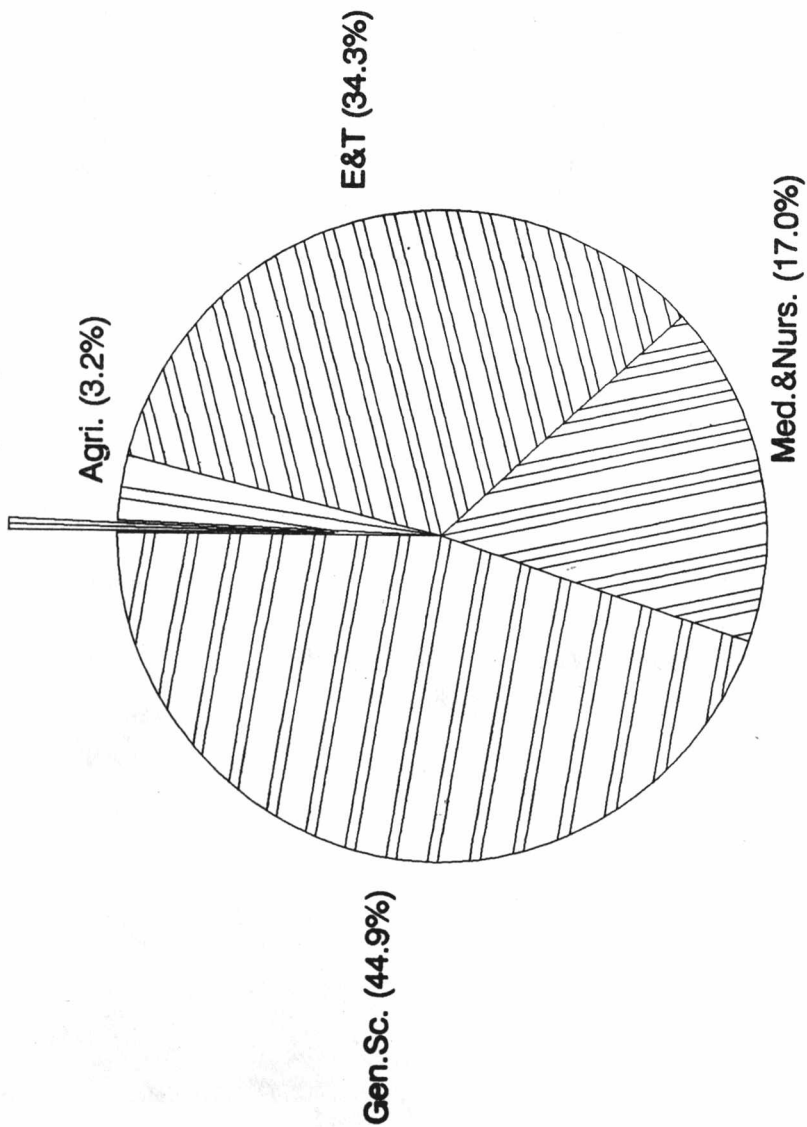
ECONOMICALLY ACTIVE S&T MANPOWER

DISTRIBUTION BY DISCIPLINE 1995-96



ECONOMICALLY ACTIVE S&T MANPOWER

DISTRIBUTION BY DISCIPLINE 2000-01
Gen. (44.9%)
E&T (34.3%)
Med.&Nurs. (17.0%)
Agri. (3.2%)
 Vet. (0.6%)

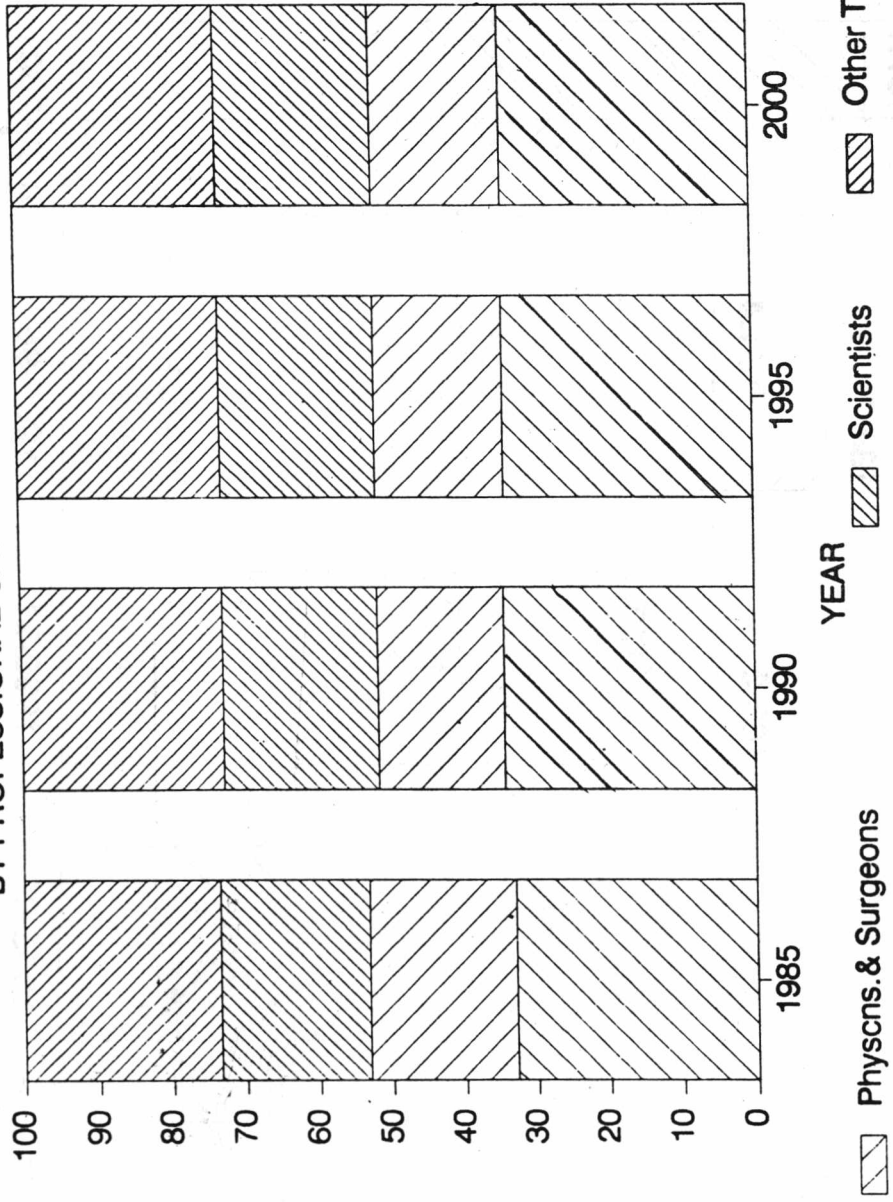


Graph-3

DISTRIBUTION OF S&T MANPOWER ABROAD

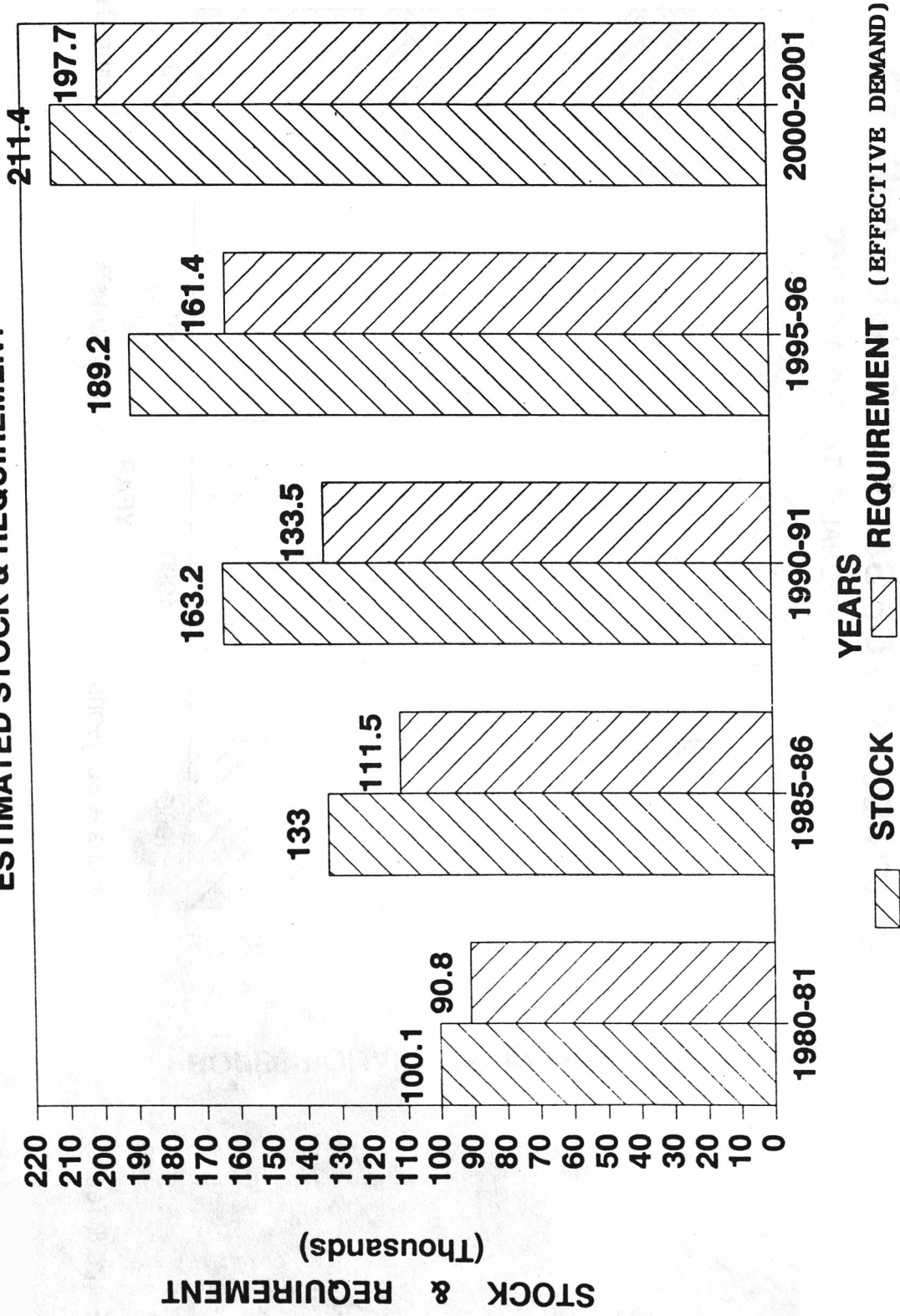
BY PROFESSIONAL CATEGORY 1985-2000

PROFESSIONAL CATEGORY (dist. in %)

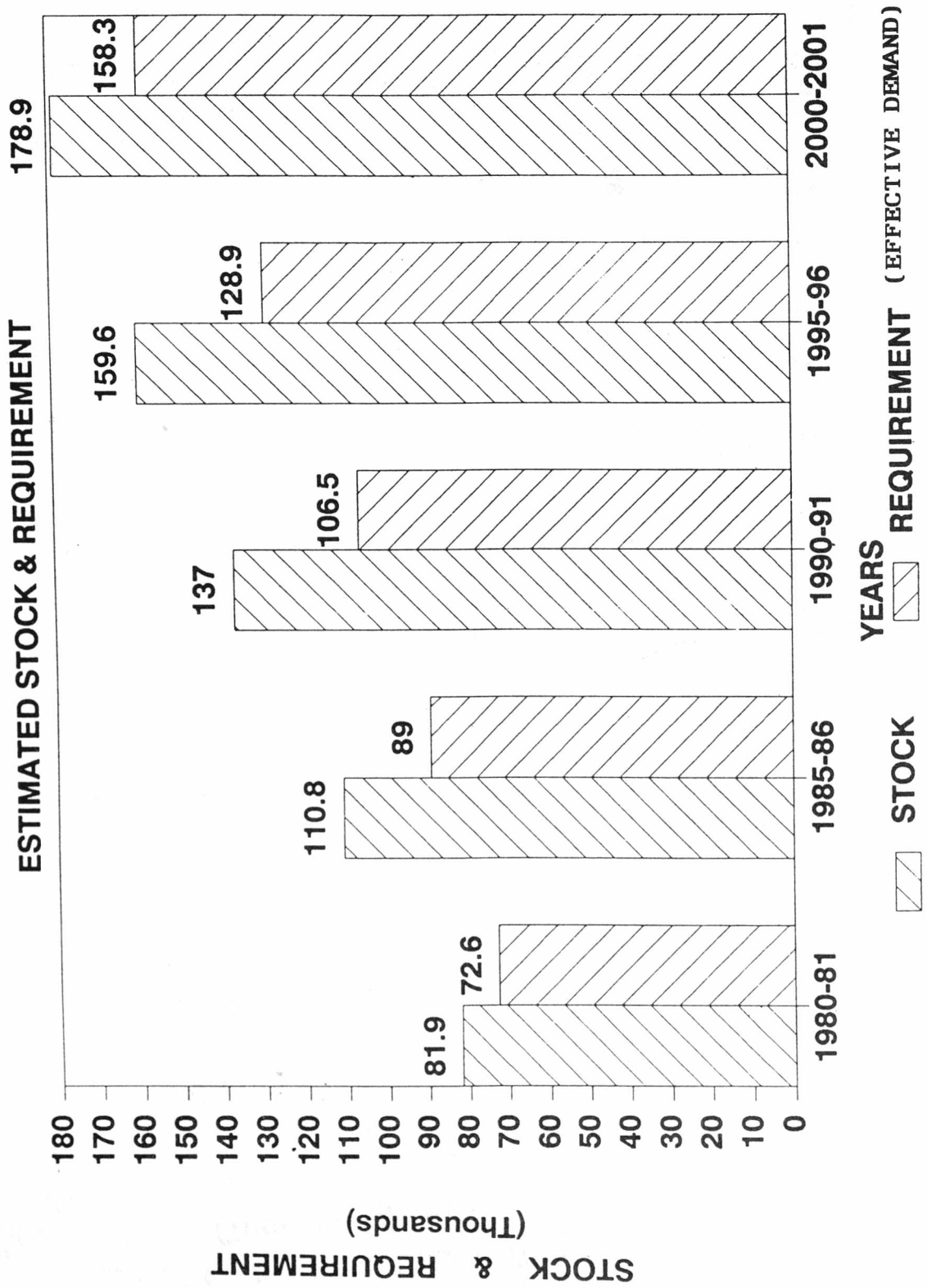


ECON. ACTIVE Ag.Sc. & V.Sc. MANPOWER

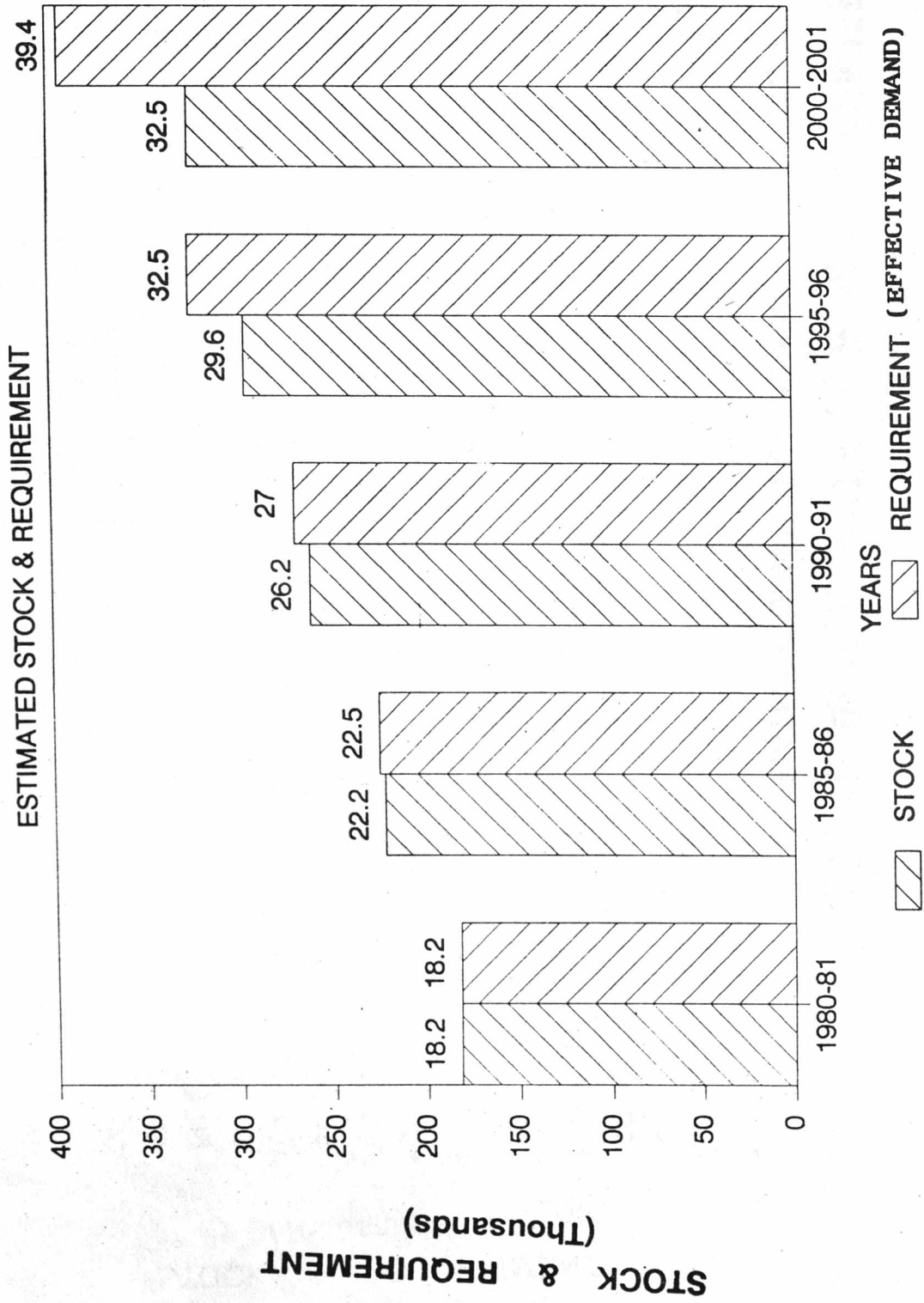
ESTIMATED STOCK & REQUIREMENT



ECON. ACTIVE AGRI. SCIENCE MANPOWER

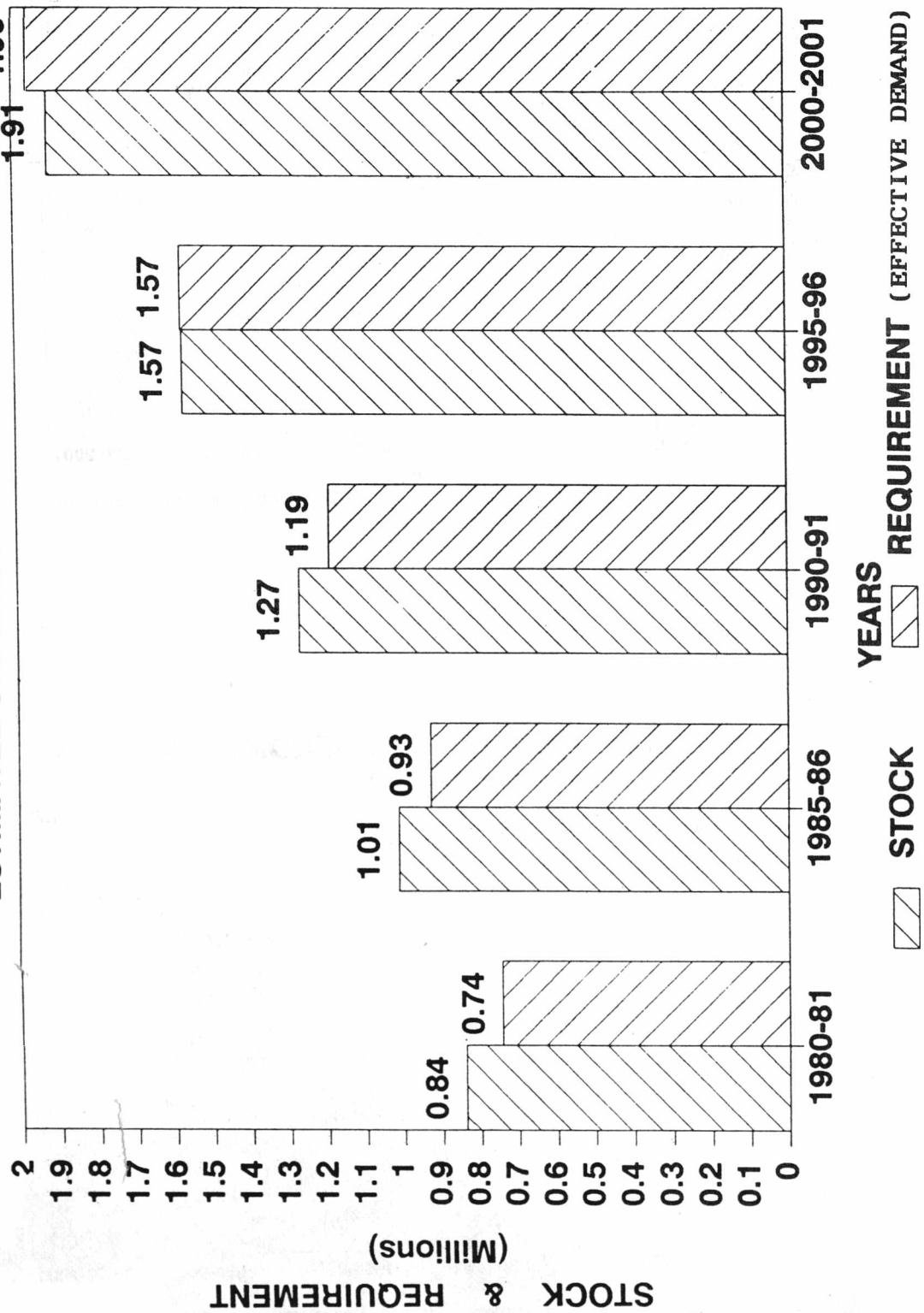


ECON.ACTIVE VETERINARY SCIENCE MANPOWER

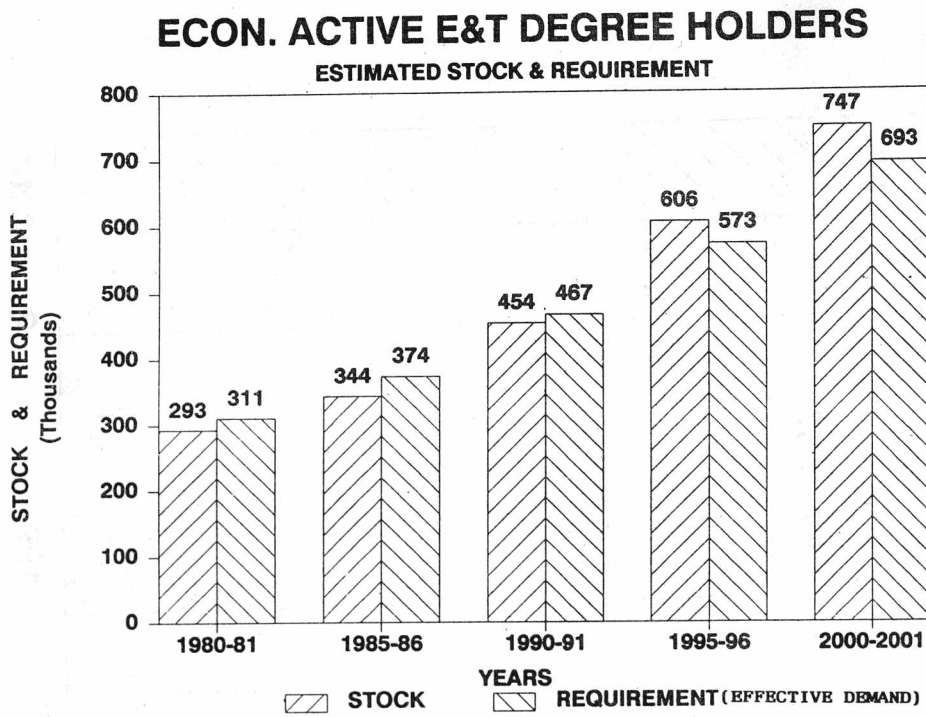


ECON. ACTIVE E&T MANPOWER

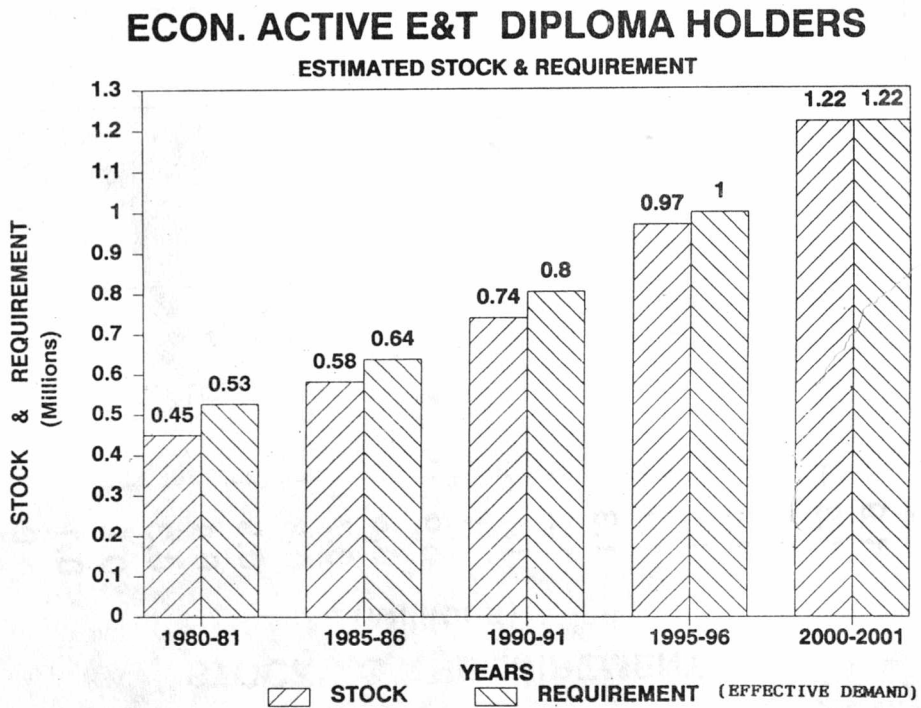
ESTIMATED STOCK & REQUIREMENT



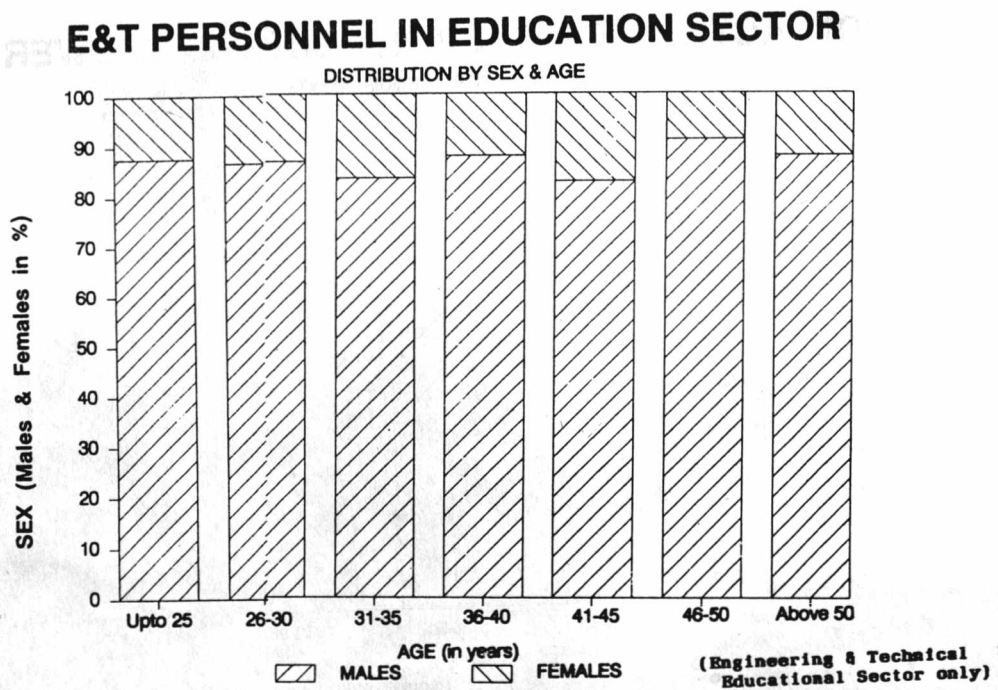
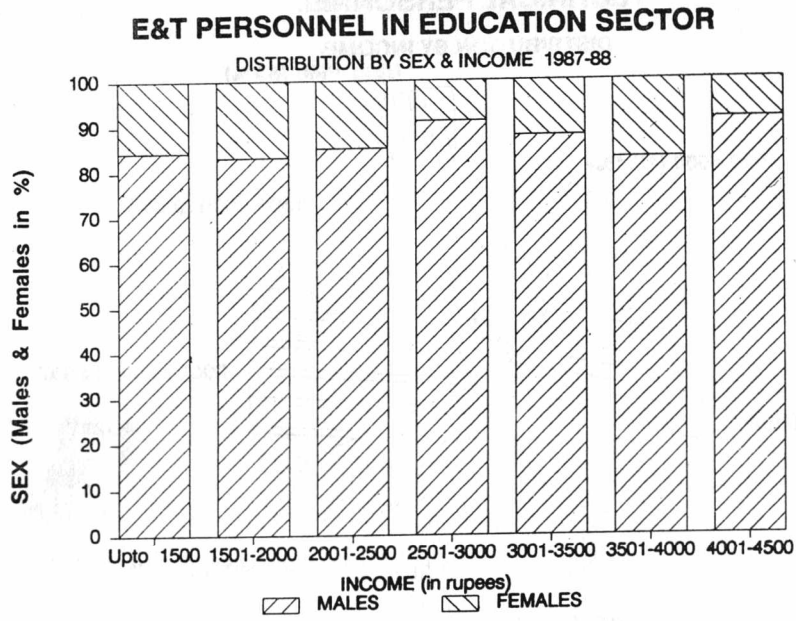
Graph-8 (a)



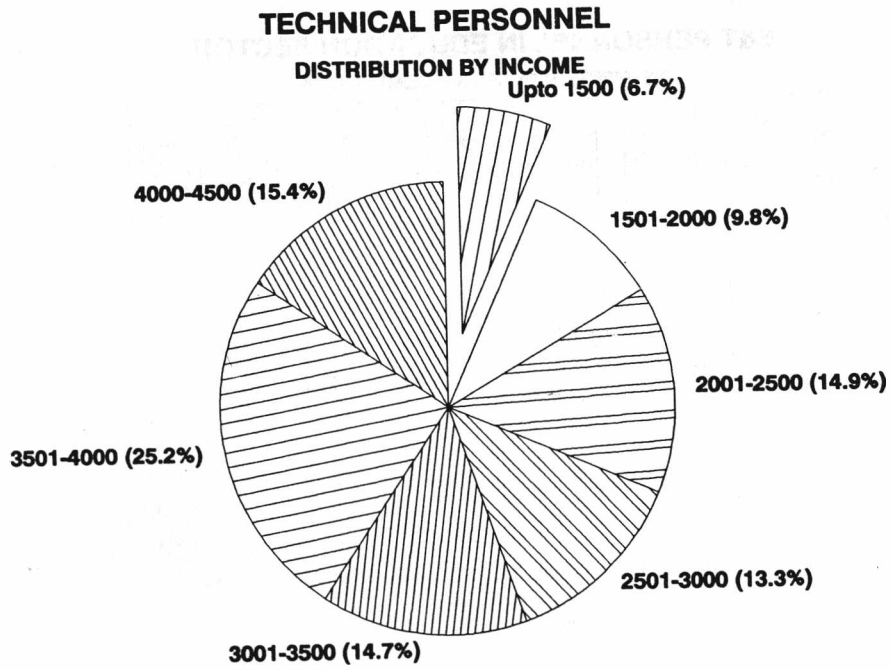
Graph-8 (b)



Graph-9

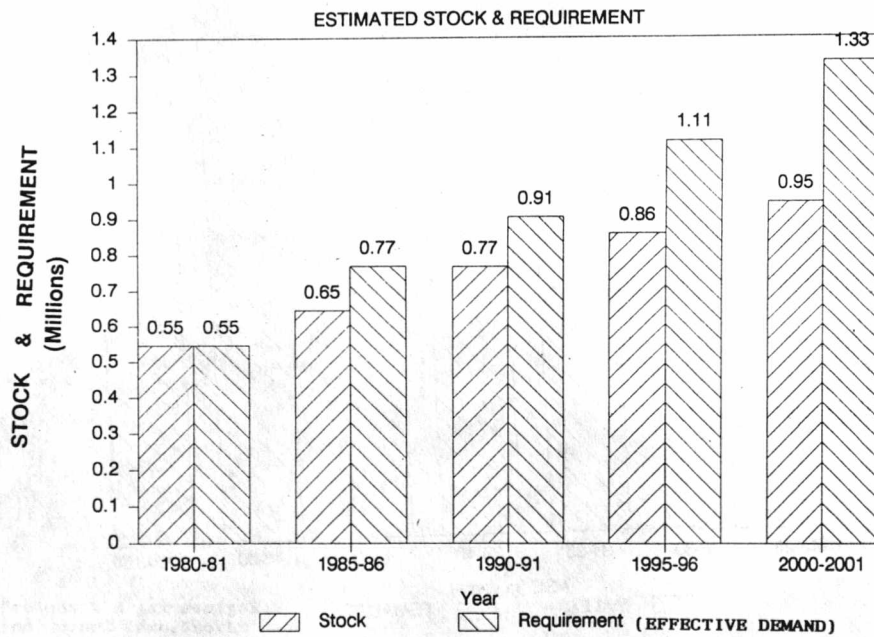


Graph-11

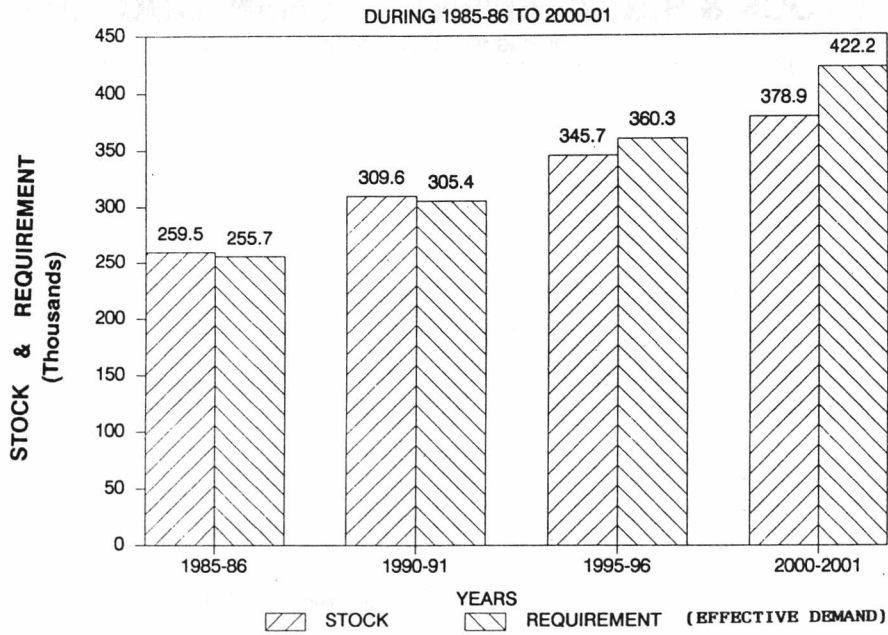


Graph-12

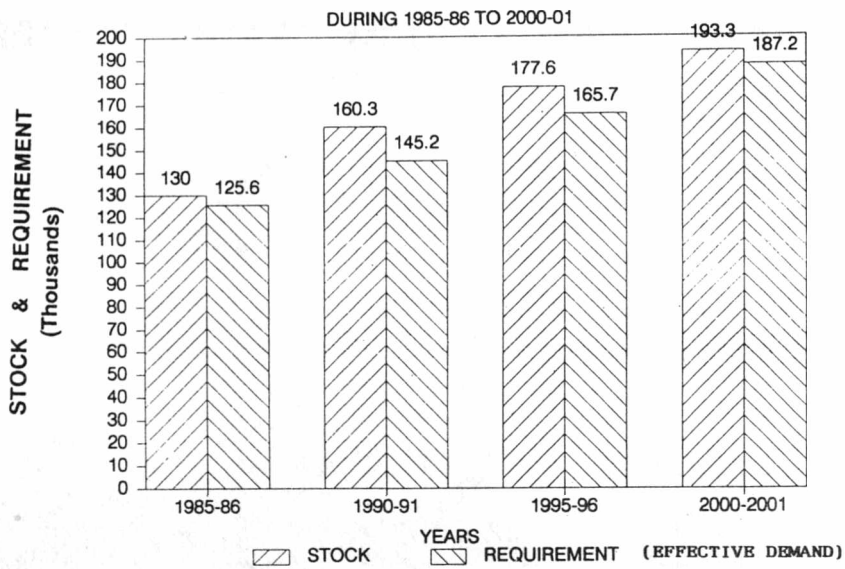
ECON. ACTIVE MEDICAL & NURSING MANPOWER



STOCK&REQUIREMENT OF ALLOPATHIC DOCTORS

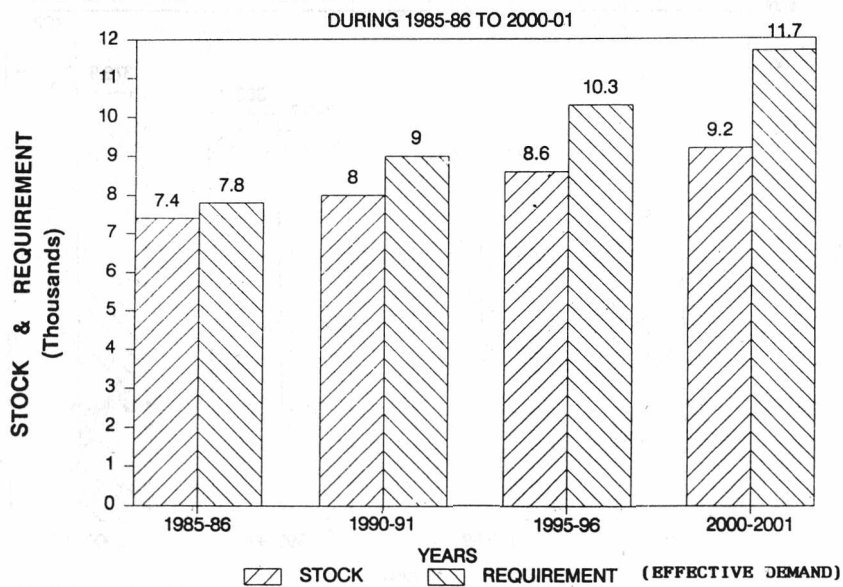


STOCK&REQUIREMENT OF AYURVEDIC DOCTORS



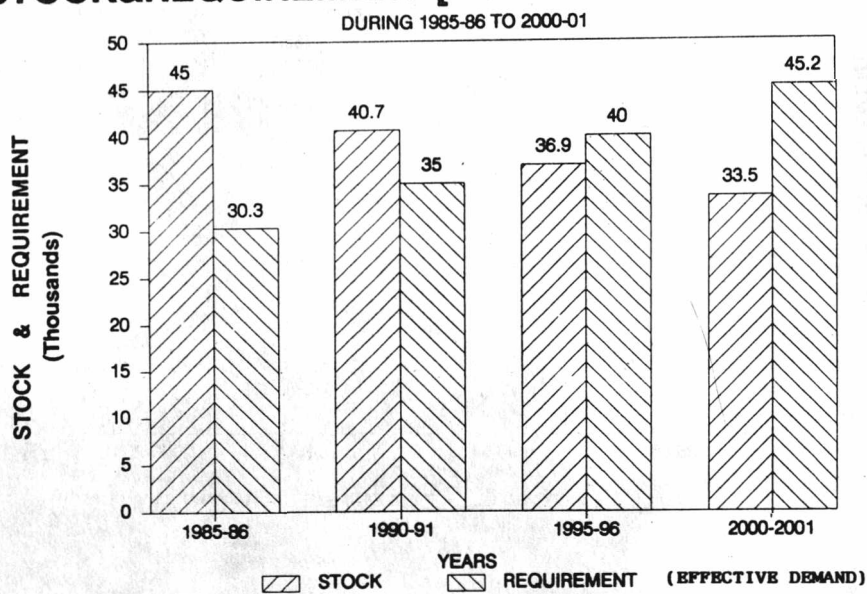
Graph-15

STOCK & REQUIREMENT OF UNANI DOCTERS



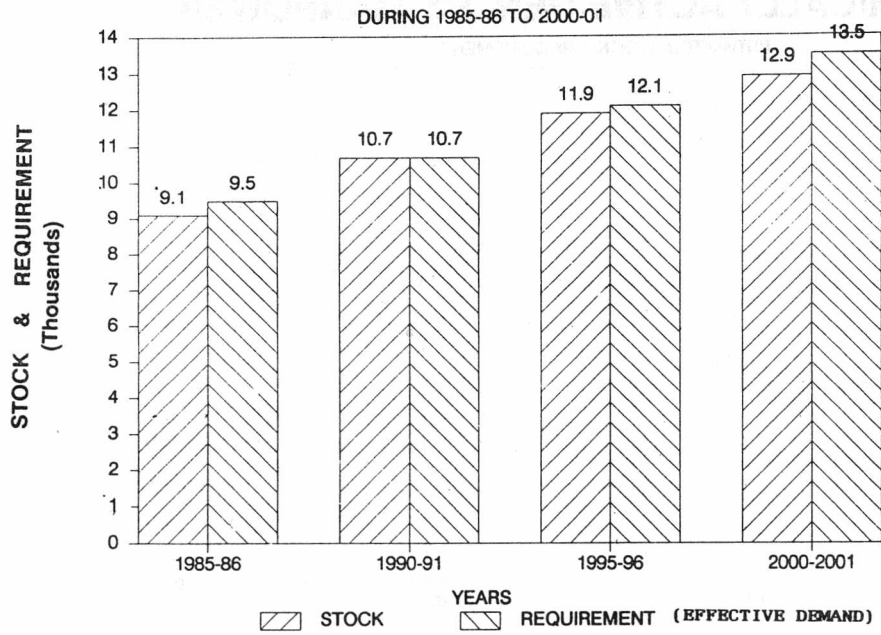
Graph-16

STOCK&REQUIREMENT [HOMEOPATHIC DOCTERS]



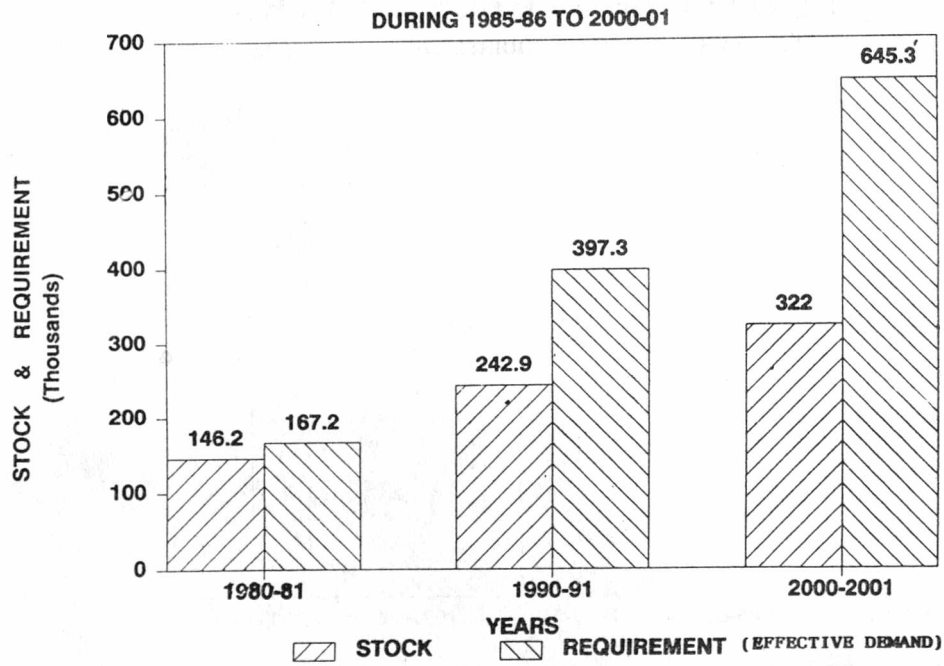
Graph-17

STOCK & REQUIREMENT DENTAL SURGEONS



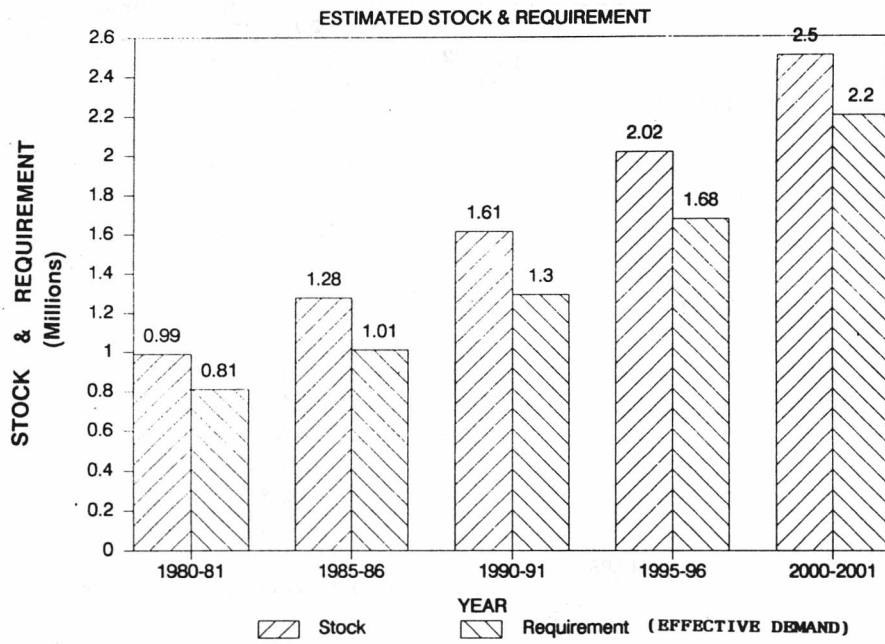
Graph-18

STOCK & REQUIREMENT OF STAFF NURSES



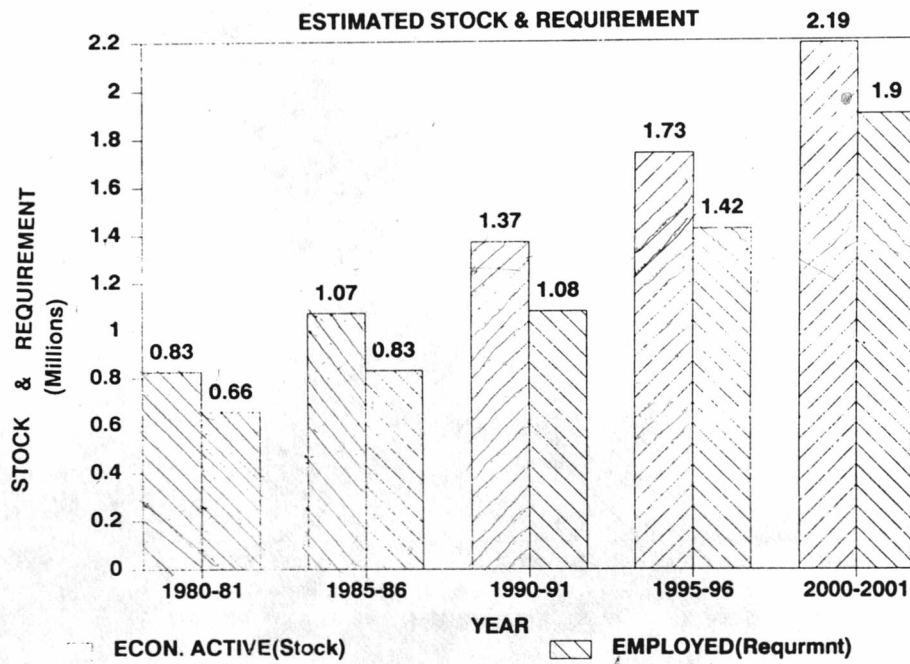
Graph-19

ECONOMICALLY ACTIVE GEN. Sc. MANPOWER

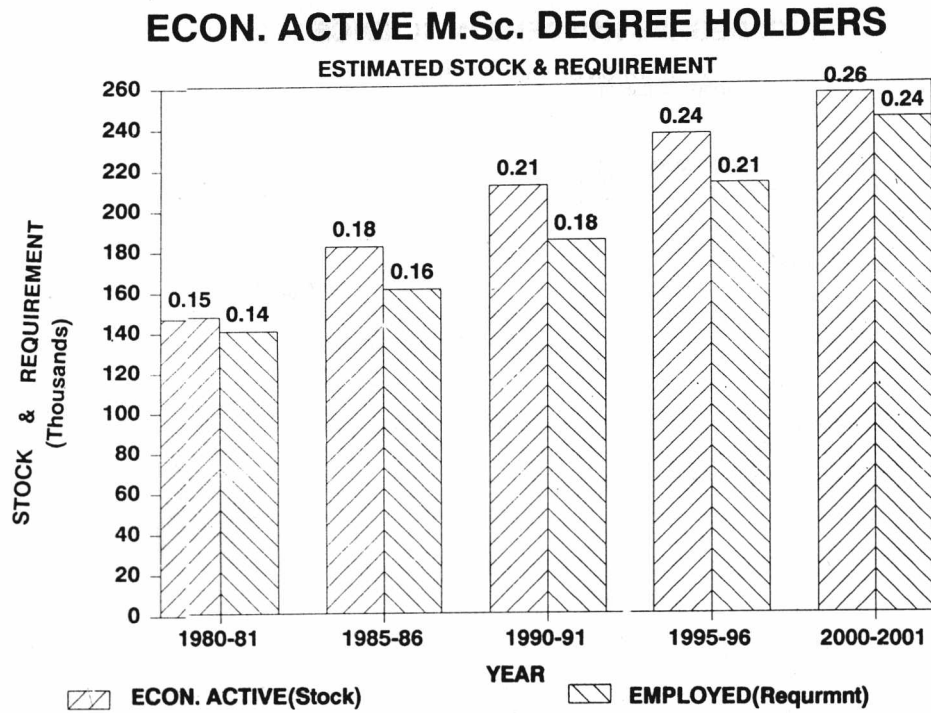


Graph-20(a)

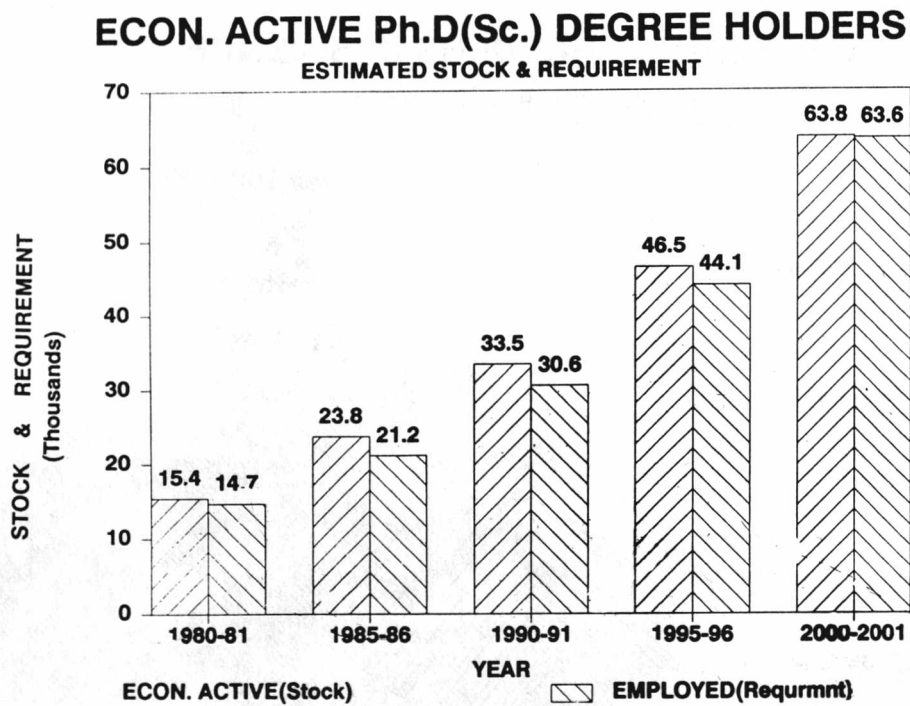
ECON. ACTIVE B.Sc. DEGREE HOLDERS



Graph-20(b)

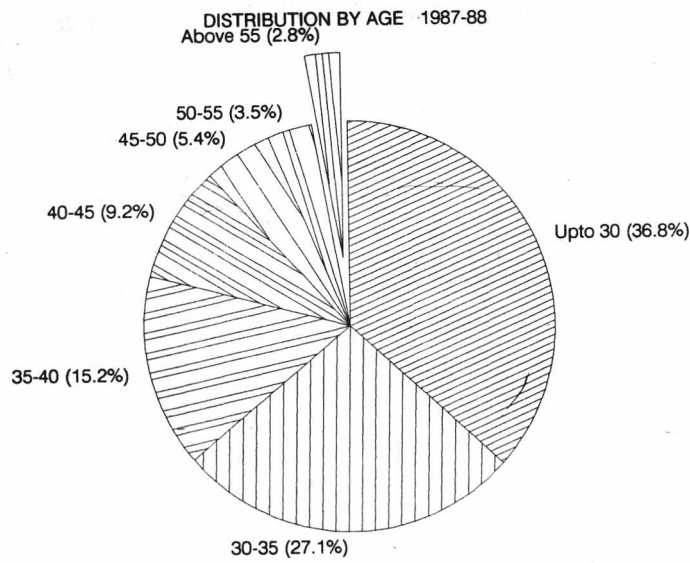


Graph-20(c)



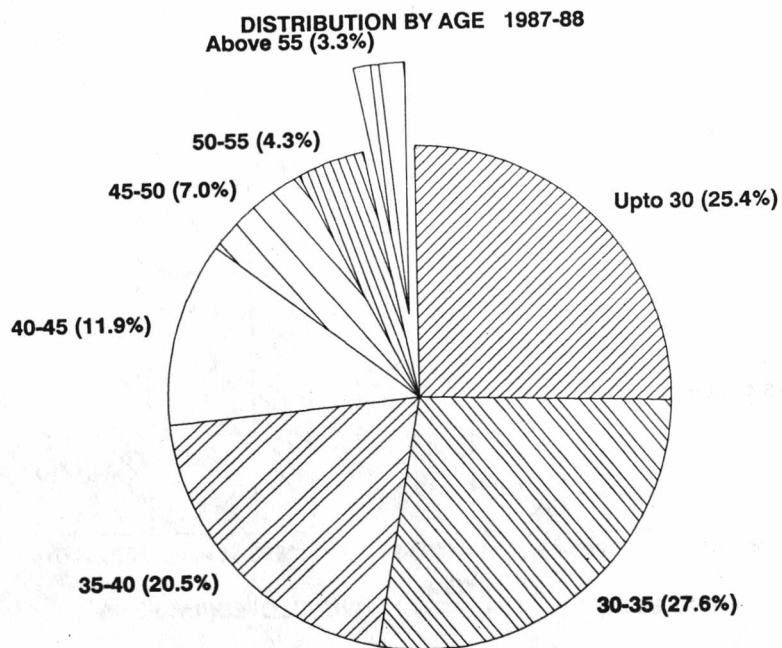
Graph-(21-a)

B.SC. DEGREE HOLDERS IN SCIENCE



Graph-21(b)

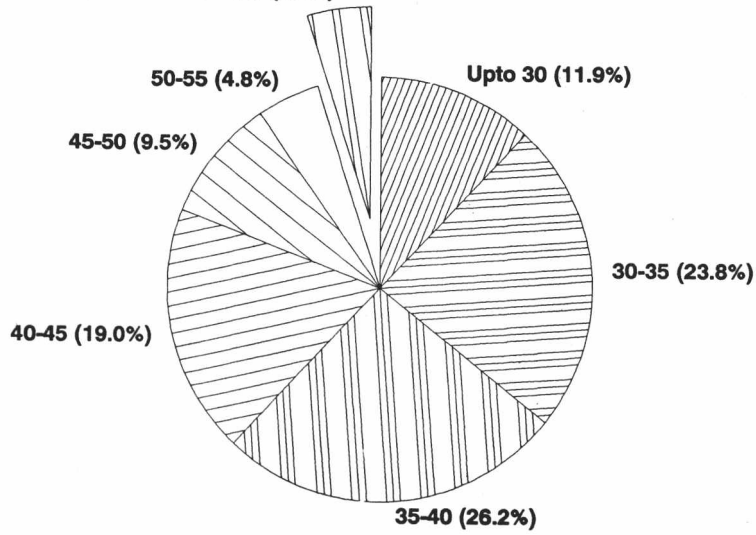
M.Sc DEGREE HOLDERS IN SCIENCE



Graph-21(c)

Ph.D(Sc.) DEGREE HOLDERS IN SCIENCE

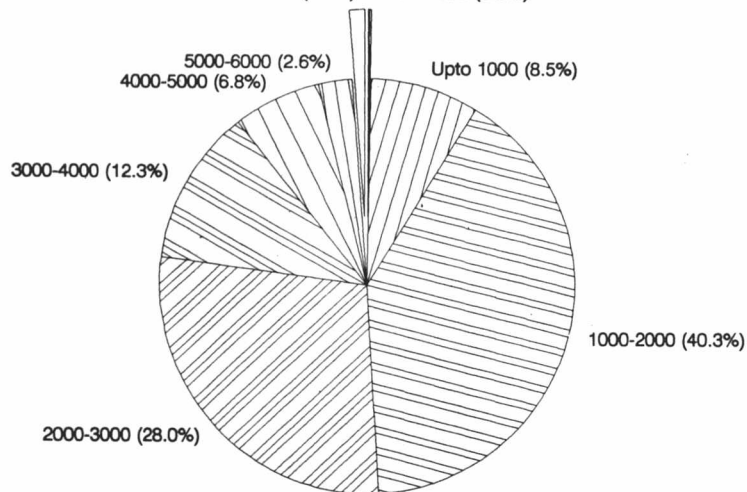
DISTRIBUTION BY AGE 1987-88
Above 55 (4.8%)



Graph-22(a)

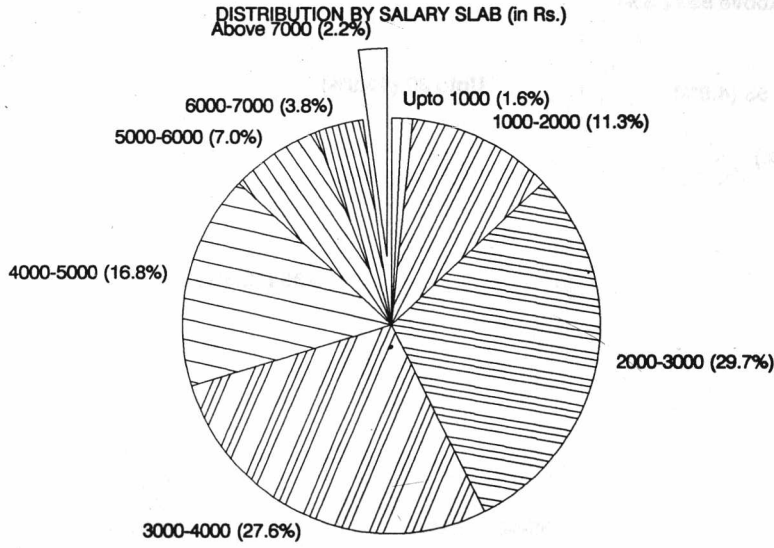
B.Sc DEG. HOLDERS IN SCIENCE 1987-88

DISTRIBUTION BY SALARY SLAB (in Rs.)
6000-7000 (1.2%) Above 7000 (0.3%)



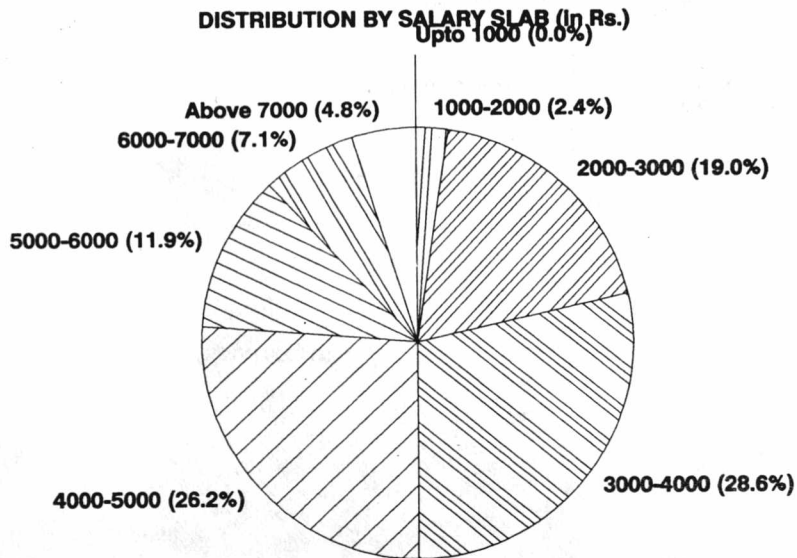
Graph-22(b)

M.Sc DEG. HOLDERS IN SCIENCE 1987-88



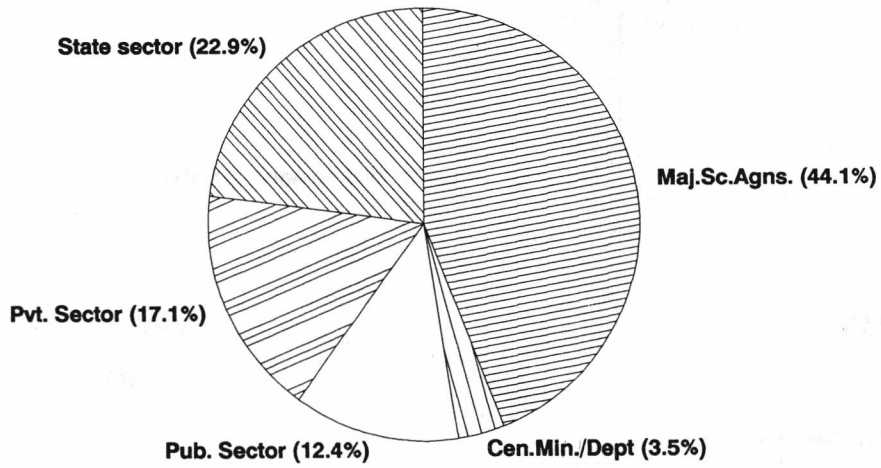
Graph-22(c)

Ph.D(Sc) DEG. HOLDERS IN SCIENCE 1987-88



Graph-23(a)

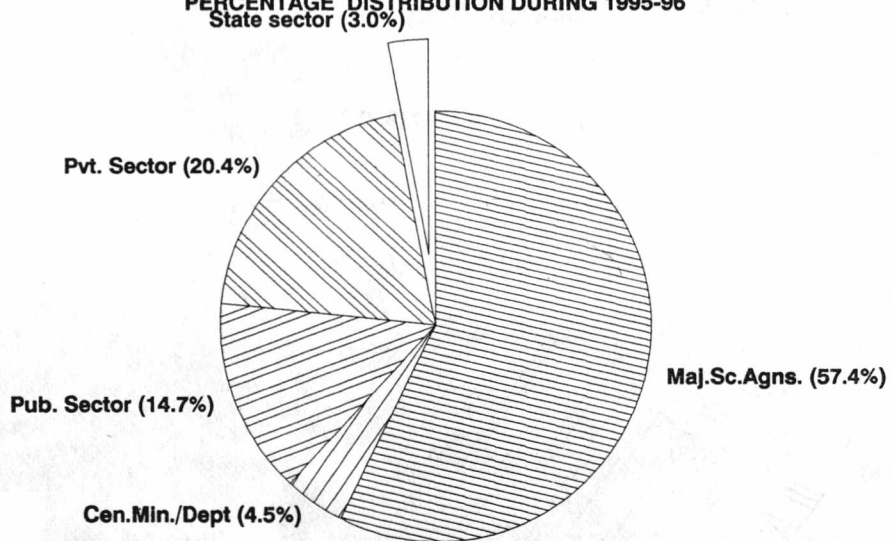
SECTOR WISE EMPLOYMENT POTENTIAL IN R&D
PERCENTAGE DISTRIBUTION DURING 1990-91



Graph-23(b)

SECTOR WISE EMPLOYMENT POTENTIAL IN R&D

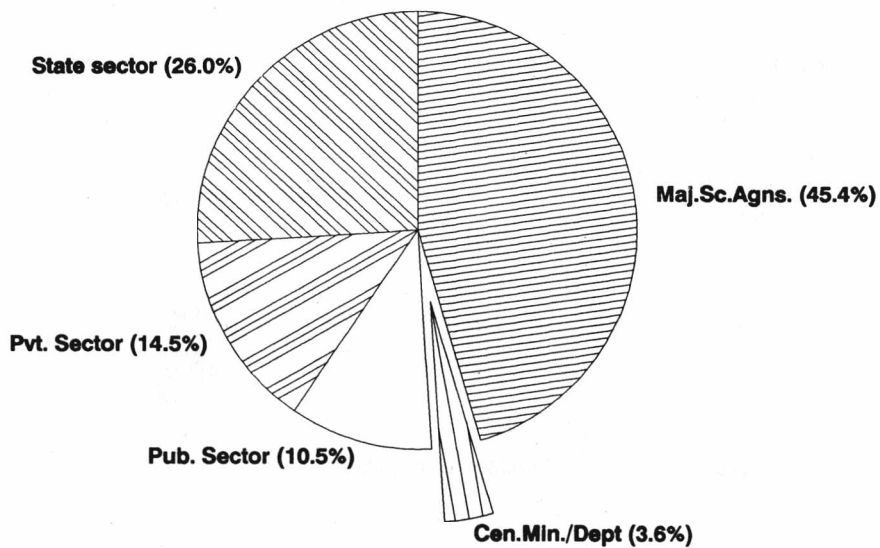
PERCENTAGE DISTRIBUTION DURING 1995-96



SECTOR WISE EMPLOYMENT POTENTIAL IN R&D

Graph-23 (c)

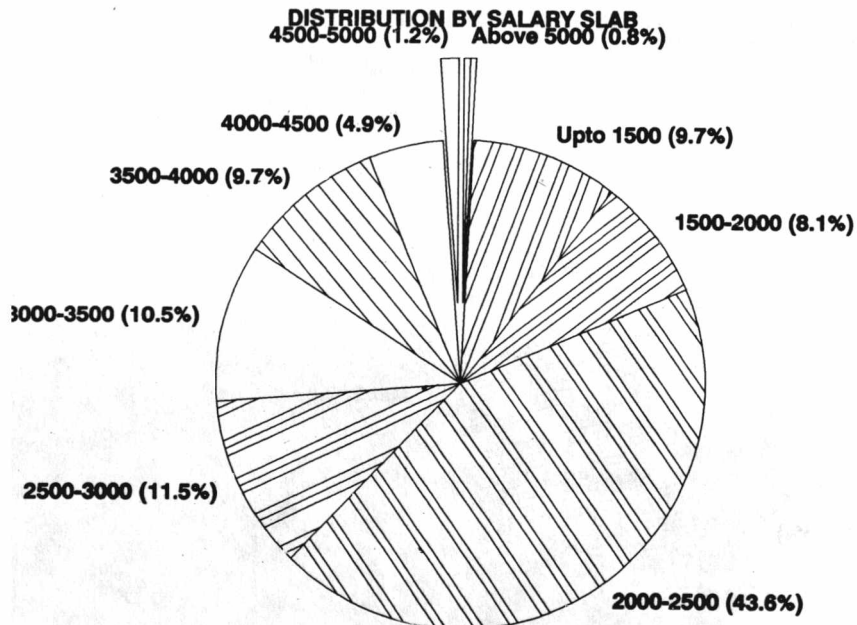
PERCENTAGE DISTRIBUTION DURING 2000-01



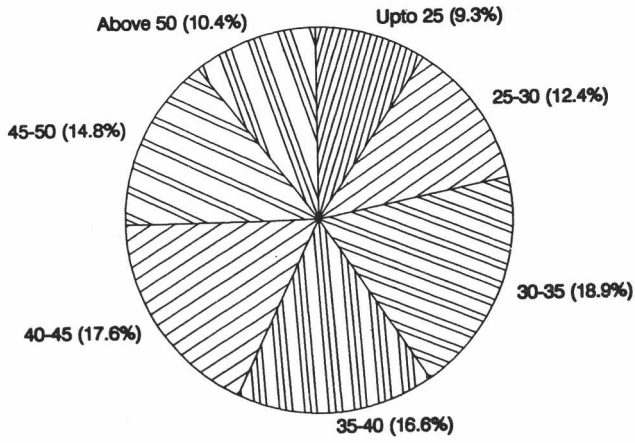
R & D PERSONNEL

Graph-24

DISTRIBUTION BY SALARY SLAB

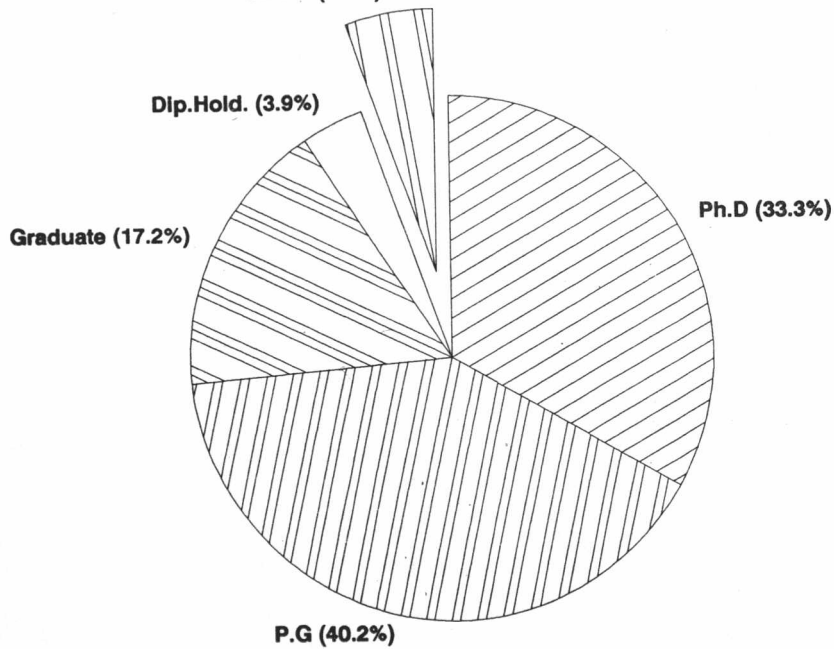


DISTT. OF R&D PERSONNEL BY AGE GROUP (IN YEARS)

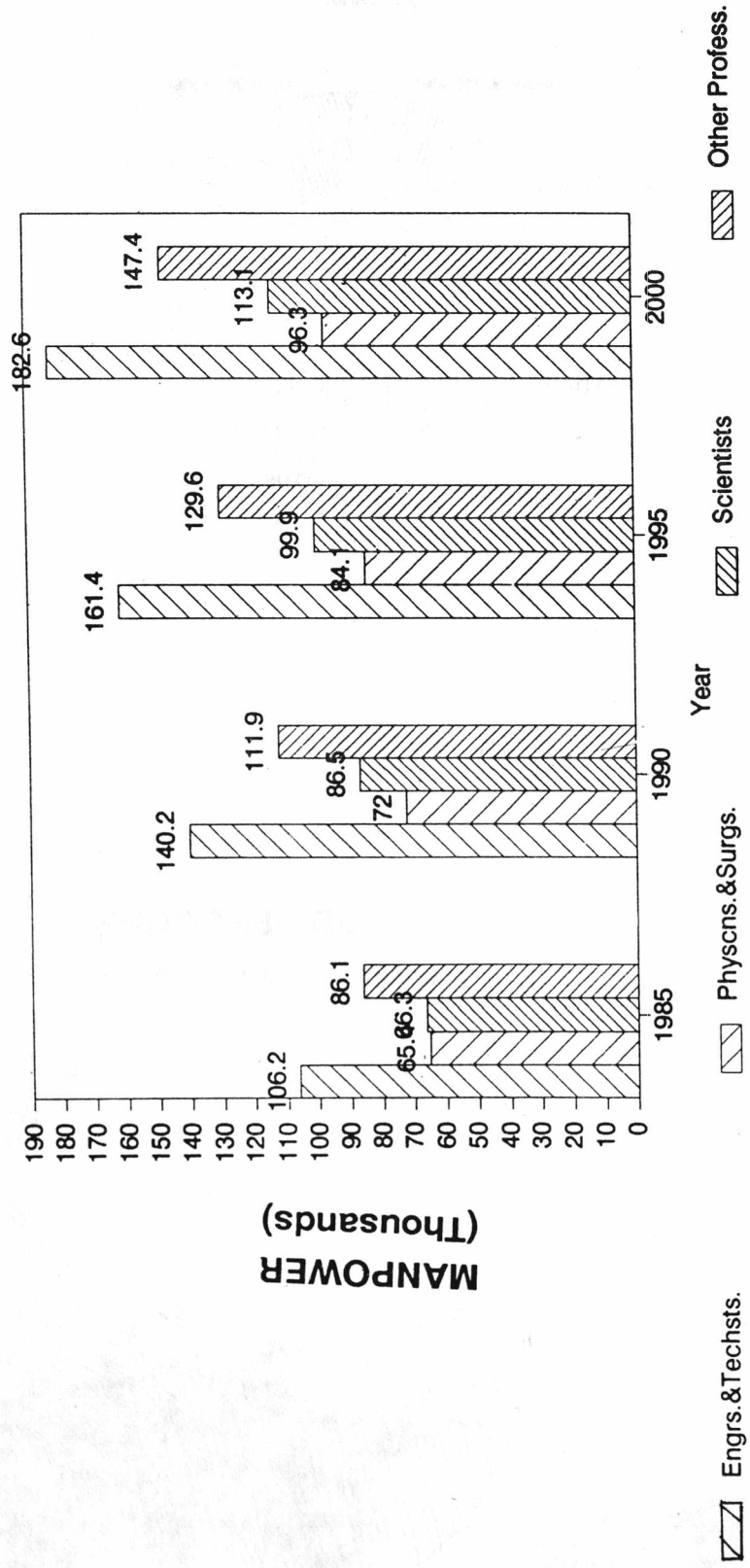


R&D PERSONNEL

DISTRIBUTION BY LEVEL OF EDUCATION



S&T MANPOWER ABROAD BY PROFESS.CATEGORY



4. MEDICAL AND PARA-MEDICAL MANPOWER

4.1 Introduction

4.1.1 The study on Medical and para medical manpower was carried out as a part of the study on Scientific and Technical manpower in India. The study attempts to project the stock vis-a-vis requirement of medical and para-medical manpower in India upto 2000 AD., in order to provide necessary data for manpower planning.

4.1.2 The stock of medical manpower at the end of 1980 as available in "Health Statistics in India" 1981, Published by Central Bureau of Health Intelligence, D.G.H.S., New Delhi has been adopted as data base. However, wherever data was not found updated suitable modifications have been carried out with the help of data for the relevant periods from D.G.H.S, Medical Council etc. The stock of para-medical manpower at the end of 1980 has been adopted from Census, 1981 and that of 1985 from the Report of the Expert Committee constituted by the Ministry of Health and Family Welfare in 1986 with Prof. J.S. Bajaj as chairman.

4.1.3 Statewise stock of employed medical and para-medical personnel, as available in B. Series tables of Census 1981 has been adopted as data base for employed medical and para-medical manpower at the end of 1980. The stock of economically active medical and para-medical manpower has been worked out based on the proportion of economically active manpower to total stock in respect of relevant category of manpower as per 32nd Round of N.S.S. data.

4.1.4 The future requirement of medical and para-medical manpower has been assessed keeping in view "Health Needs" to fulfill the national goal of "Health for All" by 2000 AD. Another method of estimation of requirements,

adopted in the report is manpower/population ratios expected to be generated to provide medical amenities comparable with other developing and developed countries.

4.2 Stock : 1980

4.2.1 As per Medical Council of India, number of allopathic doctors registered (possessing recognised medical qualifications under I.M.C.Act) with State Medical Councils upto 1980 end were 2,62,667, out of which Assam Medical Council accounted for 7165 doctors. As Assam was not covered in 1981 Census and hence number of employed allopathic doctors is not available for the State in Census tables, stock relating to Assam Medical Council has been excluded from the all India stock order to have a comparative picture of employment vis-a-vis stock.

4.2.2 The stock of Allopathic doctors for selected States/UTs at the end of 1980 alongwith their employment situation has been presented in Annexure-4.1. The information in summary form is, however, presented in table 4.1. The statements reveal that, at the end of 1980, there were 2.55.502 registered medical practitioners (allopathic) in the country excluding Assam. As per 32nd Round of NSS, 87 percent of the allopathic doctors are economically active. Taking this into view, 2,22,220 were considered economically active in 1980. Amongst economically active allopathic doctors, 2,07,640 were employed as per 1981 Census and hence 14,650 were unemployed showing the unemployment rate amongst allopathic doctors as 6.59 percent at the national level. As the stock in South Indian States was relatively more than the employment potential in those States, unemployment rate was higher than the national average in those States even after large scale migration to the deficit States.

4.1 Stock of Economically Active and Employed Allopathic Doctors:1989

Sl. No.	Category of Manpower	Total Stock (In'000)	Percentage Share
1.	Stock (As per Medical Council of India)	255.50	100.0
2.	Economically Active Doctors(87 percent of the Stock)	222.29	87.0
3.	Employed	207.64	81.3
4.	Unemployed	14.65	5.7
5.	Rate of Unemployment	6.59 %	

4.2.3 Statewise stock of total and employed Ayurvedic Practitioners at the end of 1980,presented in table 4.2, reveals that total stock of Ayurvedic registered medical practitioners in India excluding Assam was 2,24,919 as per Traditional System of Medicine in India,1980, Ministry of Health and Family Welfare (P & E Cell). As against

this,there were 63,715 Ayurvedic practitioners(NCO. Code-071) and 43,827 Physicians and Surgeons "not elsewhere classified"(079). Thus,total employed Ayurvedic Practitioners at all India level were 1,07,542. As the doctors of this system are mostly self employed, unemployment rate is negligible. However, rate of economically active to total stock works out to be very low (47.81 %)in comparison to that of allopathic doctors, which shows that a very large proportion of Ayurvedic registered practitioners might have migrated, retired or died after registration.At the State level, rate of economically active manpower varied from 11.32 percent to 123.13 percent which shows that there has been large scale interstate migration particularly to Andhra Pradesh from other States for this category of doctors. Low ratio of employment to total stock in some States may be because of many of them having a major occupation other than medical practice.

4.2 Stock of Total and Employed Registered Ayurvedic Medical Practitioners : 1980. (in Nos.)

Sl. State/U.T	Stock (1980)	Employed (1980-81)			Rate of Economically active Doctors to Total Stock (%)
		Ayurvedic (071)	Physicians & surgeon (n.e.c)(079)	Total	
	(a)	(b)	(c)		(%)
1. Andhra Pradesh	15912	3124	16469	19593	123.13
2. Bihar	30287	2289	1139	3428	11.32
3. Gujarat	13389	5052	381	5433	40.58
4. Haryana	15826	1462	8411	9873	62.38
5. Himachal Pradesh	5110	1037	-	1037	20.29
6. Karnataka	7770	3178	1477	4655	59.91
7. Kerala	10250	7826	1133	8959	87.40
8. Madhya Pradesh	13734	7176	1623	8799	64.07
9. Maharashtra	20866	5776	1808	7584	36.35
10.Punjab	17238	4692	123	4815	27.93
11.Rajasthan	14004	6767	581	7348	52.47
12.Tamil Nadu	7086	2668	1037	3705	52.29
13.Uttar Pradesh	38743	8111	6284	14395	37.41
14.West Bengal	10286	1952	2445	4397	42.75
15.Other States/UTs	4418	2605	916	3521	79.67
Total	224919	63715	43827	107542	47.81

Source:(a)For stock -TSM in India,1980,MHFW.(b)For employed -Census 1981,
Note: Some registered as Ayurvedic practitioners are also providing a variety of medical services outside purely ayurvedic system and are classified under 079 by Census.

4.2.4 Statewise stock of total and employed Homeopathic Practitioner, at the end of 1980, presented in table 4.3, reveals that at the national level (excluding Assam), there were 1,45,002 Homeopathic practitioners registered under different Homeopathic Councils/Boards. As against this only 50,104 doctors were employed as per B. Series table 1981 Census (NCO code 072). Thus, at the national level, the rate of economically active Homeopathic doctors was only 34.55 percent. At the State level, it varied from as low as 7.79 percent in Haryana to as high as 91.7 percent in Kerala. The low rate of employment of Homeopathic doctors was possibly due to this activity being pursued as a subsidiary activity by majority of them.

4.3 Stock of total and Employed Registered Homeopathic Practitioners : 1980 (in Nos.)

Sl. State/UT No.	Stock (1980)	Employed (1980-81)	Rate of Economically active doctors to total Stock %
1. Andhra Pradesh	4932	853	17.29
2. Bihar	48717	9117	18.71
3. Gujarat	759	218	28.72
4. Haryana	2915	227	7.79
5. Karnataka	1938	1074	55.41
6. Kerala	3700	3393	91.70
7. Madhya Pradesh	8707	1251	14.37
8. Maharashtra	7525	2300	30.56
9. Orissa	2766	1743	63.02
10. Punjab	2883	462	16.02
11. Rajasthan	2591	379	14.62
12. Tamil Nadu	15054	7860	52.21
13. U.P.	17465	9809	56.16
14. W. Bengal	23449	10330	44.05
15. Delhi	1343	481	35.81
16. Others States/UTs	258	607	235.27
Total	145002	50104	34.55

Source: (a) For Stock-Homeopathic Council/Exam Board (b) For employment- Census 1981

4.2.5 Table 4.4 presents statewise stock of Unani medical practitioners as also corresponding employed practitioners at the end of 1980. It would be seen from the table that at all India level there were 25,988 Registered Medical Practitioners of Unani system. Out of this only 6,697 were shown as employed as per census data. This shows that amongst Unani Practitioners only 25.77 percent were economically active which shows that this system is not so popular. State level data shows this ratio varying from 5.96 percent in Punjab to 199.33 percent in Jammu & Kashmir. This further shows that this system was popular in Jammu & Kashmir, Madhya Pradesh, Maharashtra, Karnataka and Andhra Pradesh necessitating large scale immigration to these States.

4.4 Stock of Total and Employed Unani Medical Practitioners : 1980 (in Nos.)

Sl. State/UT No.	Stock (1980) (a)	Employed (b)	Rate of Economically active Doctors to total Stock (%)
1. Andhra Pradesh	594	387	65.15
2. Bihar	3062	779	25.44
3. Gujarat	477	131	27.46
4. Haryana	2382	430	18.05
5. Himachal Pradesh	446	-	-
6. J & K	149	297	199.33
7. Karnataka	343	278	81.05
8. Kerala	52	-	-
9. Madhya Pradesh	113	201	177.88
10. Maharashtra	596	496	83.22
11. Punjab	5826	347	5.96
12. Rajasthan	707	150	21.22
13. Tamil Nadu	1001	305	30.47
14. U.P.	8790	2188	24.89
15. Delhi	1450	222	15.31
16. Other States/UTs		486	x
Total	25988	6697	25.77

Source: (a) For Stock of Traditional System of Medicine (TSM) in India, 1980 Ministry of Health & Family Welfare (b) For employment- Census 1981.

4.2.6 The stock of Registered Dental Surgeons in the country excluding Assam at the end of 1980 was 8384 as per Dental Council of India. As against this, number of Dental Surgeons employed in the beginning of 1981 was 7964 as per 1981 Census data. Statewise data on stock and employed persons at the end of 1980, presented in table 4.5, shows that there was large scale migration of Dental Surgeons from surplus States to deficit States for employment. At all India level rate of economically active dental surgeons to total stock was 95 percent.

**4.5 Stock of Total and Employed
Dental Surgeons:1980**
(in Nos.)

Sl.No.	State/UT	Stock	Employed	Surplus(+) Deficit(-)	Rate of Economically active doctors to total Stock(%)
1.	Andhra Pradesh	309	328	(-) 19	106.1
2.	Bihar	100	396	(-)296	396.0
3.	Gujarat	607	541	(+) 66	89.1
4.	Haryana	182	279	(-) 97	153.3
5.	Himachal Pradesh	77	-	(+) 77	-
6.	Karnataka	831	387	(+)444	46.6
7.	Kerala	474	617	(-)143	130.2
8.	M.P.	752	284	(+)468	37.8
9.	Maharashtra	1538	1280	(+)258	83.2
10.	Orissa	60	-	(+) 60	-
11.	Punjab	864	459	(+)405	53.1
12.	Tamil Nadu	330	421	(-) 91	127.6
13.	U.P	444	1400	(-)956	315.3
14.	W. Bengal	1302	535	(+)767	41.1
15.	Chandigarh	107	-	(+)107	-
16.	Delhi	379	375	(+) 4	98.9
17.	Goa	28	-	(+) 28	-
18.	Other States/UTs	-	662	(-)662	-
Total		8384	7964	(+)420	95.0

Source:(i) For Stock-Dental Council of India
(ii) For Employment-Census 1981, B. Series tables.

4.2.7 Distribution of medical practitioners by system of medicine for selected States at the beginning of 1981, presented in table 4.6 reveals that out of all the medical practitioners, 55.82 percent were of Allopathic system, 28.91 percent of Ayurvedic system, 13.47 percent of Homeopathic system and 1.80 percent of Unani system.

4.2.8 State level distribution reveals that more than 70 percent of the medical practitioners were of Allopathic system in the states of Gujarat and Maharashtra. In the State of Karnataka, Punjab and Delhi, 60 to 70 percent were belonging to Allopathic system, while in the States of Madhya Pradesh, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and other States/UTs, allopathic doctors accounted for 50 to 60 percent share of total doctors in respective states. In Andhra Pradesh, Bihar and Kerala they had a share of less than 50 percent.

4.2.9 The share of Ayurvedic doctors in total medical practitioners was more than 60 percent in Andhra Pradesh and over 40 percent in Kerala, Madhya Pradesh and Rajasthan. In Gujarat, Karnataka, Punjab, U.P. and Delhi, their share was 20 to 40 percent. In the States of Bihar, Maharashtra, Tamil Nadu and West Bengal 10 to 20 percent of the medical practitioners were of Ayurvedic system.

4.2.10 The share of Homeopathic doctors was highest in Bihar (37.15 percent) followed by West Bengal at 30.16 percent. In Kerala, Tamil Nadu and Uttar Pradesh their share was 17.19, 26.72 and 17.86 percent respectively. In other States/UTs their share was less than 10 percent.

4.2.11 The share of practitioners of Unani medicine was highest at 3.98 percent in Uttar Pradesh followed by Bihar (3.17 percent) and other States/UTs (3.02 percent). In the State of Punjab also their share was sizeable (more than 2 percent of the total medical practitioners). In the remaining states the Unani system of medicine was not popular.

**4.6 Distribution of Doctors by system
of Medicine for Selected States:1980**

(In Percent)

Sl.No. State/UT	Allopathic	Ayurvedic	Unani	Homeopathic	Total	N (in'000)
1. Andhra Pradesh	35.86	60.32	1.19	2.63	100.00	32.5
2. Bihar	45.71	13.97	3.17	37.15	100.00	24.5
3. Gujarat	70.55	27.67	0.67	1.11	100.00	19.6
4. Karnataka	67.06	25.53	1.52	5.89	100.00	18.2
5. Kerala	37.43	45.38	-	17.19	100.00	19.7
6. Madhya Pradesh	52.10	41.11	0.94	5.85	100.00	21.4
7. Maharashtra	74.74	18.46	1.20	5.60	100.00	41.1
8. Punjab	63.61	31.16	2.24	2.99	100.00	15.4
9. Rajasthan	53.13	43.72	0.89	2.26	100.00	16.8
10. Tamil Nadu	59.61	12.60	1.07	26.72	100.00	29.4
11. Uttar Pradesh	51.78	26.38	3.98	17.86	100.00	54.8
12. West Bengal	56.15	12.84	0.85	30.16	100.00	34.2
13. Delhi	67.95	26.44	1.62	3.99	100.00	11.0
14. Other States/UTs	53.32	35.36	3.02	8.30	100.00	33.0
All India	55.82	28.91	1.80	13.47	100.00	371.6

Source: CERPA Estimates.

**4.7 Medical Practitioners Per Million
Population in Selected States/
UTs :1981 (in Nos.)**

4.2.12 Stock of medical practitioners per million population for selected States/UTs at 1981 beginning has been presented in table 4.7. The statement reveals that Delhi is the only State/UT where availability of medical practitioners was more than two thousand per million population during 1981. Punjab is another State where availability of medical practitioners at 921 per million population was somewhat adequate. In other States availability of medical practitioners was far from adequate. The situation in the States of Bihar, Karnataka, Madhya-Pradesh, Orissa, Rajasthan and U.P was alarming as even one medical practitioner per 2000 population was not available during 1981 in these States. Availability of Dental Surgeon per million population was only 12 at all India level.

Sl. No.	State/UT	Allo- pat- hic	Ayur- ve- dic	Hom- eo pat	Una- ni	Den- tal	Total exclu- ding Dental
1.	Andhra Pradesh	218	366	16	7	6	607
2.	Bihar	160	49	130	11	6	350
3.	Gujarat	406	159	6	4	16	575
4.	Karnataka	329	125	29	7	10	490
5.	Kerala	290	352	133	-	24	775
6.	M.P.	214	169	24	4	5	411
7.	Maharashtra	489	121	37	8	20	655
8.	Orissa	160	56	66	-	-	282
9.	Punjab	585	287	28	21	27	921
10.	Rajasthan	261	214	11	4	9	490
11.	Tamil Nadu	362	77	162	7	9	608
12.	U.P	257	131	89	20	13	497
13.	W.Bengal	352	81	189	5	10	627
14.	Delhi	1502	584	88	36	60	2210
15.	Other State/UTs	264	176	41	15	20	496
	All India*	312	162	75	10	12	559

* Excluding Assam

Source: CERPA Estimates.

4.2.13 Stock of Allopathic and Non-Allopathic medical practitioners per million population for rural and urban areas of selected States has been presented in table 4.8. The statement reveals that at the national level there were 1285 medical practitioners per million population in the Urban areas as against only 245 practitioners in rural areas which shows that the medical facilities available in the rural areas were too meagre (less than one fifth) in comparison to that of the Urban areas. In the States of Andhra Pradesh, Madhya Pradesh, Orissa and

other small States and UTs the situation in rural areas in regard to availability of doctors was alarming as even two hundred medical practitioners were not available per million population in these States. Thus, although there is an immediate need to augment medical facilities in rural areas of the country in general special attention needs to be given to States mentioned above. This can be made feasible by giving special incentives to the practitioners working in rural areas. In urban areas also adequate medical manpower was not available in Andhra Pradesh, Karnataka and Orissa.

**4.8 Stock of Medical Practitioners per Million Population
in Rural and Urban Areas of Selected States
in India : 1981 (in Nos.)**

Sl. No.	State/UT's	Stock of Medical Practitioner per Million Population					
		Rural			Urban		
		Allopathic	Non-allopathic	Total	Allopathic	Non-allopathic	Total
1.	Andhra Pradesh	48	60	108	775	153	928
2.	Bihar	70	136	206	801	446	1247
3.	Gujarat	174	122	296	920	238	1158
4.	Karnataka	128	88	216	827	206	1033
5.	Kerala	174	413	587	796	561	1357
6.	Madhya Pradesh	72	104	176	771	407	1178
7.	Maharashtra	176	99	275	1070	207	1277
8.	Orissa	78	100	178	770	252	1022
9.	Punjab	271	214	485	1410	625	2035
10.	Rajasthan	113	167	280	816	385	1201
11.	Tamil Nadu	98	184	282	899	305	1204
12.	Uttar Pradesh	113	102	215	913	547	1460
13.	West Bengal	169	187	356	863	350	1213
14.	Delhi	1731	427	2158	1487	730	2217
15.	Other States/UT's	64	55	119	1114	152	1266
	INDIA	113	132	245	952	333	1285

Source: CERPA Estimates based on 1981 Census data

4.2.14 Stock of Registered Nurses, Mid-wives, Auxiliary Nurse-Mid-wives and Health visitors, as on 31.12.1980 was 146201, 141995, 71434 and 9286 respectively. Of these 2586 Nurses, 2334 Mid-wives, 2054 ANMs and 46 Health visitors were registered in Assam Nursing Council/Examining Board. Stock of different

categories of employed para-medical personnel, as per 1981 Census for selected States/UTs, has been presented in Annexure-4.2. Category-wise para-medical staff available in the country at the beginning of 1981 is, however, presented in table 4.9. Stock of para-medical manpower per doctor also presented

in table 4.9 shows that at all India level there were 2.89 para-medical personnel for every allopathic doctor. However, when all types of doctors are taken into consideration, availability of para-medical personnel for every medical practitioner works out at 1.79 only. Out of them about one third belonged to the category who did not have any specific training. This shows that the availability of para-medical personnel were much below adequate. Even for nurses, the availability was too low at 0.69 per Allopathic doctor.

4.9 Stock of Employed Para-medical Manpower : 1981

Sl. Category of No. Manpower	Stock (in'000)	Stock per Doctor(Nos)	
		Allo- pathic	Total
1. Nurses *	166.9	0.69	0.43
2. Pharmacists	178.2	0.74	0.46
3. Vaccinators, Inoculators, Medical Assistants	46.9	0.19	0.12
4. Midwife, Health Visitors @	49.6	0.21	0.13
5. X-Ray Technicians	8.8	0.04	0.02
6. Opthemetrists and Operations	2.0	0.01	Neg.
7. Physio Therapists, Occupational Therapists	1.0	Neg.	Neg.
8. Pharmaceutical Assistants	7.3	0.03	0.02
9. Dieticians and Nutritionists	0.6	Neg.	Neg.
10. Dental Assistants	2.1	0.01	Neg.
11. Nursing, Sanitary and other Health technicians not elsewhere classified @	231.2	0.96	0.60
Total	694.6	2.89	1.79

Source for Stock : 1981 Census

* Number of nurses registered in State Councils/Boards was 1,46,201 upto the end of 1980

@ Number of midwives/ANM/Health Visitors registered was 2,22,715 as on 31.12.80.

4.2.15 Stock of para-medical personnel per million population as at the beginning of 1981 for selected States/UTs has been presented in Annexure-4.3 . Their availability at the national level is presented in table 4.10. It would be seen that total para-medical manpower available per million population in 1981 was 1228, out of which about one third belonged to the category who did not receive any specific training. Thus, properly trained para-medical personnel available per million population was only 820 which is too meagre in comparison to requirement of 2816 per million population as per recommendations of the Expert Committee. Similarly, total nurses available for Hospital Services was 295 per million population as against the requirement of 679 as per recommendations of the Expert Committee.

4.10 Stock of Para-medical Manpower Per Million Population: 1981

Sl. Category of No. Manpower	Stock per Million Population, 1981
1. Nurses	295
2. Pharmacists	315
3. Vaccinators, Inoculators, Medical Assistants	83
4. Midwives, Health visitors	88
5. X-Ray Technicians	15
6. Opthemetrists & Operations	4
7. Physio Therapists, Occupational Therapists	2
8. Pharmaceutical Assistants	13
9. Dieticians, Nutritionists	1
10. Dental Assistants	4
11. Nursing, Sanitary and other Health Technicians not elsewhere Classified	408
Total	1228

Source: CERPA Estimates based on Stock & Population as per 1981 Census.

4.2.16 As per 1981 Census, only 10.9 percent of doctors were female. This ratio was higher at 15.7 percent among

allopathic doctors. Female Dental Surgeons accounted for 8.7 percent. Among ayurvedic, homeopathic and unani doctors, female doctors accounted for about 5.0, 4.8 and 4.2 percent respectively. Of the total female allopathic doctors, only 11.4 percent were in rural areas. Among female allopathic doctors in rural areas, Kerala had the highest share of 21.8 percent followed by Tamil Nadu, Andhra Pradesh and Maharashtra.

4.11 Female Doctors in Different Systems of Medicine:1981-All India

Sl. No.	Systems of medicine	Total No. of Doctors (NO.)	Female Doctors (NO.)	Female Doctors as % to total
1.	Allopathic	207632	32677	15.7
2.	Ayurvedic	107542	5406	5.0
3.	Homeopathic	50104	2426	4.8
4.	Unani	6697	284	4.2
5.	Dental	7964	695	8.7
Total		379939	41488	10.9

Source: 1981 Census.

4.12 Distribution of Allopathic Female Doctors in 1981 by States and Rural/ Urban

Sl. No.	State/UT	Female Doctors as Percentage		
		Total	Rural	Urban
1.	Andhra Pradesh	6.7	12.7	5.9
2.	Gujarat	5.4	3.8	5.6
3.	Karnataka	5.9	6.2	5.8
4.	Kerala	5.9	21.8	3.9
5.	Maharashtra	20.9	11.3	22.1
6.	Tamil Nadu	14.4	14.5	14.4
7.	Uttar Pradesh	9.1	5.6	9.6
8.	West Bengal	7.2	4.3	7.6
9.	Delhi	7.4	2.6	8.0
10.	Other States and UTs	17.1	17.2	17.1
Total		100.0	100.0	100.0
N		32677	3722	28955

Source : Census, 1981

4.2.17 As per DHTP Survey, among Allopathic doctors, 62.3 percent were graduates, 32.4 percent Post-graduates and 4.8 percent diploma holders. Ph.D holders were only 0.5 percent but highest among all systems of medicine. Very few of Ayurvedic doctors were Post-graduates or Ph.Ds. Most of these doctors were graduates and Diploma Holders. Among Homeopathic doctors, a higher proportion (64.5 percent) were Diploma holders and 31.9 percent were graduates and 3.4 percent Post-graduates. In Dental 15.5 percent were Post-graduates, 73.3 percent graduates and 11.1 percent diploma holders. Most of the Nurses constituting 70.4 percent were diploma holders and 27 percent were graduates.

4.13 Distribution of Medical & Nursing Personnel by Qualifications :1981 (in percent)

Sl. No.	Cate- gory	Ph.D	Post- gra- duate	Gra- duate	Dip- loma	To- tal N ('000)
1.	Allo- pathic	0.5	32.4	62.3	4.8	100.0 89.6
2.	Ayur- vedic	0.1	3.0	75.5	21.4	100.0 28.1
3.	Homeo- pathic	0.2	3.4	31.9	64.5	100.0 12.6
4.	Dental	0.1	15.5	73.3	11.1	100.0 3.1
5.	Other systems	-	4.2	74.1	21.7	100.0 1.8
6.	Nurses	-	2.6	27.0	70.4	100.0 7.8

Source: DHTP Survey Report, 1981

4.2.18 Again as estimated from DHTP Survey 1981, majority of doctors of Indian systems of Medicine were self employed. There was also substantial proportion of employment among doctors for Ayurvedic, Homeopathic and Unani qualifications. The level of unemployment among Allopathic doctors was 6.3 percent, among Dental doctors 8.0 percent and among Nurses were employed and also 51.0 percent of allopathic doctors were employed in and another 28.5 percent were self-employed.

4.14 Distribution of Medical & Nursing Manpower by Activity Status:1981
(in percent)

Sl. Category No.	Employed	Self-employed	Student Trainees	Retired	Unemployed	Total	N
1. Allopathic	51.0	28.5	9.5	4.7	6.3	100.0	88740
2. Ayurvedic	30.8	51.4	2.9	2.0	12.9	100.0	26687
3. Homeopathic	20.8	50.9	3.9	1.8	22.6	100.0	11843
4. Other Systems	23.7	52.2	7.0	1.5	15.6	100.0	1719
5. Dental	37.8	46.4	4.3	3.5	8.0	100.0	3053
6. Nurses	82.9	4.2	2.2	1.4	9.3	100.0	7645

Source : DHTP Survey report ,1981

4.2.19 More than half of medical doctors in each system of medicine were below the age of 35 years. In Homeopathic system, those below the age of 35 years constituted about 66 percent. Those between the age of 35 to 45, concentration was highest in case of Dental Surgeons and Nurses. Above 58 years of age, Allopathic doctors and Dental Surgeons constituted a higher proportion of 7.8 percent and 8.4 percent respectively as compared to 4.6 percent in case of Ayurvedic and Homeopathic doctors and only 1.3 percent in case of Nurses.

4.15 Distribution of Medical & Nursing Personnel by Age Group : 1981

(in percent)

Sl. Age Group No. (Yrs)	Allopathic	Ayurvedic	Homeopathic	Dental	Nurses	Others
1. Below 30	30.8	31.8	45.7	33.3	37.5	37.7
2. 30-35	22.0	22.8	20.2	19.2	19.2	21.7
3. 35-40	15.4	13.6	10.0	17.2	16.9	12.8
4. 40-45	9.5	11.9	8.5	11.3	12.6	11.1
5. 45-50	6.7	8.0	5.3	5.7	5.8	5.4
6. 50-55	5.1	5.1	3.7	3.0	4.7	4.7
7. 55-58	2.7	2.2	2.0	1.9	2.0	2.6
8. Above 58	7.8	4.6	4.6	8.4	1.3	4.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
N	86481	26871	12043	2955	7414	1696

Source : DHTP Survey report,1981

4.2.20 By salary 80 percent of the Nurses were observed to be earning below Rs.1000 per month and another 16.5 percent between Rs.1000-1500 and the rest above Rs.1500 per month. Most of homeopathic and ayurvedic doctor were also earning less than Rs.1500 per month. As against this, about 48.6 percent of the allopathic doctors were observed to be earning more than Rs.1500 per month.

**4.16 Distribution of Medical Personnel
by Salary Slab : 1981**

(in percent)

Sl.No.	Per month Salary Slab(Rs)	Allo- pathic	Ayur- vedic	Homeo- pathic	Den- tal	Nur- ses
1.	Below 1000	16.8	59.3	70.9	24.6	80.0
2.	1000-1500	34.6	32.4	20.3	30.2	16.5
3.	1500-2000	28.6	5.8	5.2	26.6	2.5
4.	2000-3000	16.5	1.6	2.5	13.7	0.7
5.	3000-4000	2.5	0.5	0.3	3.2	0.3
6.	Above-4000	1.0	0.4	0.8	1.7	-
Total		100.0	100.0	100.0	100.0	100.0

Source: DHTP Survey Report, 1981

4.2.21 Share of female doctors among M.B.B.S. Doctors is observed at 18.7 percent and among diploma holders 12.0 percent. Females have relatively high share of 32.0 percent in Bacteriology, 32.4 percent in Anaesthesia and 23.9 percent in Paediatrics. In other branches their share is relatively low.

**4.17 Distribution of Allopathic
Doctors in Different Branches:1981**

(in percent)

Sl. No.	Branches	Male	Fe- male	Total	Perce- ntage of female with res- pect to total
A.General Branches					
1.	M.B.B.S.	62.6	60.4	62.2	18.7
2.	Diploma	5.4	3.9	4.9	12.0
3.	General Medicine	4.9	1.7	4.3	7.8
4.	General Surgery	5.4	1.0	4.6	4.4
Sub-total		78.3	67.0	76.0	16.8

B.Specialised Branches

1.	Gynaecology obsterics	1.7	16.0	4.6	70.7
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2.	Paediatrics	3.1	4.1	3.3	23.9
3.	Ophthalmology	2.5	1.1	2.2	9.1
4.	Bacteriology	1.6	3.1	1.8	32.0
5.	Anaesthesia	1.3	2.6	1.6	32.4
6.	Orthopaedic	1.4	0.2	1.2	2.8
7.	Other Specia- lised Branches	10.1	5.9	9.3	6.2
Sub-total		21.7	33.0	24.0	27.1

Total 100.0 100.0 100.0

Source: DHTP Survey Report, 1981

4.3 Updated Stock : 1985

4.3.1 Stock of Registered Medical Practitioners by Systems of medicine at the end of 1985 has been presented in table 4.18. The Statement reveals that the stock of registered medical practitioners at the end of 1985, in the country excluding Assam was 2,98,326 Allopathic doctors, 2,72,242 Ayurvedic doctors, 28,711 Unani doctors and 1,30,055 Homeopathic doctors.

**4.18 Stock of Registered Medical
Practitioners by systems of Medicine:1985**
(in Nos.)

Sl. No.	State/UT	Allo- pathic	Ayur- vedic	Unani	Homeo- pathic
1.	Andhra Pradesh	27494	11917	3051	3183
2.	Bihar	22217	34706	3174	21572
3.	Gujarat	17669	11153	224	999
4.	Karnataka	24490	9952	612	2877
5.	Kerala	14208	11662	57	4571
6.	M.P.	7141	27827	221	5384
7.	Maharashtra	37394	30852	535	13444
8.	Punjab	23096	17165	5602	6062
9.	Rajasthan	10501	19303	765	3131
10.	Tamil Nadu	36860	3044	767	15454
11.	U.P	27584	47732	10073	17836
12.	West Bengal	37005	18746	-	24056
13.	Delhi	-	3535	1429	1729
14.	Other States/UTs	12667	24648	2201	9757
Total		298326	272242	28711	130055

Source:(i) Medical Council of India for Allopathic doctors

(ii) ISM Councils for Ayurvedic & Unani Doctors.

(iii) Homeopathic Council/Exam Board for Homeopathic doctors.

4.3.2 On the basis of the percentage of Registered Medical Practitioners found to be employed as at the end of 1980, effective medical manpower available at the end of 1985 under each system of medicine has been estimated and presented below in table 4.19. It would be seen from the Statement that at the national level there were 242.2 thousand Allopathic doctors, 130.2 thousand Ayurvedic doctors, 7.4 thousand Unani doctors and 50.3 thousand Homeopathic doctors.

4.19 Estimated Employed Medical Manpower by Systems of Medicine: 1985
(in '000)

Sl. State/UT No.	Allopathic	Ayurvedic	Unani	Homeopathic
1. Andhra Pradesh	14.9	14.7	2.0	0.5
2. Bihar	14.6	3.9	0.8	4.0
3. Gujarat	17.7	4.5	0.1	0.3
4. Karnataka	15.8	6.0	0.5	1.6
5. Kerala	9.5	10.2	-	4.2
6. M.P.	7.2	17.8	0.4	0.7
7. Maharashtra	29.4	11.2	Neg.	4.1
8. Punjab	11.4	4.8	0.3	1.0
9. Rajasthan	11.6	10.1	0.2	0.5
10. Tamil Nadu	21.3	1.6	0.2	8.1
11. U.P.	34.7	17.9	2.5	10.0
12. West Bengal	22.5	8.0	-	10.6
13. Delhi	10.9	4.9	0.2	0.6
14. Other-States/UT	20.7	14.6	0.2	4.1
Total	242.2	130.2	7.4	50.3

Source: CERPA Estimates based on figures in table 4.18 and ratio of employed to stock as in 1981.

4.3.3 Distribution of estimated medical practitioners by systems of medicine for selected States at the end of 1985, estimated from data given in table 4.19 has been presented in table 4.20. It would be seen from the table that, at the national level the share of Allopathic doctors among total medical practitioners in 1985 was 56.3 percent, that of Ayurvedic doctors was 30.3 percent, Unani doctors 1.7 percent and

Homeopathic doctors 11.7 percent. Thus there was slight increase in the shares of Allopathic, Ayurvedic and Unani doctors during 1985 from that of 1980 while there was sizeable decline in share of Homeopathic doctors.

4.20 Distribution of Doctors by Systems of Medicine for Selected States/UTs : 1985

(in percent)

Sl. State/UT No.	Allopathic	Ayurvedic	Unani	Homeopathic	Total
1. Andhra-Pradesh	46.5	45.8	6.2	1.6	100.0
2. Bihar	62.7	16.7	3.4	17.2	100.0
3. Gujarat	78.3	19.9	0.5	1.3	100.0
4. Karnataka	66.1	25.1	2.1	6.7	100.0
5. Kerala	39.7	42.7	-	17.6	100.0
6. M.P.	27.6	68.2	1.5	2.7	100.0
7. Maharashtra	65.8	25.0	Neg.	9.2	100.0
8. Punjab	65.2	27.4	1.7	5.7	100.0
9. Rajasthan	51.8	45.1	0.9	2.2	100.0
10. Tamil Nadu	68.3	5.1	0.6	26.0	100.0
11. U.P.	53.3	27.5	3.8	15.4	100.0
12. W. Bengal	54.7	19.5	-	25.8	100.0
13. Delhi	65.7	29.5	1.2	3.6	100.0
14. Other States/UTs	52.3	36.9	0.5	10.3	100.0
Total	56.31	30.3	1.7	11.7	100.0

Source: CERPA Estimates based on figures in table 4.19.

4.3.4 Stock of medical practitioners per million population estimated for the year 1985 has been presented in table 4.21 for selected States/UTs. The statement reveals that at the national level there were 327 Allopathic, 176 Ayurvedic, 10 Unani and 68 Homeopathic practitioners for every million people. Thus, availability of doctors in 1985 was about 3.8 percent higher than that of 1981 although there was decline in availability by about 10 percent in case of Homeopathic doctors. State level availability shows that it increased in majority of the States. However, in Andhra Pradesh, Bihar, West Bengal and smaller States/UTs it declined.

4.21 Estimated Medical Manpower per Million Population in Selected States/UT-1985 (in Nos.)

Sl. No.	State/UT	Allo- pa- thic	Ayur- vedic	Una- ni	Home- opa- thic	Total
1.	A.P.	251	248	34	9	542
2.	Bihar	18	50	10	51	297
3.	Gujarat	385	119	2	8	594
4.	Karnataka	356	145	12	39	581
5.	Kerala	356	382	-	157	895
6.	M.P.	123	303	7	12	445
7.	Maharashtra	422	161	6	59	648
8.	Punjab	614	258	18	52	942
9.	Rajasthan	298	260	4	12	574
10.	Tamil Nadu	407	30	5	154	596
11.	U.P.	281	144	20	81	526
12.	W.Bengal	372	133	-	175	680
13.	Delhi	1568	710	32	86	2396
14.	Other States/UT	309	218	3	86	592
	Total	327	176	10	68	581

Source: CERPA Estimates based on figures in 4.19 and projected population of 1985.

4.3.5 Stock of Dentists as on 31.12.1985 was 9598. Considering that 95 percent of the Dental Surgeons as economically active 9118 Dental Surgeon were employed in 1985 and hence availability per million population during the year was 12 persons. This shows that services in regard to Dentistry in 1985 did not change from that of 1981.

4.3.6 Number of Para-medical manpower as on 31.12.1985, registered with different State Nursing councils and Examination Boards have been presented in table 4.22(a) below.

4.22(a) Stock of Registered Para-medical Personnel as on 31.12.1985 (in Nos)

Category	Total	Stock Stock excluding Assam
1. Nurses		
(a) Senior "A" Grade		
(i) Men	7078	6920
(ii) Women	166914	164802

(b) Junior "A" Grade

(i) Men	515	510
(ii) Women	23228	22917
Total	197735	195149

2. Midwives

(i) A Grade	159554	157441
(ii) B Grade	12036	11815
Total	171590	169256

3. ANM/H.W.

98543	96489
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4. Health Visitors

12411	12365
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Source : Health Information India, 1987

4.3.7 Stock of other categories of para-medical manpower in rural areas during 1987-88 has been presented in table 4.22(b).

4.22(b) Stock of Para-medical Personnel in Rural Areas during 1985-1986 (in Nos.)

Category	Total	Stock Stock excluding Assam
1. Health Worker(Male)	84122	81132
2. Health Worker(Female)	95615	93383
3. Pharmacists	22448	21833
4. Block Extension/ Health Educators	4913	4762
5. Health Asstts.(Male)	26105	25408
6. Health Asstts.(Female)	15989	15779
7. Lab. Technicians	8336	8100
8. Nurse Mid-wives	9395	9357

Source: Health Information of India, 1986

4.4 Estimated Stock of Medical Manpower during 1985-2000

4.4.1 Stock of economically active Allopathic doctors at the end of 1985 has been estimated on the basis of total stock of registered medical practitioners (Allopathic) and proportion of economically active to total medical practitioners which was 87 percent as per 32nd round of NSS at the end of 1985. Projected estimates for the year 1990, 1995 and 2000 have been worked out on 1985 base data on economically active Allopathic doctors, annual outturns and attrition rate of 3 percent per annum.

Annual outturn has been worked out, from enrolment outturn ratio, on the assumption that enrolment figures will remain constant as that of 1985 upto the end of the century. Estimated stock of Allopathic doctors for selected States and U.Ts for the periods thus worked out has been presented in table 4.23. The Statement reveals that, estimated stock of Allopathic doctors will increase from 259.5 thousand in 1985 to 378.9 thousand in 2000 AD showing an annual growth rate of 2.6 percent during the period with corresponding growth rates of 2.6, 2.2 and 2.1 percent during 1985-90, 1990-91 and 1995-2000 respectively.

4.23 Estimated Stock of Allopathic Doctors during 1985 to 2000
(in percent)

Sl. State/UT No.	Stock at the end of			
	1985	1990	1995	2000
1. Andhra Pradesh	18.5	19.9	23.0	25.8
2. Bihar	16.3	20.0	23.2	26.2
3. Gujarat	17.6	20.0	22.2	24.2
4. Karnataka	17.9	21.2	24.4	27.6
5. Kerala	10.8	12.8	14.7	16.3
6. Madhya Pradesh	14.9	17.5	19.8	22.0
7. Maharashtra	40.9	48.4	55.1	61.2
8. Punjab	13.0	15.5	17.7	19.8
9. Rajasthan	12.3	14.7	16.9	18.9
10. Tamil Nadu	23.3	26.8	29.9	32.7
11. Uttar Pradesh	34.2	36.4	38.4	40.2
12. West Bengal	23.5	25.3	26.9	28.3
13. Delhi	11.9	13.3	14.7	15.9
14. Other States/UTs	16.6	17.8	18.8	19.8
Total	271.7	309.6@	345.8	378.9
G.R	x	2.6	2.2	2.1

@ Planning Commission estimate for 1990 was 302 thousand.

4.4.2 Stock of Ayurvedic, Unani and Homeopathic doctors during 1990 to 2000 AD have been projected on the basis of estimated employed doctors at the end of 1985 in the respective systems of medicine and annual outturn as in 1985. Projected stocks of non-allopathic

doctors as also of Dental Surgeons are presented below in table 4.23(a).

4.23(a) Projected Stock of Non-Allopathic Doctors and Dental Surgeons during 1990-2000 (in '000)

Category of Doctors	Actual	Projected Stock		
	1985	1990	1995	2000
Ayurvedic	130.0	160.3	177.6	193.3
Unani	7.4	8.0	8.6	9.2
Homeopathic	50.3	40.7	36.9	33.5
Dental	9.1	10.7	11.9	12.9

4.4.3 Projected Stock of Para-medical staff for the years 1990 to 2000 have been presented in table 4.24 below.

4.24 Projected Stock of Para-medical Manpower during 1990 to 2000
(in '000)

Sl. Category of No. Manpower	Actual Stock	Projected Stock		
	1985	1990	1995	2000
1. Nurses	206.6	242.9	284.9	322.0
2. Health Educators	4.9	4.6	4.3	4.0
3. Ophthalmic Assistants	1.0	3.7	6.1	8.1
4. Pharmacists	24.4	37.2	51.1	63.0
5. Lab. Technicians	8.3	14.5	19.8	24.3
6. X-Ray Techns.	8.8	11.8	13.0	14.0
7. Nurses Midwives	9.4	10.7	12.2	13.4
8. Health Asstts. (Male)	16.0	20.0	24.4	28.2
9. Health Asstts. (Female)	26.1	34.5	44.6	52.9
10. Health Workers (Male)	84.1	77.6	70.5	64.4
11. Health Workers (Female)	95.6	143.1	194.9	239.4

4.5 Requirement of Medical Manpower by 2000 AD

4.5.1 Requirement of Allopathic doctors for the year 2000-01 has been estimated taking into consideration the projected population for the year,

number of beds required to be provided for indoor treatment and number of medical practitioners required on the basis of staffing norms for in-patient and out-patient treatment.

4.5.2 Estimated population of selected States/UT for the years 1986-2001, presented in Annexure-4.4 shows that by 2000 AD the population of India excluding Assam is expected to be 965.08 millions at medium couple protection rate. As the national goal of 1 hospital-bed per thousand population is required to be achieved by 2000 AD. total number of hospital-beds in 2000 AD for the country excluding Assam will be 965080. Considering the necessity of medical services for 24 hours (i.e. in 3 shifts) requirement of doctors for indoor treatment at the rate of one doctor 20 beds including 25 percent extra for Senior medical advice will be 180.9 thousand $[(965080 \times 3/20)+25\%]$.

4.5.3 For out-patient treatment, availability of doctors is required to be increased from one doctor for 5000 population in 1980 to one doctor for 4000 population by 2000 AD in order to provide proper medical facilities, as per programme of "Health for All" by 2000 AD. Thus, for out-patient treatment there is a need of 241.3 thousand doctors. Taking into view both types of medical services, total requirement of doctors will be 422.2 thousand. To fulfill the above target by 2000-01, it is felt necessary to fulfill 90 percent of the above target by 1995-96 and 81 percent by 1990-91. Requirement of doctors for other years have thus been worked out considering bed population ratio as 0.81 per thousand population in 1990-91 and 0.90 per thousand in 1995-96 respectively for indoor patients and one doctor for 4500 people in 1990-91 and one doctor for 4250 people in 1995-96 for out door treatment. Year wise requirements of doctors during 1986 to 2001 have been presented in table 4.25.

4.25 Requirement of Allopathic Doctors during 1985-86 to 2000-01

Year	Population (in million)	Requirement of Doctors in'000		
		For in- patient	For Out- patient	Total
1985-86	739.95	99.9	155.8	255.7
1990-91	816.20	124.0	181.4	305.4
1995-96	891.68	150.5	209.8	360.3
2000-01	965.08	180.9	241.3	422.2

4.5.4 Requirement of Non-allopathic doctors for future years upto 2000 AD. have been estimated on the basis of doctor-population ratio as on 1980 and subsequent improvement in ratio in order to provide better medical facilities to the extent of 20 percent by 2000 AD. Year wise requirements of non-allopathic doctors during 1986-86 to 2000-01 have been presented in table 4.26. Requirements of different types of non-allopathic doctors have been worked out at the same proportion as that of 1980.

4.5.5 Projection of requirement for Dental Surgeons has been made by setting up a target of 1 Dental Surgeons for a population of 3 lakh in Rural Areas and 23.5 thousand in Urban Areas as against Dental Surgeon for a population of about 3.4 lakh in Rural Areas and 23.93 thousand in Urban Areas. Yearwise requirements of Dental Surgeons during 1985-86 to 2000-01 have been presented in table 4.26(a).

4.26 Requirement of Non-Allopathic Doctors and Dental Surgeons during 1985-86 to 2000-01

Year	Popu- lation (in million)	Requirement of Doctors in'000			
		Total	Ayur- vedic	Unani	Homeo- pathic
1985-86	739.95	191.9	125.6	7.8	58.5
1990-91	816.20	221.8	145.2	9.0	67.6
1995-96	891.68	253.3	165.7	10.3	77.3
2000-01	965.08	286.1	187.2	11.7	87.2

4.26(a) Requirement of Dental Surgeons during 1985-86 to 2000-01 (in '000)

Year	Rural	Urban	Total
1985-86	1.9	7.6	9.5
1990-91	2.0	8.7	10.7
1995-96	2.2	9.9	12.1
2000-01	2.4	11.1	13.5

4.5.6 Requirement of Nurses at all India level have been estimated by the Expert Committee for 1986, 1991 and 2001 AD. Requirements of Nurses for the country excluding Assam have been estimated on the basis of proportionate population of 1981 and presented below in table 4.27.

4.27 Requirement of Staff Nurses During 1986-2000

	Nursing Manpower Requirement in'000			
	1986	1991	1995	2000
For India	342.0	409.2	521.5	664.6
For India excluding Assam	332.1	397.3	506.4	645.3

4.5.7 Requirement of other types of para-medical manpower for the period for the country excluding Assam have been estimated on the basis of Expert Committee estimates for the corresponding manpower for the year 1991 to 2000 and presented in table 4.28.

4.28 Requirements of Para-medical Staff Other than Nurses during 1986 to 2000(excluding Assam)

Sl. No.	Category	Stock (1986)	Requirement in'000		
			1991	1995	2000
1.	Health Educators	4915	27.8	30.2	32.9
2.	Ophthalmic Asstts.	951	6.1	6.6	7.2
3.	Pharmacists	24449	33.8	36.9	40.3
4.	Lab.Techns.	8336	33.8	36.9	40.3
5.	X-Ray Techns.	N.A.	6.1	6.6	7.2

6. Nurses Midwives	9395	64.3	70.0	76.2
7. Health Asstts. (Male)	15989	33.2	36.1	39.3
8. Health Asstts. (Female)	26105	33.2	36.1	39.3
9. Health Workers (Male)	84122	132.6	134.9	137.2
10. Health Workers (Female)	95615	154.3	168.0	182.9

Source: CERPA estimates on the basis of Expert Committee estimates for corresponding years.

4.6 Stock vis-a-vis Requirement

4.6.1 Estimated Stock of Allopathic doctors vis-a-vis their requirement during 1985-86 to 2000-01 presented in table 4.29 reveals that in 1985-86 there were 3.8 thousand Allopathic doctors excess of requirement and in 1990-91 this excess marginally increased to 4.2 thousand. However, in percentage terms, the excess will decline from 1.46 percent to 1.36 percent during 1985-86 to 1990-91. If the enrolment capacity for medical education is not further increased by 1995-96, there will be shortage of Allopathic doctors by 14.6 thousand and by 2000-01 this shortage will increase to 43.3 thousand. Thus, there is a need to increase the enrolment capacity in Allopathic medical education by 5 percent per annum.

4.29 Stock vis-a-vis Requirement of Allopathic Doctors during 1985-86 to 2000-01

Year	Allopathic Doctors(in'000)			
	Stock	Require-ment	Surplus(+)	Deficit(-)
1985-86	259.5	255.7	(+) 3.8	
1990-91	309.6	305.4	(+) 4.2	
1995-96	345.7	360.5	(-) 14.6	
2000-01	378.9	422.2	(-) 43.3	

4.6.2 Estimated Stock of Ayurvedic doctors as against their requirement presented in table 4.30 shows that the present enrolment capacity in the

faculty of Ayurvedic medicine is just adequate to meet the requirement of Ayurvedic doctors upto 2000-01. However, the quality of training may be improved to make the services comparable with that of Allopathic system.

4.30 Stock vis-a-vis Requirement of Ayurvedic Doctors during 1985-86 to 2000-01

Year	Ayurvedic Doctors (in' 000)		
	Stock	Require-ment	Surplus(+)/Deficit(-)
1985-86	130.0	125.6	(+) 4.4
1990-91	160.3	145.2	(+) 15.1
1995-96	177.6	165.7	(+) 11.9
2000-01	193.3	187.2	(+) 6.1

4.6.3 Estimated stock of Unani doctors as against their requirement presented in table 4.31 shows that if the enrolment capacity in the faculty of Unani medicine is not further augmented there is a likelihood of shortage of manpower under this category throughout the period and by 2000-01, the shortage will be by 2.5 thousand (or by 21.4 percent of the requirement). Thus, there is immediate need for augmenting the enrolment capacity by 5 percent per annum.

4.31 Stock vis-a-vis Requirement of Unani Doctors during 1985-86 to 2000-01 (in'000)

Year	Unani Doctors (in' 000)		
	Stock	Require-ment	Surplus(+)/Deficit(-)
1985-86	7.4	7.8	(-) 0.4
1990-91	8.0	9.0	(-) 1.0
1995-96	8.6	10.3	(-) 1.7
2000-01	9.2	11.7	(-) 2.5

4.6.4 Estimated stock of Homeopathic doctors for the period 1985-86 to 2000-01 vis-a-vs corresponding requirement have been presented in table 4.32. It would be seen that if the present rate of growth of economically active to total stock of Homeopathic doctors will continue, in that case, there is a likelihood of shortage of manpower of this category by 1995-96. By 2000-01, the shortage will be by 11.7 thousand.

4.32 Stock vis-a-vis Requirement of Homeopathic Doctors during 1985-86 to 2000-01

(In '000)

Year	Homeopathic Doctors (in' 000)		
	Stock	Require-ment	Surplus(+)/Deficit(-)
1985-86	45.0	30.3	(+) 14.7
1990-91	40.7	35.0	(+) 5.7
1995-96	36.9	40.0	(-) 3.1
2000-01	33.5	45.2	(-) 11.7

4.6.5 Estimated stock of various categories of para-medical manpower during 1990-91 and 2000-01 and corresponding requirement are presented in table 4.33. The statement reveals that there would be a huge shortage of Nurses, Health Educators, Lab. Technicians, Nurse Mid-wives, Health Asstts.(Male) and Health workers(Male). The existing situation can only be improved significantly if organisation structures responsible for Health manpower development are further strengthened with speed.

**4.33 Estimated Stock vis-a-vis Requirement of Para-medical Staff
During 1990-91 and 2000-01 (in'000)**

Sl. Category of Manpower No.	1990-91			2000-01		
	Stock	Require- ment	Surplus(+) Deficit(-)	Stock	Require- ment	Surplus(+) Deficit(-)
1. Staff Nurses	242.9	397.3	(-)154.4	322.0	645.3	(-)323.3
2. Health Educators	4.6	27.8	(-) 23.2	4.3	32.9	(-) 28.6
3. Ophthalmic Asstts.	3.7	6.1	(-) 2.4	8.1	7.2	(+) 0.9
4. Pharmacists	37.2	33.8	(+) 3.4	63.0	40.3	(+) 22.7
5. Lab. Technicians	14.5	33.8	(-) 19.3	24.3	40.3	(-) 16.0
6. X-Ray Technicians	11.8	6.1	(+) 5.7	14.0	7.2	(+) 6.8
7. Nurse Mid-wives	10.7	64.3	(-) 53.6	13.4	76.2	(-) 62.8
8. Health Asstts.(Male)	20.0	33.2	(-) 13.2	28.2	39.3	(-) 11.1
9. Health Asstts.(Female)	34.5	33.2	(+) 1.3	52.9	39.3	(+) 13.6
10. Health Workers (Male)	77.6	132.6	(-) 55.0	64.4	137.2	(-) 72.8
11. Health Workers(Female)	143.1	154.3	(-) 11.2	194.9	182.9	(+) 12.0

**4.34 Distribution by Discipline of
Allopathic Doctors (in percent)**

Discipline	Actual Staff		
	1985-86	1986-87	
4.7 Some Structural Magnitudes			
4.7.1 In the course of the survey some Hospitals and Medical Institutions were contacted to collect structural information regarding medical and health sector. This information as largely collected in urban areas is summarised here.	B.A.M.S	2.42	4.23
	M.B.B.S.	28.92	26.57
	Speech Science	0.65	0.58
	Anaesthesia	5.33	5.40
	Paediatrics	2.10	2.19
	Pharmacology	0.81	0.88
	Physiology	0.97	1.17
	Anatomy	2.75	3.21
	Pathology	3.39	4.38
	Surgery	14.70	13.43
	Medicine	13.41	13.27
	Cardiology	0.48	0.44
	Orthopaedic	0.65	0.88
	Ophthalmology	3.07	3.36
	Radiology	0.97	0.88
	Dermatology	0.65	0.73
	Psychiatry	2.10	2.34
	Bio-Chemistry	0.81	0.88
	Microbiology	0.48	0.44
	M.Sc.	2.26	2.19
	ENT	5.01	4.82
	Physiotherapy	0.48	0.58
	Audiology	0.97	1.02
	P.S.M.	0.81	0.73
	Obst.& Gynaec	4.36	4.09
	Electronics	1.13	1.02
	Engineering	0.32	0.29
	Total	100.00	100.00

Source : CERPA field Survey

4.7.3 In medical institutions contacted on an average, 54.8 percent of total intake were in M.B.B.S. course, about 9.8 percent in M.D., 9.9 percent in M.S. (Gen.Surgery), 7.4 percent in M.S. (ENT) and 0.9 percent in M.S. (Ophthalmology).

4.7.4 Of all indoor beds, 16.8 percent were allocated to Gyneacology and Obstetrics, 9.9 percent to Medical and 6.8 percent to Surgical. Other important branches which had a substantial share in total available beds were Surgical and Ophthalmology 6.8 percent each, ENT 3.8 percent and Cardiology 3.9 percent.

4.7.5 The share of indoor patients was, however, different than respective bed allocation. 27.6 percent were in Medical, 13.7 percent in Gyneacology/Obstetrics. Other disciplines had a smaller share among indoor patients.

4.7.6 Out door patients were largely, in the areas of Medical (21.9 percent), Paediatrics (17.2 percent) and Pathological Investigations (20.4 percent).

4.7.7 In most medical disciplines females were about 1/3rd of the total personnel except for nurses where share of females was about 85 percent. Among chemists and Pharmacists share of female was about one-sixth of total.

4.7.8 During 1986 the female medical personnel had a higher share of 53 % among those below 30 years. This share gradually declined till age group 41-45 years but increased again for higher age brackets.

4.35 Distribution of Medical Personnel by Sex and Age Group:1986 (in percent)

S.N.	Age Group(Yrs.)	Male	Female	Total
1.	Below 30	46.8	53.2	100.0
2.	31-35	61.3	38.7	100.0
3.	36-40	68.9	31.1	100.0
4.	41-45	81.1	18.9	100.0
5.	46-50	63.5	36.5	100.0
6.	51-55	65.3	34.7	100.0
7.	56 and Above	90.0	10.0	100.0
	All Groups	68.3	31.7	100.0

Source: CERPA Field Survey

4.7.9 During 1986 there was a concentration of women in the salary slab Rs. 1501 to 2000 p.m. (63.0 percent). The share of women was much less for salary slab of Rs. 3501 and above (11.5 percent).

4.36 Distribution of Medical Personnel by Sex and Salary Slab:1986 (in percent)

Sl. No	Salary Slab (in Rs.)	Male	Female	Total
1.	Below 1000	85.7	14.3	100.0
2.	1001- 1500	83.3	16.7	100.0
3.	1501- 2000	37.0	63.0	100.0
4.	2001- 2500	57.8	42.2	100.0
5.	2501- 3000	65.1	34.9	100.0
6.	3001- 3500	79.0	21.0	100.0
7.	3501 above	88.5	11.5	100.0
	All Slabs	68.3	31.7	100.0

Source: CERPA Field Survey

5. GENERAL SCIENCE MANPOWER

5.1 Introduction

5.1.1 The study of Manpower having degree in Science has been carried out as part of the study of Science and Technology Manpower in India. The study utilises both primary and secondary data and extends over all the branches of general science. The study attempts to review not only the existing demand supply imbalance of this category of manpower both at the National as well as Regional Levels but also expected demand-supply situation by the end of the Century at both the levels. Measures needed to overcome the imbalance have also been suggested in the study.

5.2 Stock of Degree Holders in Science

5.2.1 The stock of degree holders in Science for the year 1980 has been estimated from annual outturn of graduates, post-graduates and Ph.Ds in Science reported for the years 1950 to 1979 in the U.G.C reports, estimated outturn on the basis of enrolment data for 1980 and enrolment-outturn ratio. For estimating the future stock, future estimated enrolment based on growth rates of enrolment during past few years have been taken into consideration. For estimating stock, attrition of previous stock at 3 percent per annum has also been taken into consideration.

5.2.2 As the base line stock at the end of 1949 is not available, the same has been ignored while estimating the stock during different years. This resulted in under-estimation of very high magnitude during fifties but by 1980, the effect of ignoring the baseline stock of 1949 has been completely eliminated due to attrition. This observation is substantiated as the stock for 1970 estimated by this method compares well with the stock of degree

holders presented in 1971 census G.Series tables. The stock of degree holders in science as reported in the G.Series tables, 1971 census was 4,46,814 as against the estimated stock at the end of 1970 which was 5,08,434.

5.2.3 Estimated Stock of Science graduates for different years is worked out by applying the formula :

$$S_r = S_{r-1} \left(1 - \frac{3}{100}\right) + O_r - P_r$$

Where, S_r - Stock for rth year,

S_{r-1} - Stock for (r-1)th year,

O_r - Outturn/expected outturn for rth year,

P_r - Attrition out of outturns/expected outturns for the year due to their acquiring post graduate qualification later.

Estimated stock of post graduates in science for different years has also been worked out applying the same formula with slight modification. Here P_r is substituted by D_r where D_r is expected attrition out of outturns/expected outturns due to their acquiring doctorate degree later. For Ph.D in Science, Stock has been estimated by applying the formula:

$$S_r = S_{r-1} \left(1 - \frac{3}{100}\right) + O_r$$

5.2.4 Estimated stock of degree holders in Science for the years 1980 to 2000 is presented in table 5.1. Corresponding Index of stock with base 1985 = 100 presented in table 5.1(a) reveals that overall stock by 2000 AD would be almost double that of 1985. The stock of M.Sc. and Ph.Ds shows 40 and 168 percent growth during same interval of time.

5.1 Estimated Stock of Degree Holders in Science, 1980-2000 (in '000)

Year	B.Sc.	M.Sc.	Ph.D	Total
1980	1060.0	188.8	19.7	1268.5
1985	1374.3	233.1	30.5	1637.9
1990	1759.0	271.2	43.0	2073.2
1995	2229.6	302.5	59.6	2591.7
2000	2805.3	327.2	81.8	3214.3

5.1(a) Index of estimated Stock of Degree Holders in Science with base 1985= 100

Year	B.Sc.	M.Sc.	Ph.D	Total
1985	100.0	100.0	100.0	100.0
1990	128.0	116.3	141.0	126.6
1995	162.2	129.8	195.4	158.2
2000	204.1	140.4	268.2	196.2

5.2.5 According to 32nd Round of National Sample Survey, 78 percent of the stock of degree holders in Science were economically active. It is assumed that there will not be any significant change in this rate in near future. 32nd Round NSS results also reveal that unemployment rate among economically active Science graduates and post graduates was 20.57 and 4.87 percent respectively. The 1980 estimates of unemployment have been made on the assumption that there has not been any significant change in these rates since 1977-78, when the survey was conducted.

5.2.6 Estimated stock of economically active degree holders in Science, presented in table 5.1(b), for the period 1980 to 2000 shows that the growth rate of Labour Force (economically active) is the same as that of stock.

5.1(b) Estimated Stock of Economically Active Degree Holders in Science: 1980-2000 (in '000)

Year	B.Sc.	M.Sc.	Ph.D.	Total
1980	826.8	147.3	15.4	989.5
1985	1071.9	181.8	23.8	1277.5
1990	1372.0	211.5	33.5	1617.0
1995	1739.1	236.0	46.5	2021.6
2000	2188.1	255.2	63.8	2507.1

5.2.7 D.H.T.P. Survey results, presented in table 5.2(a), shows that among all the States, Tamil Nadu was having maximum share of Stock of degree holders in Science (12.01 percent), followed by Maharashtra (11.33 percent), West Bengal (10.85 percent), Karnataka (10.64 percent), Uttar Pradesh (10.59 percent) and Kerala (9.54 percent) in that order. These six States together were having around 65 percent of the total stock of degree holders. Among Ph.D. degree holders, Uttar Pradesh had a maximum share of 15.34 percent. Maharashtra, Tamil Nadu, Karnataka and West Bengal were other major States. These five States together were having 63 percent of the estimated stock. Amongst M.Sc. degree holders, Uttar Pradesh alone had 21.53 percent of the total stock. Madhya Pradesh and Maharashtra were other major States occupying around 23 percent share.

5.2(a) Distribution of Degree Holders in General Science by States, 1981 (in percent)

Sl.State/UT No	B.Sc.	M.Sc.	Ph.D. (Sc.)	Total
1. Andhra Pradesh	5.55	5.59	4.68	5.54
2. Bihar	8.17	4.45	4.37	7.56
3. Gujarat	3.98	3.61	5.19	3.95
4. Karnataka	11.14	8.09	8.24	10.64
5. Kerala	10.17	6.60	3.96	9.54
6. M.P.	5.26	11.27	6.70	6.17
7. Maharashtra	11.21	11.75	13.70	11.33
8. Orissa	2.15	2.44	2.77	2.20
9. Rajasthan	2.12	3.18	3.43	2.30
10. Tamil Nadu	13.06	6.46	8.33	12.01
11. U.P.	8.56	21.53	15.34	10.59
12. W. Bengal	12.01	4.66	7.41	10.85
13. Delhi	2.53	4.60	8.46	2.93
14. Other States/UTs	4.09	5.77	7.42	4.39
Total N('000)	1060.0	188.8	19.7	1268.5

Source: DHTP Survey, 1981

5.2.8 Percentage distribution of Stock of degree holders in Science by level of degree, presented in table

5.2(b), shows that the share of B.Sc. degree holders among total degree holders in Science varied from 92.55 percent in West Bengal to 67.5 percent in U.P. For M.Sc. the share varied between 30.25 percent in U.P. to 6.39 percent in West Bengal. For Ph.D. the share varied between 4.48 percent in Delhi to only 0.64 percent in Kerala.

5.2(b) Distribution of Degree Holders in General Science by Level of Degree in Selected States & All India, 1981
(in percent)

Sl. No.	States/ UT	B.Sc.	M.Sc.	Ph.D	Total	N('oo)
1.	Andhra Pradesh	83.68	15.01	1.31	100.0	703.1
2.	Bihar	90.34	8.76	0.90	100.0	958.6
3.	Gujarat	84.34	13.62	2.04	100.0	500.3
4.	Karnataka	87.48	11.32	1.20	100.0	1349.8
5.	Kerala	89.07	10.29	0.64	100.0	1210.4
6.	M.P.	71.17	27.15	1.68	100.0	783.5
7.	Maharashtra	82.68	15.44	1.88	100.0	1437.1
8.	Orissa	81.56	16.49	1.95	100.0	279.5
9.	Rajasthan	77.09	20.59	2.32	100.0	291.5
10.	T.N.	90.91	8.01	1.08	100.0	1522.7
11.	U.P	67.50	30.25	2.25	100.0	1344.1
12.	W.Bengal	92.55	6.39	1.06	100.0	1375.6
13.	Delhi	72.15	23.37	4.48	100.0	371.7
14.	Other States/UTs	77.82	19.56	2.62	100.0	557.1
	All India	83.56	14.89	1.55	100.0	12685.0

Source : DHTP Survey 1981

5.3 No. of Employed & Unemployed Science Graduate & Post-graduates as on 1980 (in '000)

Level of Degree	Economically active persons	Unemployed	Employed
B.Sc.	826.8	170.07	656.73
M.Sc.	147.3	7.17	140.13
Ph.D(Sc.)	15.4	0.75	14.65
Total	989.5	177.99	811.51

5.2.9 Estimated stock of economically active and employed degree holders in Science presented in table 5.3 reveals

that in 1980, out of 989.5 thousand economically active degree holders in Science, 811.51 thousand were employed. Among employed degree holders, 656.73 thousand were B.Sc., 140.13 thousand M.Sc. and 14.65 thousand Ph.D(Sc.).

5.2.10 As per 1981 Census, 1.34 lakh degree holders in Science were employed in scientific occupations. Out of them 62.7 percent were employed in other services including education and 24.6 percent in industry. Other important sectors having scientific occupations are Agriculture and Trade & Commerce. These four sectors together occupied 96.8 percent of the total scientific workers.

5.4 Number of persons Engaged in Scientific Occupation by Sectors, 1981

Sl. No.	Sectors	No. of Scientific Workers	Percentage
1.	Agriculture	7173	5.36
2.	Mining	1594	1.19
3.	Manufacturing	32875	24.56
4.	Construction	1190	0.89
5.	Trade	5532	4.13
6.	Transport	1531	1.14
7.	Others	83955	62.73
	Total	133850	100.00
	Female	10813	8.08
	Urban	103761	77.52
	Rural	30089	22.48

Source : 1981 Census

5.2.11 Out of 1.34 lakh of scientific workers, 1.23 lakh were male and only 0.11 lakh female. Again, out of total scientific workers 1.04 lakh were employed in Urban areas and 0.3 lakh in rural areas.

5.2.12 Maharashtra alone had around 24 percent of the scientific workers. Other major States were Uttar Pradesh, Gujarat, West Bengal, Andhra Pradesh, Delhi and Karnataka covering around 6 to 7 percent each. Female workers were maximum in Maharashtra (26 percent) followed by Kerala (18 percent). However, ratio of female to male workers was maximum in Kerala (1:2).

**5.5(a) Distribution of Workers Employed
in Scientific Occupations in Selected
States : 1981**

(in percent)

Sl.No.	States/UTs	Male	Female	Total
1.	Andhra Pradesh	6.4	5.6	6.3
2.	Bihar	3.6	0.9	3.4
3.	Gujarat	6.9	4.6	6.7
4.	Karnataka	6.2	6.5	6.2
5.	Kerala	3.2	17.6	4.4
6.	Madhya Pradesh	5.3	2.8	5.1
7.	Maharashtra	24.0	25.9	24.1
8.	Orissa	2.5	0.9	2.4
9.	Rajasthan	1.4	0.9	1.3
10.	Tamil Nadu	5.1	9.3	5.4
11.	Uttar Pradesh	7.3	2.8	7.0
12.	West Bengal	6.9	3.7	6.7
13.	Delhi	6.0	8.3	6.2
14.	Other States/UTs	15.2	10.2	14.8
	India	100.0	100.0	100.0
	N ('000)	123.0	10.8	133.8

Source: CERPA estimates based on Census 1981 data from General Economic Tables B-1 to B-5 and relate to specific scientific occupations.

5.2.13 State level stock of degree holders in science by level of degree for 1985 has been estimated by updating the State wise estimated stock of 1980 of different level of degree holders with the help of State wise annual estimated outturn during 1981 to 1985 and annual attrition rate etc. by applying the same method as that of estimating future stock of degree holders in science for the country as a whole. Distribution of stock of degree holders in Science in 1985 by level of degree shows that stock of B.Sc. degree holders occupied maximum share in all the States with shares varying from 70 to 92 percent. Among all the degree holders share of B.Sc. was maximum (92.3 percent) in West Bengal followed by Bihar (91.1 percent). The share occupied by M.Sc. among degree holders was maximum in Uttar Pradesh (28.3 percent) followed by Madhya Pradesh (25.2 percent) while for Ph.D.(Science), Delhi occupied maximum share (5.3 percent) followed by Uttar Pradesh (3.3 percent).

**5.5(b) Distribution of Stock of S & T
Manpower in General Science by level
of Degree in Selected States and
All India Level : 1985**

(in percent)

Sl. State/ No. UTs	B.Sc	M.Sc	Ph.D	Total	N
					('000)
1. Andhra Pradesh	83.7	14.7	1.6	100.0	103.4
2. Bihar	91.1	8.0	0.9	100.0	131.3
3. Gujarat	83.0	14.5	2.5	100.0	16.2
4. Karnataka	88.1	10.4	1.5	100.0	163.7
5. Kerala	90.1	9.2	0.7	100.0	152.6
6. M.P.	73.0	25.2	1.8	100.0	107.3
7. Maharashtra	83.4	14.4	2.2	100.0	181.2
8. Orissa	79.8	17.6	2.6	100.0	34.5
9. Rajasthan	77.0	20.5	2.5	100.0	41.0
10. Tamil Nadu	90.6	8.2	1.2	100.0	203.2
11. U.P.	68.4	28.3	3.3	100.0	172.9
12. W. Bengal	92.3	6.4	1.3	100.0	171.3
13. Delhi	70.4	24.3	5.3	100.0	48.8
14. Other States/UTs	79.7	17.8	2.5	100.0	65.5
All India	83.9	14.2	1.9	100.0	1637.9

5.2.14 Statewise Stock of B.Sc., M.Sc. and Ph.D.(Science) degree holders for 1990 to 2000 have been projected for 12 selected States and Delhi taking into consideration respective stocks in 1985 as also projected outturns during 1986-2000 on the basis of growth rate of enrolment - outturn ratio for each level of degree realised during recent past. Distribution of State wise stock of B.Sc. degree holders for 1990 to 2000, based on their projected stock for the relevant years shows that Tamil Nadu will have the maximum share (13.6 to 13.9 percent) throughout the period, showing slightly increasing trend. West Bengal is the next major State with 11.3 to 10.8 percent share during the same period. Other major States are Maharashtra, Kerala and Karnataka with around 10 percent share each. These five States together will have more than 55 percent of the total stock of B.Sc. degree holders.

5.6(a) Statewise Distribution of Projected Stock of B.Sc. Degree Holders during 1990 to 2000 (in percent)

Sl.No.	State/UT	1990	1995	2000
1.	Andhra Pradesh	6.7	7.1	7.3
2.	Bihar	9.2	9.6	9.8
3.	Gujarat	3.4	3.0	2.7
4.	Karnataka	10.1	9.4	9.5
5.	Kerala	10.0	10.4	10.5
6.	Madhya Pradesh	5.9	6.0	6.1
7.	Maharashtra	10.9	10.7	10.5
8.	Orissa	2.0	2.0	2.1
9.	Rajasthan	2.2	2.2	2.0
10.	Tamil Nadu	13.6	13.8	13.9
11.	Uttar Pradesh	8.8	9.0	9.1
12.	West Bengal	11.3	11.0	10.8
13.	Delhi	2.5	2.4	2.4
14.	Other States/UTs	3.4	3.4	3.3
	All India	100.0	100.0	100.0
	N(in '000)	1759.0	2229.6	2805.3

5.2.15 Projected Statewise stock of M.Sc. degree holders shows that Uttar Pradesh will play a leading role throughout the period with 20.5 percent share in 1990, 20 percent in 1995 and 19.5 percent in 2000. Other major States having at least 10 percent share are Madhya Pradesh and Maharashtra.

5.6(b) Statewise Distribution of Projected Stock of M.Sc. Degree Holders during 1990 to 2000 (in percent)

Sl.No.	States/UTs	1990	1995	2000
1.	Andhra Pradesh	7.1	7.5	7.8
2.	Bihar	4.6	4.7	4.8
3.	Gujarat	4.2	4.4	4.6
4.	Karnataka	7.0	6.8	6.7
5.	Kerala	5.6	5.3	5.1
6.	Madhya Pradesh	11.1	10.8	10.6
7.	Maharashtra	10.9	10.7	10.6
8.	Orissa	2.8	3.0	3.2
9.	Rajasthan	3.9	4.1	4.2
10.	Tamil Nadu	7.5	7.8	8.0
11.	Uttar Pradesh	20.5	20.0	19.5
12.	West Bengal	4.5	4.4	4.3
13.	Delhi	5.5	5.8	6.0
14.	Other States/UTs	4.8	4.7	4.6
	All India	100.0	100.0	100.0
	N(in '000)	271.2	302.5	327.2

5.2.16 For Ph.D.(Science) degree holders also, Uttar Pradesh will play a leading role with 20.5 to 23.3 percent share during 1990 to 2000. Maharashtra, Delhi, Tamil Nadu and West Bengal are other major States with 12 to 7.7 percent share.

5.6(c) Statewise Distribution of Projected Stock of Ph.D Degree Holders during 1990 to 2000 (in percent)

Sl.No.	State/UT	1990	1995	2000
1.	Andhra Pradesh	6.0	6.3	6.1
2.	Bihar	3.8	3.6	3.5
3.	Gujarat	4.2	3.4	2.8
4.	Karnataka	7.6	7.4	7.3
5.	Kerala	3.5	3.4	3.3
6.	Madhya Pradesh	6.2	6.1	5.9
7.	Maharashtra	12.6	12.3	12.1
8.	Orissa	3.2	3.3	3.4
9.	Rajasthan	3.4	3.4	3.4
10.	Tamil Nadu	8.1	8.0	8.0
11.	Uttar Pradesh	20.5	21.9	23.3
12.	West Bengal	7.5	7.6	7.7
13.	Delhi	8.6	8.7	8.8
14.	Other States/UTs	4.8	4.6	4.4
	All India	100.0	100.0	100.0
	N(in '000)	43.0	59.6	81.8

5.3 Employment Potential for Degree Holders in Science

5.3.1 Requirements of Degree Holders in Science for future years have been projected at three different scenarios by adopting following three different methods namely (i) Investment method (ii) Output method and (iii) Manpower Norms method.

5.3.2 For estimating requirement of degree holders in Science for future years by Investment approach, sectorwise estimated investments have been projected at existing 5 percent as also at 8 percent growth rates of economy. On the basis of average of these two types of investment in each sector and the corresponding norms/adjusted norms of outlay for employment generation during a year

[provided in table 2.10 (a)], additional employment potential for the year have been worked out for that sector by using the formula :

Estimated addition in employment in a sector for a year

$$= \frac{\text{Estimated investment during the year}}{\text{Norms of outlay per standard person years for relevant year}} \times \text{Success rate realised of envisaged employment in the sector during 1980-81}$$

Total estimated addition to employment potential thus worked out was 53 lakh in 1980-81 which is expected to rise to 131.5 lakh by 2000-01 showing annual growth rate in manpower absorption as 4.65 percent.

5.3.3 Taking into account expected

share of degree holders in Science in total employment during a year, requirement of degree holders in Science was estimated for that year. Sector wise expected share of degree holders in science in total employment for different years, has been estimated on the basis of ratio of total employed science degree holders to total main workers as per 1981 census in each sector and expected growth of this ratio owing to adoption of more and more modern scientific techniques in concerned sector needing more and more science graduates it is assumed that this ratio for agriculture sector will grow at an annual growth rate of 0.75 percent while that of Mining and manufacturing will grow at 0.01 percent and other sector at 0.35 percent annual growth rate. Estimated requirement of degree holders in science works out to be around 9.7 lakh in 1985-86 which will increase to 22.0 lakh in 2000-01.

5.7 Estimated Requirement of Degree Holders in Science during 1985-86 to 2000-01 at Scenario - I

(in '00)

Sector	Requirement of degree holders in Science during				
	1980-81 (Actual)*	1985-86	1990-91	1995-96	2000-01
1. Agriculture	216.7	241.9	278.6	331.7	405.4
2. Mining and Manufacturing	1476.6	1820.5	2309.1	3009.1	4024.3
3. Transport	447.0	536.8	663.7	844.1	1102.9
4. Others	5974.8	7104.3	9135.8	12123.3	16507.5
Total	8115.1	9703.5	12387.2	16308.2	22040.1

* Source: Census, 1981

5.3.4 In order to estimate future requirements of degree holders in science employment output norms for different sectors of economy, at 1970-71 constant prices, for different years have been worked out on the basis of GDP and total employment of degree holders in Science in the corresponding sector in 1980-81 as well as expected annual growth in per capita income due to growth of national economy. These norms are presented in Annexure-5.1. Applying these norms on the projected sectorwise G.D.P of the corresponding years, as presented in Annexure-2.1 total employment potential have been worked out with the help of following formula :

Estimated Requirement in a sector in a year

$$= \frac{\text{(Estimated Gross Domestic Product in the Sector)} \times \text{(Norms of employment of degree holders in science per crore Rs. of output during the year)}}{\text{G.D.P of the corresponding years}}$$

Estimated requirement of degree holders in Science by this approach was 10.5 lakh in 1985-86 which is expected to rise to 23.7 lakh by 2000-01.

5.3.5 The Seventh Five Year Plan envisaged to generate additional employment of the order of 40.36 million standard person year with an implied growth rate of 3.99 percent per annum. Growth rates of employment for different sectors envisaged by the Planning Commission for the seventh plan period are presented below in table 5.9(a).

5.9(a) Sectorwise Growth rates of Employment Envisaged during Seventh Plan Period

Sector	Annual growth rates of employment (%)
Agriculture	3.49
Mining & Quarrying	5.32
Manufacturing	4.55
Construction	3.90
Electricity	7.76
Railways	1.80
Other Transport	4.58
Communication	5.18
Other Services	4.60
Total	3.99

5.8 Estimated Requirement of Degree Holders in Science during 1985-86 to 2000-01 at Scenario - II (in '00)

Sector	Requirement of degree holders in Science during				
	1980-81	1985-86	1990-91	1995-96	2000-01
1. Agriculture	216.7	262.5	317.0	382.7	462.1
2. Mining & Quarrying	49.7	76.2	116.7	178.7	273.8
3. Manufacturing	1426.9	2095.8	3079.5	4524.8	6648.3
4. Construction	124.4	134.6	145.7	157.7	170.8
5. Trade & Commerce	1957.4	2418.2	2987.7	3691.3	4560.5
6. Transport and Communication	447.0	602.0	811.0	1092.5	1471.7
7. Education	1802.8	2128.8	2513.7	2968.2	3504.9
8. Other Services	2090.2	2784.1	3708.7	4941.2	6584.3
Total	8115.1	10502.2	13680.0	17937.1	23676.4

5.3.6 On the basis of future growth rates of employment, as envisaged by the Planning Commission, overall employment in different sectors for different years upto 2000-01 have been projected. By relating overall estimated employment in each sector with manpower requirement

of degree holders in Science, estimated requirements of this category of manpower for future years upto 2000-01 have been obtained. It is seen that estimated requirement of degree holders in Science for 1985-86 was 10.2 lakh which will increase to 20.4 lakh by 2000-01.

5.9 (b) Estimated Requirement of Degree Holders in General Science during 1985-86 to 2000-01 at Scenario III

(in '00)

Sector	1980-81	1985-86	1990-91	1995-96	2000-01
1. Agriculture	216.7	252.6	294.5	343.2	400.1
2. Mining	49.7	76.6	117.9	181.5	279.4
3. Manufacturing	1426.9	1957.8	2686.2	3685.8	5057.2
4. Construction	124.4	152.5	186.9	229.2	281.1
5. Trade & Commerce	1957.4	2443.4	3050.0	3807.2	4752.4
6. Transport & Communication	447.0	576.3	742.9	957.7	1234.5
7. Education	1802.8	2128.8	2513.7	2968.2	3504.9
8. Others	2090.2	2588.6	3205.8	3970.2	4916.9
Total	8115.1	10176.6	12797.9	16143.0	20426.5

5.3.7 Requirements of degree holders in Science during 1980-81 to 2000-01 projected through different approaches are presented below in table 5.10(a) and corresponding index of requirement, with base 1985-86 = 100 is presented in table 5.10(b). It is observed that although all the three types of estimates compare well with one another, the estimates arrived through investment approach is closest to the average of all types of estimates.

5.10(a) Requirement of Degree Holders in Science during 1980-81 to 2000-01 (in '000)

Approach	1980-81	1985-86	1990-91	1995-96	2000-01
Investment	811.5	970.3	1238.7	1630.8	2204.5
Output	811.5	1050.2	1368.0	1793.7	2367.6
Manpower norms	811.5	1017.7	1279.8	1614.3	2042.6
Average	811.5	1012.7	1295.5	1679.6	2204.7

5.10(b) Index of Estimated Requirement of Degree Holders in Science with base 1985-86 = 100.

Scenario	1985-86	1990-91	1995-96	2000-01
Scenario-I	100.0	127.7	168.1	227.2
Scenario-II	100.0	130.3	170.8	225.5
Scenario-III	100.0	125.8	158.6	200.7
Average	100.0	127.9	165.9	217.7

5.3.8 Requirements of degree holders in Science by level of degree for future years, estimated on the basis of their respective shares in employment in 1980-81 and expected growth in their respective shares due to change in the requirement pattern have been presented in table 5.11(a). There will be uniform growth in requirement at 2.8 percent per annum for M.Sc. and 7.6 percent for Ph.D. while for B.Sc. the growth rate will be 4.8 percent per annum during 1980-81 to 1985-86 and 5.9 percent per annum during 1995-96 to 2000-01.

5.11(a) Requirement of Degree Holders in Science by Level of Degree (in'000)

Level of Degree	1980-81	1985-86	1990-91	1995-96	2000-01
B.Sc.	656.7	830.7	1080.4	1423.5	1897.7
M.Sc.	140.1	160.8	184.6	212.0	243.4
Ph.D	14.7	21.2	30.5	44.1	63.6
Total	811.5	1012.7	1295.5	1679.6	2204.7

5.11(b) Distribution of Requirement of Degree Holders in Science by Level of Degree, during 1985-86 to 2000-01 (in percent)

Level of Degree	1985-86	1990-91	1995-96	2000-01
B.Sc.	82.0	83.4	84.8	86.1
M.Sc.	15.9	14.2	12.6	11.0
Ph.D	2.1	2.4	2.6	2.9
Total	100.0	100.0	100.0	100.0

5.4 Demand Supply Balance

5.4.1 While reviewing the expected availability of economically active degree holders in Science vis-a-vis their requirement during 1980-81 to 2000-01, it is observed that magnitude of unemployment among degree holders in Science is expected to grow from 1.78 lakh in 1980-81 to 3.42 lakh in 1995-96 and thereafter it is expected to decline slowly to 3.02 lakh in 2000-01. The rate of unemployment will however, continually decline from 20.72 percent in 1985-86 to 12.06 percent in 2000-01.

5.12(a) Estimated Stock of Economically Active Degree Holders in Science and their Requirements during 1980-81 to 2000-01 (in '000)

Year	Economically Active	Requirement	Unemployed	Unemployment rate(%)
1980-81	989.5	811.5	178.0	17.99
1985-86	1277.5	1012.7	264.8	20.72
1990-91	1617.0	1295.5	321.5	19.88
1995-96	2021.6	1679.6	342.0	16.94
2000-01	2507.1	2204.7	302.4	12.06

5.4.2 Magnitude of unemployment amongst B.Sc. degree holders is expected to rise from 1.7 lakh in 1980-81 to 3.16 lakh in 1995-96 and thereafter will slowly decline to 2.9 lakh by the end of the century. The unemployment rate, however, will show declining trend after 1985-86 as observed in case of total degree holders in Science. It will decline from 22.5 percent in 1985-86 to 13.27 percent in 2000-01.

5.12(b) Estimated Stock of Economically Active B.Sc. Degree Holders and their Requirements during 1980-81 to 2000-01 (in '000)

Year	Economically Active	Requirement	Unemployed	Unemployment rate(%)
1980-81	826.8	656.7	170.1	20.57
1985-86	1071.9	830.7	241.2	22.50
1990-91	1372.0	1080.4	291.6	21.25
1995-96	1739.1	1423.5	315.6	18.15
2000-01	2188.1	1897.7	290.4	13.27

5.4.3 Magnitude of unemployment among M.Sc. degree holders will rise from 7.2 thousand to 26.9 thousand during 1980-81 to 1990-91 and thereafter will decline to 11.8 thousand by 2000-01. The rate of unemployment in 2000-01 will be almost of the same order as that of 1980-81, after taking a peak of 12.72 percent in 1990-91.

5.12(c) Estimated Stock of Economically Active M.Sc. Degree Holders and their Requirements during 1980-81 to 2000-01 (in '000)

Year	Economically Active	Requirement	Unemployed	Unemployment rate(%)
1980-81	147.3	140.1	7.2	4.89
1985-86	181.8	160.8	21.0	11.55
1990-91	211.5	184.6	26.9	12.72
1995-96	236.0	212.0	24.0	10.17
2000-01	255.2	243.4	11.8	4.62

5.4.4 For Ph.Ds, magnitude of unemployment is below 3 thousand even when it is the highest. The unemployment rate grew from 4.55 percent to 10.92 percent during 1980-81 to 1985-86 and thereafter shows declining trend. By 2000-01 magnitude of unemployment will be only nominal.

5.12(d) Estimated Stock of Economically Active Ph.D. (Sc.) Degree Holders & Corresponding Requirements during 1980-81 to 2000-01 (in '000)

Year	Economically Active	Requirement	Surplus	Unemployment rate(%)
1980-81	15.4	14.7	0.7	4.55
1985-86	23.8	21.2	2.6	10.92
1990-91	33.5	30.6	2.9	8.66
1995-96	46.5	44.1	2.4	5.16
2000-01	63.8	63.6	0.2	0.31

5.4.5 The proportion of economically active manpower having B.Sc. Degree to corresponding employment potential during 1990-91 is expected to be very much disproportionate among various States and this imbalance will further increase over time.

5.4.6 In Gujarat, employment potential is expected to be higher than availability of economically active B.Sc. Degree holders resulting in large scale immigration during 1995-96. Around 8.62 percent of the requirement of B.Sc. degree holders is to be met from the stock of other States during this period. This shortage will further increase to 29.28 percent by 2000-01. In all other States/UTs, requirement in 1995-96 is expected to be lower than the stock of economically active B.Sc. degree holders. Unemployment rate in 1990-91 will be higher than the national average in all the States excepting Gujarat, Karnataka, Kerala, Maharashtra, Orissa, West Bengal, Delhi and smaller States/UTs. The rate of unemployment in 1995-96 between States/UTs other than Gujarat will vary between 1.85 percent to 36.03 percent. By 2000-01, the shortage of B.Sc. degree holders is apprehended in Karnataka and smaller States/UTs also

to the extent of 1 percent and 7.33 percent respectively.

5.13(a) Estimated Stock of Economically Active and Requirements of B.Sc. Degree for Selected States/UTs during 1990-91 (in '000)

Sl. No.	State/UT	Economically Active	Requirement	Surplus	Unemployment rate(%)
1.	A.P.	92.5	60.0	32.5	35.14
2.	Bihar	125.5	88.3	37.2	29.64
3.	Gujarat	46.0	43.0	3.0	6.52
4.	Karnataka	139.2	120.4	18.8	13.51
5.	Kerala	137.2	109.9	27.3	19.90
6.	M.P.	80.9	56.8	24.1	29.79
7.	Maharashtra	149.6	121.1	28.5	19.05
8.	Orissa	27.0	23.2	3.8	14.07
9.	Rajasthan	30.8	22.9	7.9	25.65
10.	Tamil Nadu	186.6	141.1	45.5	24.38
11.	U.P.	120.7	92.5	28.2	23.36
12.	West Bengal	155.0	129.7	25.3	16.32
13.	Delhi	34.3	27.3	7.0	20.41
14.	Other States/UTs	46.7	44.2	2.5	5.35
	Total	1372.0	1080.4	291.6	21.25

5.13(b) Estimated Stock of Economically Active B.Sc. Degree Holders and their Requirements for Selected States/UTs during 1995-96 (in '000)

Sl. No.	State/UT	Economically Active	Requirement	Surplus	Unemployment rate(%)
1.	A.P.	123.5	79.0	44.5	36.03
2.	Bihar	167.0	116.3	50.7	30.36
3.	Gujarat	52.2	56.7	-4.5	-8.62
4.	Karnataka	163.8	158.6	5.2	3.17
5.	Kerala	180.9	144.8	36.1	19.96
6.	M.P.	104.3	74.9	29.4	28.19
7.	Maharashtra	186.1	159.6	26.5	14.24
8.	Orissa	35.0	30.6	4.4	12.57
9.	Rajasthan	37.5	30.2	7.3	19.47
10.	Tamil Nadu	240.0	185.9	54.1	22.54
11.	U.P.	156.5	121.8	34.7	22.17
12.	West Bengal	191.3	170.9	20.4	10.66
13.	Delhi	41.7	36.0	5.7	13.67
14.	Other States/UTs	59.3	58.2	1.1	1.85
	Total	1739.1	1423.5	315.6	18.15

5.13(c) Estimated Stock of Economically Active B.Sc. Degree Holders and their Requirements for Selected States/UTs during 2000-01 (in '000)

Sl. No.	State/UT	Economically Active	Requirement	Surplus	Unemployment rate(%)
1.	Andhra-Pradesh	159.7	105.4	54.3	34.00
2.	Bihar	214.4	155.1	59.3	27.66
3.	Gujarat	58.4	75.5	-17.1	-29.28
4.	Karnataka	209.3	211.4	-2.1	-1.00
5.	Kerala	229.8	193.0	36.8	16.01
6.	M.P.	133.5	99.8	33.7	25.24
7.	Maharashtra	229.7	212.8	16.9	7.36
8.	Orissa	45.4	40.8	4.6	10.13
9.	Rajasthan	43.5	40.2	3.3	7.59
10.	Tamil Nadu	304.2	247.8	56.4	18.54
11.	U.P.	199.1	162.4	36.7	18.43
12.	W.Bengal	236.3	227.9	8.4	3.55
13.	Delhi	52.5	48.0	4.5	8.57
14.	Other-States/UTs	72.3	77.6	-5.3	-7.33
	Total	2188.1	1897.7	290.4	13.27

5.4.7 In view of ever increasing tendency of imbalance between States in regard to manpower need and availability so far as B.Sc. degree holders are concerned, there is a need to augment the educational system. In Gujarat enrolment capacity for B.Sc. teaching is required to be increased as per need by augmenting capacities in University and affiliated colleges where facilities of Science teaching are already existing and opening new colleges with such facilities. In Karnataka and smaller States/UTs also, B.Sc. teaching is to be augmented. In the remaining States, more stress is needed to be given in qualitative improvement in Science teaching ensuring supply of properly trained manpower to cope with the technological advancement.

5.4.8 Absorption capacity and stock of economically active M.Sc. degree holders also varies too much between different States/UTs. In Karnataka, Kerala and other small States/UTs the

employment potential is higher than the availability of economically active M.Sc. Degree Holders, whereas in other States/UTs the unemployment is expected to vary between 6.06 percent to 31.33 percent in most of the major States including Andhra Pradesh, Bihar, Gujarat, Orissa, Rajasthan, Tamil Nadu and Delhi, the unemployment rate will be higher than the national average. In 1995-96 shortage of M.Sc. degree holders in Karnataka, Kerala and smaller States/UTs will further increase. On the other hand unemployment rate in the States of Andhra Pradesh, Orissa and Rajasthan will also increase. In the remaining States, there will be no significant change from 1990-91. In 2000-01, shortage of M.Sc. degree holders is apprehended in Karnataka, Kerala and smaller States/UTs to the extent of 15.2 to 23.85 percent. By this period shortage of M.Sc degree holders in relation to employment potential is apprehended in Madhya Pradesh, Maharashtra, Uttar Pradesh and West Bengal also, although marginal.

5.14(a) Estimated Stock of Economically Active M.Sc. Degree Holders and their Requirements for Selected States/UTs during 1990-91 (in '000)

Sl. No.	State/UT	Economically Active	Requirement	Surplus	Unemployment rate(%)
1.	Andhra-Pradesh	15.0	10.3	4.7	31.33
2.	Bihar	9.7	8.2	1.5	15.46
3.	Gujarat	8.9	6.7	2.2	24.72
4.	Karnataka	14.8	14.9	-0.1	-0.67
5.	Kerala	11.8	12.2	-0.4	-3.39
6.	M.P.	23.5	20.8	2.7	11.49
7.	Maharashtra	23.1	21.7	1.4	6.06
8.	Orissa	5.9	4.5	1.4	23.73
9.	Rajasthan	8.2	5.9	2.3	28.05
10.	Tamil Nadu	15.9	11.9	4.0	25.16
11.	U.P.	43.3	39.7	3.6	8.31
12.	West Bengal	9.5	8.6	0.9	9.47
13.	Delhi	11.6	8.5	3.1	26.72
14.	Other States/UTs	10.3	10.7	-0.4	-3.88
	Total	211.5	184.6	26.9	12.72

5.14(b) Estimated Stock of Economically Active M.Sc. Degree Holders and their Requirements for Selected States/UTs during 1995-96 (in'000)

Sl. No	State/UT	Economically Active	Requirement	Surplus	Unemployment rate(%)
1.	Andhra-Pradesh	17.7	11.9	5.8	32.77
2.	Bihar	11.1	9.4	1.7	15.31
3.	Gujarat	10.4	7.7	2.7	25.96
4.	Karnataka	16.0	17.1	-1.1	- 6.87
5.	Kerala	12.5	14.0	-1.5	-12.00
6.	M.P.	25.5	23.9	1.6	6.27
7.	Maharashtra	25.2	24.9	0.3	1.19
8.	Orissa	7.1	5.2	1.9	26.76
9.	Rajasthan	9.7	6.7	3.0	30.93
10.	Tamil Nadu	18.4	13.7	4.7	25.54
11.	U.P.	47.2	45.6	1.6	3.39
12.	West Bengal	10.4	9.9	0.5	4.81
13.	Delhi	13.7	9.8	3.9	28.47
14.	Other States/UTs	11.1	12.2	-1.1	- 9.91
Total		236.0	212.0	24.0	10.17

5.14(c) Estimated Stock of Economically Active M.Sc. Degree Holders and their Requirements for Selected States/UTs during 2000-01 (in'000)

Sl. No.	State/UT	Economically Active	Requirement	Surplus	Unemployment rate(%)
1.	Andhra-Pradesh	19.9	13.6	6.3	31.66
2.	Bihar	12.3	10.8	1.5	12.19
3.	Gujarat	11.7	8.8	2.9	24.79
4.	Karnataka	17.1	19.7	-2.6	-15.20
5.	Kerala	13.0	16.1	-3.1	-23.85
6.	M.P.	27.0	27.4	-0.4	- 1.48
7.	Maharashtra	27.0	28.6	-1.6	- 5.92
8.	Orissa	8.2	5.9	2.3	28.05
9.	Rajasthan	10.7	7.7	3.0	28.04
10.	Tamil Nadu	20.4	15.7	4.7	23.04
11.	U.P.	49.8	52.4	-2.6	- 5.22
12.	West Bengal	11.0	11.4	-0.4	- 3.64
13.	Delhi	15.3	11.2	4.1	26.80
14.	Other States/UTs	11.7	14.1	-2.4	-20.51
Total		255.1	243.4	11.7	4.59

5.4.9 During 1990-91 as regards Ph.D. degree holders, there is likelihood of shortage in Gujarat to the extent of 77.78 percent. In Smaller States/UTs also, shortage is expected to the tune of 43.75 percent. In Andhra Pradesh, Orissa and Uttar Pradesh, however, there will be surplus of economically active Ph.D (Science) degree holders to the extent of 27.27 percent to 35.62 percent. In the remaining States, situation will be almost balancing. Although, the surplus of manpower will decline by 2000-01 in Andhra Pradesh, Orissa and Uttar Pradesh, even then around 23.08, 18.18 and 34.67 percent of manpower of these States will have to be absorbed in other States for employment. Out of the remaining States, only in West Bengal and Delhi the position will be balancing. In the remaining States, shortage of manpower is apprehended. Considering the above, facilities of Ph.D(Science) Research are required to be augmented in almost all the States excepting Andhra Pradesh, Orissa and Uttar Pradesh.

5.15(a) Estimated Stock of Economically Active Ph.D. Degree Holders in Science and their Requirements for Selected States/UTs during 1990-91 (in'000)

Sl. No.	State/UT	Economically Active	Requirement	Surplus	Unemployment rate(%)
1.	Andhra-Pradesh	2.0	1.4	0.6	30.00
2.	Bihar	1.3	1.3	-	-
3.	Gujarat	0.9	1.6	-0.7	-77.78
4.	Karnataka	2.6	2.5	0.1	3.84
5.	Kerala	1.2	1.2	-	-
6.	M.P.	2.1	2.1	-	-
7.	Maharashtra	4.2	4.2	-	-
8.	Orissa	1.1	0.8	0.3	27.27
9.	Rajasthan	1.1	1.0	0.1	9.09
10.	Tamil Nadu	2.7	2.6	0.1	3.70
11.	U.P.	7.3	4.7	2.6	35.62
12.	West Bengal	2.5	2.3	0.2	8.00
13.	Delhi	2.9	2.6	0.3	10.34
14.	Other States/UTs	1.6	2.3	-0.7	-43.75
Total		33.5	30.6	2.9	8.66

5.15(b) Estimated Stock of Economically Active Ph.D. Degree Holders in Science and their Requirements for Selected States/UTs during 1995-96 (in'000)

Sl. No.	State/UT	Econo- mically Active	Requi- ment	Surp- lus	Unemp- loyment rate(%)
1.	Andhra-Pradesh	2.9	2.1	0.8	27.59
2.	Bihar	1.7	1.9	-0.2	-11.76
3.	Gujarat	1.2	2.3	-1.1	-91.67
4.	Karnataka	3.4	3.6	-0.2	- 5.88
5.	Kerala	1.6	1.7	-0.1	- 6.25
6.	M.P.	2.8	3.0	-0.2	- 7.14
7.	Maharashtra	5.7	6.0	-0.3	- 5.26
8.	Orissa	1.5	1.2	0.3	20.00
9.	Rajasthan	1.6	1.5	0.1	6.25
10.	Tamil Nadu	3.7	3.7	-	-
11.	U.P.	10.6	6.8	3.8	35.85
12.	West Bengal	3.5	3.3	0.2	5.71
13.	Delhi	4.0	3.7	0.3	7.50
14.	Other States/UTs	2.1	3.3	-1.2	-57.14
	Total	46.3	44.1	2.2	4.75

5.15(c) Estimated Stock of Economically Active Ph.D Degree Holders in Science and their Requirements for Selected States/UTs during 2000-01 (in'000)

Sl. No.	State/UT	Econo- mically Active	Requi- ment	Surp- lus	Unemp- loyment rate(%)
1.	Andhra Pradesh	3.9	3.0	0.9	23.08
2.	Bihar	2.2	2.8	-0.6	-27.27
3.	Gujarat	1.6	3.3	-1.7	-106.25
4.	Karnataka	4.7	5.2	-0.5	-10.64
5.	Kerala	2.1	2.5	-0.4	-19.05
6.	M.P	3.8	4.2	-0.4	-10.53
7.	Maharashtra	7.7	8.7	-1.0	-12.99
8.	Orissa	2.2	1.8	0.4	18.18
9.	Rajasthan	2.2	2.2	-	-
10.	Tamil Nadu	5.1	5.3	-0.2	- 3.92
11.	U.P	15.0	9.8	5.2	34.67
12.	W.B	4.9	4.7	0.2	4.08
13.	Delhi	5.6	5.4	0.2	3.57
14.	Other States/UTs	2.8	4.7	-1.9	-67.86
	Total	63.8	63.6	0.2	0.31

5.5 Structure

5.5.1 For effective planning of Scientific and Technical manpower, it is necessary not only to have the estimates of different categories of manpower in different points of time, but also to have proper idea about their structural details in regard to age, salary, pay scale, sectors of work and Nature of work etc. Keeping the above in view, a field survey on Scientific and Technical personnel was carried out by CERPA. In the course of field survey, in total 12,888 bio-data sheets of S & T Personnel were collected out of which 877 related to degree holders in Science. Of these, 650 related to B.Sc. degree holders, 185 to M.Sc. degree holders and 42 to Ph.D(Sc.) degree holders.

5.5.2 Distribution of each level of manpower in Science by age group presented in table 5.16(a) shows that 33.2 percent of total manpower are within 30 years of age, 27 percent are in the age group of 30 to 35 years and 16.9 percent in the age group of 35 to 40 years. Thus, the share of younger age group, upto 40 years, in total scientific manpower is as high as 77.1 percent. The average age of manpower having degree in Science works out to be 34.7 years that of Ph.D(Sc.), M.Sc. and B.Sc. degree holders being 38.5, 36.2 and 33.6 years respectively.

5.16(a) Distribution of Manpower in Science by Age Group (in percent)

Age Group (Years)	Level of Education			
	Ph.D.	M.Sc.	B.Sc.	Total
Upto 30	11.9	25.4	36.8	33.2
30 - 35	23.8	27.6	27.1	27.0
35 - 40	26.2	20.5	15.2	16.9
40 - 45	19.0	11.9	9.2	10.2
45 - 50	9.5	7.0	5.4	5.9
50 - 55	4.8	4.3	3.5	3.8
Above 55	4.8	3.3	2.8	3.0
Total	100.0	100.0	100.0	100.0
Average Age	38.5	36.2	33.6	34.7
N	42	185	650	877

5.5.3 Distribution of Manpower having degree in Science by level of education for different Age Groups, presented in table 5.16(b), reveals that the share of B.Sc. degree holders in total manpower is 74.1 percent while that of M.Sc. and Ph.D. degree holders is 21.1 and 4.8 percent respectively. The share of B.Sc. degree holders among those upto 30 years age group is the maximum at 82.1 percent. This share declines to 74.3 percent in the age-group of 30 to 35 years. There after, upto the age of 50 years the share of B.Sc. degree holders is almost stable (varying between 66.7 to 67.3 percent). At the age group of 50 to 55 years, their share again increases to 69.7 percent and at above 55 years it slightly decreases to 69.2 percent.

5.16(b) Distribution of Manpower in Science by Level of Education for different Age Groups (in percent)

Age Group (Years)	Level of Education				
	Ph.D	M.Sc.	B.Sc.	Total	N
Upto 30	1.7	16.2	82.1	100.0	291
30 - 35	4.2	21.5	74.3	100.0	237
35 - 40	7.4	25.7	66.9	100.0	148
40 - 45	8.9	24.4	66.7	100.0	90
45 - 50	7.7	25.0	67.3	100.0	52
50 - 55	6.1	24.2	69.7	100.0	33
Above 55	7.7	23.1	69.2	100.0	26
Total	4.8	21.1	74.1	100.0	877

5.5.4 Distribution of each level of degree holders in Science by salary slab, presented in table 5.17(a) shows that 6.6 percent of total degree holders are in the salary slab upto Rs.1000 per month, 32.4 percent in the salary slab of Rs.1000 to Rs.2000, 27.9 percent in the slab of Rs.2000 to Rs.3000, 16.3 percent in Rs.3000 to Rs.4000, 9.8 percent in the slab of Rs.4000-Rs.5000 and the remaining 7.0 percent are having their salary more than Rs.5000 per month. The average income of degree holders in Science works out to Rs. 2574 that of Ph.D.(Sc.), M.Sc. and B.Sc.

degree holders being Rs.4097, Rs.3454 and Rs.2350 respectively. Around 73.8 percent of Ph.D degree holders are in the income range of Rs.2000 to Rs.5000. While 68.6 percent of M.Sc. degree holders are in the income range of Rs. 1000 to Rs.4000 around 68.3 percent of B.Sc. degree holders are in the income range of Rs.1000 to Rs.3000.

5.17(a) Distribution of Degree Holders in Science by Salary Slab (in percent)

Salary Slab (in Rs.)	Level of Education			
	Ph.D.	M.Sc.	B.Sc.	Total
Upto 1000	-	1.6	8.5	6.6
1000-2000	2.4	11.3	40.3	32.4
2000-3000	19.0	29.7	28.0	27.9
3000-4000	28.6	27.6	12.3	16.3
4000-5000	26.2	16.8	6.8	9.8
5000-6000	11.9	7.0	2.6	4.0
6000-7000	7.1	3.8	1.2	2.1
Above 7000	4.8	2.2	0.3	0.9
Total	100.0	100.0	100.0	100.0
Average Income	4097	3454	2350	2574
N	42	185	650	877

5.5.5 Distribution of degree holders in Science by level of education for different salary slabs, presented in table 5.17 (b) shows that their distribution in different pay ranges is not uniform. In the salary slab of Rs.1000 to Rs.2000, only 0.4 percent are having Ph.D. degree. This proportion increases with pay range and at the pay range of above Rs.7000, as high as 25 percent of the manpower in Science are having Ph.D degree. For M.Sc. degree holders also, the trend is similar. Their share increases from 5.2 percent at below Rs.1000 salary slab to 50 percent at above Rs.7000 salary slab. The trend in share of B.Sc. degree holders in different pay ranges is opposite to that of post-graduates. Of the total degree holders in Science in the pay range upto Rs.1000, B.Sc. degree holders occupy 94.8 percent. This

proportion decreases with pay range and in the pay range of above Rs.7000 their share decreases to as low as 25 percent.

5.17(b) Distribution of Degree Holders in Science by Level of Education for different Salary Slabs (%)

Salary Slab (in Rs.)	Level of Education				N
	Ph.D	M.Sc.	B.Sc.	Total	
Upto 1000	-	5.2	94.8	100.0	58
1000-2000	0.4	7.4	92.2	100.0	284
2000-3000	3.3	22.4	74.3	100.0	245
3000-4000	8.4	35.7	55.9	100.0	143
4000-5000	12.8	36.0	51.2	100.0	86
5000-6000	14.3	37.1	48.6	100.0	35
6000-7000	16.7	38.9	44.4	100.0	18
Above7000	25.0	50.0	25.0	100.0	8
Total	4.8	21.1	74.1	100.0	877

5.5.6 Distribution of each level of manpower in Science by nature of work has been presented in table 5.18(a). It would be seen that, at the aggregate level, 41.4 percent of manpower having degree in science are engaged in teaching, 29.9 percent in administration and 12.4 percent in production. These three types of work together has provided employment for 83.7 percent of the total employed degree holders in Science. Around 88 percent of Ph.D. degree holders are pursuing either teaching or R & D work. Besides, 80 percent of the M.Sc degree holders are engaged in these two types of activities. For B.Sc. degree holders, administration is the most important type of work providing employment to 39.2 percent of them followed by teaching (36.2 percent) and production and allied manufacturing (14.0 percent). These three types of work is providing employment to more than 89 percent of this category of manpower.

5.18(a) Distribution of Manpower in Science by Nature of work

(in percent)

Sl. No.	Nature of Work	Level of Education			Total
		Ph.D.	M.Sc.	B.Sc.	
1.	Teaching	66.7	54.1	36.2	41.4
2.	R & D	21.4	25.9	1.2	7.4
3.	Production & allied Mfg.	4.8	8.7	14.0	12.4
4.	Marketing & Sale	2.4	4.3	6.2	5.6
5.	Construction	-	1.1	0.1	0.3
6.	Administration	2.4	3.2	39.2	29.9
7.	Other Services	2.3	2.7	3.1	3.0
	Total	100.0	100.0	100.0	100.0
	N	42	185	650	877

5.5.7 Distribution of manpower having degree in Science engaged in different types of work by level of education has been presented in table 5.18(b) for broad categories of work pursued by them. The statement shows that among degree holders in Science, B.Sc. degree holders have the maximum share (74.1 percent) in employment potential of degree holders in science followed by M.Sc. degree holders (21.1 percent). In R & D and teaching activities, Ph.D.(Sc.) degree holders play important role occupying 13.8 percent and 7.7 percent of the share in total manpower in science employed in the respective activity. M.Sc degree holders play most important role in construction, occupying two third of the manpower in science engaged in this activity. In all other types of work, maximum share of manpower in science is occupied by B.Sc. degree holders, their share in the manpower in science varying from 64.7 percent in teaching to 97.3 percent in administration.

5.5.8 Distribution of Workers having degree in Science by Sector of industry has been presented in table 5.19(a) for each level of degree holders in Science. It would be seen from the table that 85.7 percent of Ph.D.(Sc.) degree holders are engaged in other services. Among M.Sc. degree holders, 61.1 percent are engaged in other services. Trade & Commerce and manufacturing are other two major sectors employing 16.8 percent and 15.1 percent respectively of M.Sc degree holders. Other services is the most important sector for the employment of B.Sc. degree holders also, employing 41.8 percent of them followed by Trade & Commerce and Manufacturing Occupying 27.7 percent and 18.9 percent share respectively of employment potential of this category of manpower. At the aggregate level, maximum share of employment potential is occupied by other services (48 percent) followed by Trade & Commerce (24 percent) and Manufacturing (17.7 percent) in that order.

5.5.9 Distribution of Manpower in Science engaged in different sectors by Level of education presented in table 5.19(b) reveals that in Agricultural Sector 8.3 percent of the total degree holders in Science are having Ph.D.(Sc.) degree, 25 percent having M.Sc. degree and remaining 66.7 percent having B.Sc. degree. In other services also the trend is similar where 8.5 percent are having Ph.D.(Sc.) Degree, 26.8 percent M.Sc. and 64.7 percent B.Sc. Degree . On the whole, maximum share of employment for science degree holders is occupied by B.Sc.degree holders, their share varying from 64.7 percent to 91.7 percent in different sectors.

5.18(b) Distribution of Manpower in Science by Level of Education for Nature of Work (in percent)

Nature of Work	Level of Education				N
	Ph.D	M.Sc	B.Sc	Total	
1.Teaching	7.7	27.6	64.7	100.0	363
2.R & D	13.8	73.9	12.3	100.0	65
3.Production & allied Mfg.	1.8	14.7	83.5	100.0	109
4.Marketing&Sale	2.1	16.3	81.6	100.0	49
5.Construction	-	66.7	33.3	100.0	3
6.Administration	0.4	2.3	97.3	100.0	262
7.Other Services	3.9	19.2	76.9	100.0	26
Total	4.8	21.1	74.1	100.0	877

5.19(a) Distribution of Manpower in Science by Sector (in percent)

Sector	Level of Education				Total N
	Ph.D.(Sc.)	M.Sc.	B.Sc.	Total	
1.Agriculture	4.8	3.2	2.5	2.7	2.7
2.Mining & Quarrying	-	0.5	0.8	0.7	0.7
3.Manufacturing	9.5	15.1	18.9	17.7	17.7
4.Construction	-	1.1	1.5	1.4	1.4
5.Trade & Commerce	-	16.8	27.7	24.0	24.0
6.Transport,Storage & Communication	-	2.2	6.8	5.5	5.5
7.Other Services	85.7	61.1	41.8	48.0	48.0
Total	100.0	100.0	100.0	100.0	877
N	42	185	650	877	

5.19(b) Distribution of Manpower in Science by Level of Education for different Sectors(in percent)

Sector	Level of Education				Total N
	Ph.D(Sc.)	M.Sc	B.Sc	Total	
1.Agriculture	8.3	25.0	66.7	100.0	24
2.Mining&Quarrying	-	16.7	83.3	100.0	6
3.Manufacturing	2.6	18.1	79.3	100.0	155
4.Construction	-	16.7	83.3	100.0	12
5.Trade&Commerce	-	14.7	85.3	100.0	211
6.Transport,Storage & Communication	-	8.3	91.7	100.0	48
7.Other Services	8.5	26.8	64.7	100.0	421
8.Total	4.8	21.1	74.1	100.0	877

6. RESEARCH AND DEVELOPMENT

6.1 R & D and Related S&T Activities

6.1.1 Expenditure on R&D and related S&T activities expressed in terms of percentage of GNP has been rising from 0.39 percent in 1965-66 to 1.11 percent in 1986-87. The long term trend reveals that, by the turn of the century, this is expected to rise to over 2 percent of GNP. The rapid growth of expenditure in recent past shows that it may even grow to a higher percentage of GNP, between 2 to 3 percent. However, views expressed in certain quarters about the rise of expenditure to 4 percent of GNP, say by 2000-01, do not seem to be realistic under the present financial constraints in view of higher demands of investment for achieving higher planned rates of growth of the economy.

6.1.2 The growth rate of GNP realised in recent past was 5 percent per annum. Due to various developmental efforts it may increase further in future. It is envisaged by the planners that it may grow to 6 percent by 1995-96 and 7 percent by 2000-01. Although it may be difficult to achieve this target under the present resource constraints, it is expected that it may moderately grow to 5.5 percent by 1995-96 and to 6 percent by 2000-01. All these three growth scenarios of GNP have been taken into consideration for estimating future expenditure on R&D and related S & T activities.

6.1.3 About 20 percent of the expenditure on R & D and related S & T is incurred by Industrial Sector. Out of the remaining expenditure 90 percent is spent by Central Govt. and 10 percent by the State Governments. Again out of the Central Government expenditure 83 percent is incurred by Major Scientific Agencies and the rest by the Central Ministries/Departments. These ratios have been taken into consideration to estimate R & D and

related S & T expenditure by different agencies during future years also.

6.1.4 Sector wise R & D and related S & T expenditures have been estimated for 2 different scenarios of the expenditure on R & D and related S & T activities expressed as percentage of Gross National Product (GNP) viz Scenario-I (at 2 percent of GNP by 2000-01) and Scenario-II (at 3 percent of GNP by 2000-01) for three different growth scenarios of GNP viz (i) at existing 5 percent growth rate of G.N.P, (ii) at moderately higher growth rate of GNP i.e at 6 percent growth rate by 2000 AD. and (iii) at higher envisaged growth rate of GNP, i.e at 7 percent growth rate by 2000 AD. Estimated R & D and related S & T expenditure for 1990-91, 1995-96 and 2000-01 for Scenario-I and Scenario-II of R & D and related S & T expenditures are presented in Annexures-6.1 & 6.2 respectively. Estimated expenditure for 1990-91, 1995-96 & 2000-01 at the average of two growth scenarios of R & D and related S & T expenditure (expressed as percentage of GNP), for second scenario of growth of GNP, would be as per table 6.1. Respective shares of funding by different Sectors are presented in table 6.1(a).

6.1 Sector wise estimated expenditure on R & D and related S&T activities during 1990-91 to 2000-01

(Rs.in crore at 1987-88 prices)

Sl. Source of No.funding	Estimated Expenditure		
	1990-91	1995-96	2000-01
1. Central Govt.	3662.0	6482.0	11802.5
2. State Govts.	406.5	720.5	1311.5
3. Private Sector.	503.0	890.0	1641.5
Total	4571.5	8092.5	14755.5
Index (base 1990-91 = 100)	100.0	177.0	322.8

6.1(a) Estimated Share of Funding in R & D and Related S & T Activities by Different Sectors

(in percent)

Sl. Source of No. funding	1990-91	1995-96	2000-01
1. Central Govt.	80.0	80.1	80.0
2. State Govt.	8.9	8.9	8.9
3. Private Sector.	11.0	11.0	11.1
Total	100.0	100.0	100.0

6.1.5 For estimating future employment potential in R&D and related S&T activities three factors have been taken into consideration viz (i) Estimated expenditure for the relevant year, (ii) Average expenditure per person as in 1986-87 at 1987-88 prices and (iii) Escalation of expenditure per person which is assumed at the rate of 2.3 percent per annum due to increase in salary in real terms.

6.1.6 Estimated employment potential in R & D and related S & T activities for the years 1990-91, 1995-96 and 2000-01 is expected to be 3.52 lakh, 5.56 lakh and 9.05 lakh respectively. Out of this 65.1 percent will be under Central Govt. 23.0 percent under State Govt. and 11.9 percent in Private Sector.

6.2 Sector wise employment potential in R & D and Related S & T activities during 1990-91 to 2000-01

(Nos. in '000)

Sl. Sector No.	Estimated Employment		
	1990-91	1995-96	2000-01
1. Central Govt.	229.3	362.3	588.8
2. State Govt.	80.8	127.8	207.5
3. Private Sector	41.8	66.0	108.7
Total	351.9	556.1	905.0

6.2(a) Distribution of Employment Potential by Sector, 1990-91 to 2000-01

(in percent)

Sl. No. Sector	Share of employment		
	1990-91	1995-96	2000-01
1. Central Govt.	65.1	65.1	65.1
2. State Govt.	23.0	23.0	22.9
3. Private Sector.	11.9	11.9	12.0
Total	100.0	100.0	100.0

6.2 R & D Activities in Central Govt.

6.2.1 During 1984-85 and 1987-88, around 94.3 percent of the total expenditure on R & D and related S & T activities was devoted to R & D activity only. Again around 91 percent of the total R & D expenditure of the Central Government (excluding public sector undertakings) is incurred by major Scientific Agencies and the rest 9 percent by the S & T Ministries/Departments. Taking the above into consideration the estimated expenditure on R & D by Central Govt. excluding Public Sector R & D Units for future years would be as per table 6.3.

6.3 Estimated R & D and related S & T expenditure by Central Govt. by Source of funding during 1990-91 to 2000-01

(Rs. in crores at 1987-88 Prices)

Sl. Source of No. Funding	Estimated Expenditure		
	1990-91	1995-96	2000-01
1. Major Scientific Agencies	2822.7	4996.3	9098.4
2. Other Central Ministries/Departments	275.3	487.5	887.6
3. Central Govt. (excluding Public-Sector undertakings)	3098.0	5483.8	9986.0

6.2.2 Future employment potential in R & D work of the Central Government, projected on the basis of total estimated expenditure and estimated per person expenditure during the corresponding years is presented in table 6.4. It would be seen that estimated employment in R & D activity under Central Govt. is expected to rise from 1.9 lakh in 1990-91 to 3.06 lakh in 1995-96 and 4.96 lakh in 2000-01 which shows 58.3 percent rise by 1995-96 and 156.6 percent rise by 2000-01 from 1990-91 level.

6.4 Estimated Employment in Central Govt. R & D establishments

(Nos. in '000)

Sl. Agency NO.	Estimated Employment		
	1990-91	1995-96	2000-01
1. Major Scientific Agency	176.8	279.3	453.9
2. Other Central Ministeries/ Departments	17.2	27.2	44.2
3. Central Govt. (excluding Public Sector undertakings)	194.0	306.5	498.1
Index (base-1990-91 = 100)	100.0	158.3	256.6

6.3 Major Scientific Organisations

6.3.1 From the previous trend in regard to proportion of different categories of personnel in Major Scientific agencies as also the expected thrust in new areas, it is expected that in future also 31 percent of the staff in these organisations would be primarily engaged in R & D activity. Future requirements of total R & D personnel in these organisations presented in table 6.5 shows that total requirement of R & D personnel in Major Scientific Agencies will be 54.8 thousand in 1990-91, 86.6 thousand in 1995-96 and 140.7 thousand in 2000-01 showing a growth of 9.9 percent per annum during 1990-91 to 2000-01.

6.5 Projected requirements of Personnel in Major Scientific agencies for R & D activity (Nos. in '00)

Year	Estimated employment	Index (base 1990-91=100)	G.R. (%)
1990-91	548	100.0	-
1995-96	866	158.0	9.6
2000-01	1407	256.8	10.2

6.3.2 Disciplinewise staff requirements estimated at the existing proportion of the personnel of different disciplines have been presented in table 6.6(a).

6.6(a) Projected Requirement of Personnel for R & D Activity in Major Scientific Agencies by Discipline (Nos. in '00)

Discipline	Estimated Requirement		
	1990-91	1995-96	2000-01
E & T	179.7	284.0	461.5
Natural Science	263.1	415.7	675.4
Agrl. Science	77.8	123.0	199.8
Medical Science	11.5	18.2	29.5
Social Science	15.9	25.1	40.8
Total	548.0	866.0	1407.0

6.3.3 Considering the new thrust areas outlined in the Seventh Plan and current thinking on the Eighth Plan, the representation of personnel from the disciplines of E&T and Agriculture science is expected to be higher by 5 percent in 1990-91, 11 percent in 1995-96 and 18 percent in 2000-01 from the current level of their proportion in total employment in R & D activity. Similarly, for Medical Science the corresponding share in total employment would increase by 10 percent, 23 percent and 35 percent during the corresponding years with consequent drop in proportion for the discipline of Engineering and Technology. Considering the expected increase in proportion of personnel of Agriculture and Medical Science the expected distribution of staff of different disciplines during 1990-91 to 2000-01 would be as per table 6.6(b) and estimated requirement by discipline as per table 6.6(c).

6.6(b) Expected Distribution of R & D Personnel in Major Scientific Agencies by Discipline during 1990-91 to 2000-01

(in percent)

Discipline	Estimated Requirement		
	1990-91	1995-96	2000-01
E & T	31.9	30.7	29.5
Natural Science	48.0	48.0	48.0
Agri. Science	14.9	15.8	16.8
Medical Science	2.3	2.6	2.8
Social Science	2.9	2.9	2.9
Total	100.0	100.0	100.0

6.6(c) Projected Requirement of R & D Personnel in Major Scientific Agencies by Discipline [At expected proportion] (Nos. in '00)

Discipline	Estimated Requirement		
	1990-91	1995-96	2000-01
E & T	174.8	265.8	415.0
Natural Science	263.1	415.6	675.4
Agri. Science	81.6	136.9	236.4
Medical Science	12.6	22.5	39.4
Social Science	15.9	25.2	40.8
Total	548.0	866.0	1407.0

6.3.4 While estimating future requirements of personnel for R & D activity by level of education it is presumed that, with the thrust in new areas of technology, the proportion of Ph.Ds and post-graduates will go up by 15 and 7 percent respectively by 1995-96 and 30 percent and 15 percent by 2000-01. Estimated employment potential of R & D personnel by level of education would accordingly be as under.

6.7(a) Estimated R & D Employment in Major Scientific Agencies by level of Education

(Nos. in '00)

Level of education	Estimated Requirement		
	1990-91	1995-96	2000-01
Ph.D	131.5	239.0	439.0
Post-graduate	178.1	301.4	526.2
Graduate	132.6	209.6	340.5
Diploma	48.8	44.1	28.1
Others	57.0	71.9	73.2
Total	548.0	866.0	1407.0

6.7(b) Distribution R & D Employment in Major Scientific Agencies by level of Education (in percent)

Level of education	Estimated Requirement		
	1990-91	1995-96	2000-01
Ph.D	24.0	37.6	31.2
Post-graduate	32.5	34.8	37.4
Graduate	24.2	24.2	24.2
Diploma	8.9	5.1	2.0
Others	10.4	8.3	5.2
Total	100.0	100.0	100.0

6.4 R & D in other S & T Ministries/ Departments

6.4.1 Considering the deployment pattern of personnel engaged in R & D establishments attached to various Ministries/Departments as also the nature of R & D work in those establishments, it is felt that proportion of R & D personnel to Auxilliary/ Administrative personnel will be 2 : 3 in future. Future employment potential of S & T Personnel in R & D activity in these establishments have accordingly been worked out from the total employment in these establishments and presented in table 6.8. It is seen

that estimated employment potential of S & T Personnel in R & D activity in these Ministries/Departments will be 43 thousand in 1990-91, 68 thousand in 1995-96 and 110.6 thousand in 2000-01 showing an overall growth of 9.9 percent per annum.

6.8 Projected Requirement of R & D Personnel in Central Ministries/Departments

Year	Estimated requirement (in '00)	Index base 1990-91 = 100	Growth rate (%)
1990-91	43.0	100.0	-
1995-96	68.0	158.1	9.6
2000-01	110.6	257.2	10.2

6.4.2 Future requirement of different categories of personnel in R & D activity in Ministries/Departments have been estimated at their proportionate share in R & D employment during 1986-87 and presented below in table 6.9.

6.9 Estimated Requirement of R & D Personnel in Central Ministries/Departments by Disciplines

(in '00)

Discipline	Estimated Requirement		
	1990-91	1995-96	2000-01
E & T	16.2	25.6	41.6
Natural Science	20.3	32.2	52.4
Agricultural Science	0.8	1.2	2.0
Medical Science	3.2	5.2	8.3
Social Science	2.5	3.8	6.3
Total	43.0	68.0	110.6

6.4.3 Estimated employment of personnel in R & D activity in Central Ministries/Departments by level of education for the years 1990-91, 1995-96 and 2000-01 is presented in table 6.10.

6.10 Estimated Requirement of R & D Personnel in Central Ministries/Departments by level of education

(in '00)

Level of education	Estimated Requirement		
	1990-91	1995-96	2000-01
Ph.D	4.4	6.8	11.2
Post-graduate	16.0	25.3	41.0
Graduate	14.4	22.8	37.2
Diploma	2.2	3.5	5.7
Others	6.0	9.6	15.5
Total	43.0	68.0	110.6

6.5 Industrial Sector

6.5.1 Industrial sector comprising of Public Sector Industries (both Central and State) and Private Sector Industries accounted for 19.4 percent of the total national R & D and related S & T investment and 23.1 percent of the total R & D employment at the national level in 1986-87. The growth rate of R & D expenditure at constant prices during 1984-85 to 1987-88 was 11.54 percent for public sector and 11.07 percent for private sector. Considering the above, it is expected that the share of R & D expenditure by Industrial sector in the national expenditure on R & D and related S&T activities is expected as 20 percent throughout the period upto 2000-01 and within Industrial sector the share of Public Sector and Private Sector will be 42 and 58 percent respectively.

6.5.2 Different approaches have been applied for estimating future R & D expenditure in Industrial sector. But, estimates obtained on the basis of assumptions made in para 6.5.1 seem to be more realistic as these estimates compare well with those obtained through short term growth rate of R & D expenditure in Industrial sector expressed in terms of percentage of GNP.

Estimated R & D expenditure in this sector for 1990-91, 1995-96 and 2000-01 have been presented in table 6.11.

6.11 Estimated R & D expenditure in Industrial Sector
(Rs. lakhs at 1987-88 Prices)

Sl. Source of No. Funding	Estimated Expenditure		
	1990-91	1995-96	2000-01
1. Public Sector	36557	59640	99162
2. Private Sector	50483	82360	136938
3. Industrial Sec.	87040	142000	236100

6.5.3 The share of R & D personnel in the total manpower of Industrial sector R & D establishments is expected to be of the level of 1986-87, when it was 47.9 percent. Accordingly, estimated employment potential for R & D personnel in the sector would be as per table 7.12.

6.12 Estimated Requirement of R & D Personnel in Industrial Sector

(Nos. in '00)

Year	Estimated Requirement	Index base 1990-91=100	Growth rate(%)
1990-91	365.5	100.0	-
1995-96	528.5	144.6	7.86
2000-01	771.5	211.1	7.75

6.5.4 Discipline-wise requirements of R & D personnel in Industrial sector during 1990-91 to 2000-01 is expected to be as under.

6.13 Discipline-wise Projected Demand of R & D Personnel in Industrial Sector by Discipline (Nos. in '00)

Sl. Discipline No.	Estimated Demand		
	1990-91	1995-96	2000-01
1. E & T	235.0	339.8	496.1
2. Natural Science	108.2	156.4	228.4
3. Agril. Science	6.2	9.4	13.1
4. Medical Science	6.6	9.5	13.9
5. Social Science	9.5	13.7	20.0
Totl	365.5	528.8	771.5

6.5.5 Projected demands of R & D personnel in Industrial sector by level of education for 1990-91 to 2000-01 are presented in table 6.14.

6.14 Projected Demand of R & D Personnel in Industrial Sector by Level of Education

(Nos. in '00)

Sl. Level of No. education	Estimated Demand		
	1990-91	1995-96	2000-01
1. Ph.D	26.9	38.9	56.7
2. Post-graduate	75.9	109.8	160.2
3. Graduate	130.4	188.6	275.2
4. Diploma	132.3	191.5	279.4
Total	365.5	528.8	771.5

6.6 R & D in State Sector

6.6.1 During 1986-87 around 9.0 percent of the total national expenditure on R & D and related S & T activities was incurred by State Governments, which accounted for 0.074 percent of the GNP. The growth rate of expenditure on R & D and related S & T activities by the State sector during 1982-83 to 1986-87 works out at 11.27 percent per annum. The growth rate of corresponding expenditure expressed in terms of percentage of GNP works out at 5.27 percent. These two types of growth rates have been taken into consideration for projecting future expected R & D expenditure by State Governments.

6.6.2 While analysing different sets of estimates obtained through different approaches, it is observed that these estimates closely resemble with one another. However, estimates obtained by applying the growth rate of the share of expenditure in GNP seems to be more realistic and hence presented below in table 6.15.

6.15 Estimated Expenditure on R & D and Related S & T activities by State Governments

(Rs. crores at 1987-88 Prices)

Year	Estimated expenditure	Index base 1990-91=100	Growth rate(%)
1990-91	448.7	100.0	-
1995-96	837.9	197.0	14.5
2000-01	1593.5	355.1	13.7

6.6.3 As 80 percent of the State Governments R & D related S & T expenditure is spent in R & D activity, projected R & D expenditure would be as per table 6.16 below.

6.16 Estimated R & D expenditure by State Govts. during 1990-91 to 2000-01

(Rs. crores at 1987-88 Prices)

Year	Estimated expenditure	Index base 1990-91=100	Growth rate(%)
1990-91	232.1	100.0	-
1995-96	620.1	267.2	21.7
2000-01	1179.2	588.1	13.7

6.6.4 Employment potential in R & D establishments under State Governments have been estimated on the basis of projected expenditure and average estimated expenditure per person in the corresponding years. As 43.0 percent of the total personnel in the R & D establishments were engaged in R & D activity in 1986-87, it is expected that this proportion will continue in future also. Accordingly, future R & D employment have been estimated and presented in table 6.17. The statement shows that State Govts. R & D establishments will provide employment to 28.5 thousand S & T Personnel by 1990-91, 47.5 thousand by 1995-96 and 80.5 thousand by 2000-01.

6.17 Estimated Requirement of Personnel in R & D Activity in R & D Establishments under State Governments

Year	Estimated Requirement (in'00)	Index base 1990-91=100	Growth rate(%)
1990-91	284.7	100.0	-
1995-96	474.4	166.6	10.8
2000-01	805.4	282.9	11.0

6.6.5 Based on the existing pattern of R & D personnel in State sector the distribution of future employment potential by discipline have been projected and presented below in table 6.18.

6.18 Estimated Requirement of R & D Personnel in State Governments (in'00)

Sl. Discipline NO.	Estimated Requirement		
	1990-91	1995-96	2000-01
1. Natural Science	60.7	101.0	171.5
2. Agrl. Science	185.0	308.4	523.5
3. E & T	25.9	43.2	73.4
4. Medical Science	6.8	11.4	19.3
5. Social Science	6.3	10.4	17.7
Total	284.7	474.4	805.4

6.6.6 Distribution of R & D personnel by level of education have accordingly been worked out and presented in table 7.19.

6.19 Estimated Requirement of R & D Personnel under State Governments by level of Education. (Nos. in '00)

Sl. Level of No. education	Estimated Requirement		
	1990-91	1995-96	2000-01
1. Ph.D	61.8	103.0	174.8
2. Post-graduate	135.2	225.3	382.6
3. Graduate	58.1	96.8	164.3
4. Diploma	2.0	3.3	5.6
5. Others	27.6	46.0	78.1
Total	284.7	474.4	805.4

6.7 Employment of S&T Manpower in R&D

6.7.1 Table 6.20 and 6.21 present consolidated picture in regard to employment potential for future year up to 2000-01 for S & T Manpower in R & D activities carried out by Major Scientific Agencies under Central Government, State Govt.'s R & D establishments and Industrial Sector by discipline and level of education respectively.

6.20 Total Estimated Employment Potential for S & T Manpower in R & D Activity by Discipline (in'00)

Sl.Discipline No.	Estimated Employment		
	1990-91	1995-96	2000-01
1. Engineering & Technology	451.9	674.4	1026.1
2. Natural Science	452.3	705.2	1127.7
3. Agrl. Science	273.6	455.9	775.0
4. Medical Science	29.2	48.6	80.9
Social Science	34.2	53.1	84.8
Total	1241.2	1937.2	3094.5

6.21 Total Estimated Employment Potential in R & D Activity by Level of Education (in '00)

Sl.Level of No.education	Estimated Employment		
	1990-91	1995-96	2000-01
1. Ph.D	224.6	387.7	405.2
2. Post-graduate	405.2	661.8	1110.0
3. Graduate	335.5	517.8	817.2
4. Diploma	185.3	242.4	318.8
5. Others	90.6	127.5	166.8
Total	1241.2	1937.2	3094.5

6.7.2 A comparison of estimated employment potential of S & T personnel presented above with the corresponding estimates worked out on the basis of employment data for all activities together and for R & D activity from DHTP survey, 1981 shows that although these estimates compare well with each other so far as total S & T personnel is concerned, for individual disciplines they are widely divergent for all the disciplines, excepting for Agricultural

Science. Possibly because of high non-response in DHTP Survey, much reliance cannot be placed on the estimates that have become available through DHTP survey.

6.8 Structure of R & D Personnel

6.8.1 In order to have proper idea about the structural details of S & T personnel in regard to age, experience, salary, sex, level of education, discipline etc. a field survey on Scientific and Technical Personnel was carried out by CERPA in 1987-88. In course of the Survey relevant data have been collected by the field staff directly from 298 R & D personnel by paying field visit to 20 R & D establishments. In addition to this, postal information have been collected from another 34 scientific Organisations in regard to structural details of their R & D employees. From these Scientific Organisations, data were available for 2315 R & D Workers.

6.8.2 Analysis of field data reveals that around 5.1 percent of the personnel employed primarily in R & D activity were female.

6.8.3 Distribution of R & D personnel by age, presented in table 6.22 reveals that maximum share (18.9 percent) of R & D personnel were in the age group 30-35 years which shows that direct recruitment of S & T personnel in R & D is prevalent upto 35 years of age. Average age of R & D personnel was 37.8 years.

6.22 Distribution of R&D Personnel by Age

Age Group (in Yrs)	Percentage Share
Upto 25	9.3
25 - 30	12.4
30 - 35	18.9
35 - 40	16.6
40 - 45	17.6
45 - 50	14.8
Above-50	10.4
Total	100.0
(N)	(290)
Average age	37.8 Years

6.8.4 Distribution of R & D personnel of each age group by sex shows that the share of female was highest (20 percent) in the age group of 30-35 years followed by that in the age group of 35-40 years (16.7 percent). At higher age group (above 50 years), their share was 10 percent. This shows that there has been a sizeable increase in female participation in recent years. It is also worth noting that average age of female members amongst R & D personnel, which worked out as 38.2 years, was slightly higher than that of male members (37.8 years). This was mainly due to their comparatively lower participation in lower age groups upto 30 years.

6.8.5 Distribution of R&D personnel by level of education has also to be based on field interviews only. It would be seen from the distribution presented in table 6.23 that Ph.D degree holders accounted for one third share amongst total R & D employees. Post-graduates accounted for a little over 40 percent share. It is worth mentioning here that as most of the R & D institutions covered under field interviews are engaged in Research on Agricultural and other related areas, this distribution may be used for any policy decision with caution.

6.23 Distribution of R & D Personnel by level of Education

Sl. Level of No. education	Percentage Distribution by level		
	Male	Female	Total
1. Ph.D	33.3	33.3	33.3
2. Post-graduate	38.1	66.7	40.2
3. Graduate	18.5	-	17.2
4. Diploma Holder	4.3	-	3.9
5. Others	5.8	-	5.4
Total	100.0	100.0	100.0
N	(189)	(15)	(204)

6.8.6 Distribution of reporting female employees in R & D shows that one third of them were having Ph.D degree and the remaining two third were post graduates. As 50 percent of the female members did not report their qualifications, the results are not sufficiently representative.

6.8.7 Distribution of R & D personnel by length of experience, presented in table 6.24 reveals that, as high as 25 percent of the R & D personnel were having experience of upto 10 years. The personnel having experience of more than 25 years was also very high (21.1 percent). Amongst all the R & D personnel, Ph.D. degree holders were having relatively less percentage of persons in the experience group of upto 5 years.

6.24 Distribution of R & D Personnel by experience (in percent)

Length of Experience (in Yrs.)	Ph.D	Post Graduate	Graduate	Diploma holders	Others	Total
Upto 5	7.4	12.2	14.3	12.5	9.1	10.8
5-10	20.6	11.0	11.4	12.5	9.1	14.2
10-15	20.6	20.7	25.7	25.0	18.2	21.6
15-20	16.2	15.9	34.3	12.5	18.2	19.1
20-25	17.6	12.2	5.7	12.5	18.2	13.2
Above-25	17.6	28.0	8.6	25.0	27.2	21.1
Total	100.0	100.0	100.0	100.0	100.0	100.0
N	(68)	(82)	(35)	(8)	(11)	(204)

6.8.8 Distribution of R & D personnel by salary slab presented in table 6.25 reveals that maximum number of R & D personnel were in the salary slab of Rs.2000-2500. It may be mentioned here that most of the new recruits of R & D personnel were in this salary slab. Persons reported to be within Rs.2000 as their monthly salary belonged to auxiliary activity in the R & D establishments. Average monthly salary of R & D personnel worked out to Rs.2572.

**6.25 Distribution of R & D Personnel
by salary slab
(in percent)**

Salary Slab (In Rs.- per month)	By field inter- views	By Postal inter- views	Total
Upto 1500	2.8	9.9	9.7
1500-2000	17.0	7.8	8.1
2000-2500	17.9	44.6	43.6
2500-3000	10.4	11.6	11.5
3000-3500	14.6	10.3	10.5
3500-4000	10.4	9.7	9.7
4000-4500	10.9	4.7	4.9
4500-5000	7.5	0.9	1.2
Above- 5000	8.5	0.5	0.8
Total	100.0	100.0	100.0
(Average income- in Rs.per month)	3151	2550	2572
N	(212)	(5644)	(5856)

6.8.9 The growth rates of employment at the aggregate level worked out on the basis of field data was 3.91 percent per annum during 1986-87 to 1990-91 and 2.51 percent during 1990-91 to 1995-96. At disaggregate level, the growth rate for medical personnel would improve from 3.69 percent during 1986-87 to 4.47 percent during 1990-91 to 1995-96. For E & T

personnel also, growth rate is expected to improve from 3.14 percent to 3.53 percent during the same period. Requirement of personnel of other disciplines of S & T is expected to decline during 1990-91 to 1995-96.

**6.26 Discipline-wise Staff Strength and
Envisaged Requirement of S & T
Personnel in R & D**

Sl. Discip- No. line	Staff Stren- gth in (Nos)	Envisaged require- ment	Growth rate (percent)		
	1986- 87	1990- 91	1995- 96	1990- 91	1995- 96
1. Medical Science	712	823	1024	3.69	4.47
2. Agricul- ture Sc.	2674	2888	3104	1.94	1.45
3. Natural Science	2298	2547	2779	2.60	1.76
4. E & T	2517	2848	3387	3.14	3.53
5. Science/ E & T	3817	4904	5563	6.46	2.55
Total	12018	14010	15857	3.91	2.51

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7. BRAIN - DRAIN

7.1 Introduction

7.1.1 World economy is increasingly becoming integrated and inter-dependent. There is, today, almost universal flow of knowledge at great speed. Also world economy is sufficiently sophisticated to organise, at short notice, capital flows from any part of the world to any other part. Along with capital flow, the flow of technology is being made easy and speedy.

7.1.2 Two important inputs other than information, capital and technology are labour & Land. Land is location specific. Labour, especially skilled and technical labour today has the urge and the capacity to move to a point of its maximum return. Because of this, in past few decades, considerable movement of skilled manpower from developing to developed countries has been observed.

7.1.3 Since skilled manpower is an important input to increased growth, production and productivity, considerable interest surrounds the size of flow of this input and its direction. Past behaviour of its movement established that it moves away

from locations where it has maximum opportunities for itself and its own reward. Therefore, this becomes an important area of study, particularly in the context of supply demand relationship for skilled manpower in a developing economy such as India.

7.1.4 In this background the past and likely future behaviour of flow of skilled manpower from India has been examined as a part of the study on "Perspective for Scientific and Technical Manpower for India upto year 2000".

7.2 Magnitude

7.2.1 Table 7.1 suggests that in 1981 there were about 13874 thousand persons of Indian origin abroad. Of these 5451 thousand were born in India and have migrated. The break up suggests that, of these, 9.72 percent were in West Europe, 5.58 percent in North America, 17.52 percent in Middle East, 7.57 percent in South East Asia, 2.79 percent in African countries and 56.22 percent in neighbouring countries.

7.1 Estimated share of total Population born in India and of Indian Origin in Selected Regions : 1981 (in percent)

Sl. Region No.	Total Population	Estimated Population born in India	Estimated Indian Origin abroad	Indian Origin abroad as percentagr to total population
1. West Europe	5.97	9.72	4.86	0.80
2. North America	26.90	5.58	3.49	0.76
3. Middle East	3.46	17.52	7.12	3.02
4. Australia	1.58	0.60	0.25	0.23
5. South East Asia	2.30	7.57	9.93	15.44
6. Pacific & South-American Countries	27.12	N.A	7.97	0.42
7. African Countries	25.68	2.79	10.66	0.60
8. Neighbouring Countries	6.99	56.22	55.72	6.77
Total	100.00	100.00	100.00	
N (in '000)	994770	5451	13874	1.46

Source: (i) "Total Population Estimates" United Nations monthly Bulletin of Statistics, August 1984 and September 1987. (ii) Other Estimates are from UNCTAD documents No TD/B/AC/11/25/Rev 1, TD/B/C-6/7 and TD/B/C-6/47.

7.2.2 Manpower that has migrated from India to neighbouring countries, as of ethnic in nature and hence may not be treated as brain drain. The study, therefore, is limited to those who have migrated largely to North America, Europe, West Asia and other countries which attracted talent and skilled manpower from India. Based on "Total Population Estimates", United Nations Monthly Bulletin of statistics, August 1984 & September 1987 and UNCTAD documents on 'Brain-Drain' No., (i) TD/B/AC/11/25/Rev1, (ii) TD/B/C-6/7 and (ii) TD/B/C-6/47, total Indian immigrants abroad account for 30.75 lakh Indian as in 1985. Of these about 53 percent were in workforce accounting for 16.30 lakh Indians working in foreign countries. Immigrants in labour force as percentage of total immigrants is highest in West Asia at 63.1 percent followed by 48.4 percent each in West Europe, Australia and USA. This suggests that more workers in West Asia leave their families behind than those in other countries.

7.2.3 Of all the skilled manpower abroad 19.9 percent consist of professional, technical and kindred workers, 2 percent are managers and administrators, 41.5 percent are salesmen and clerical personnel including craftsmen and 36.6 percent are service workers and labourers.

7.2.4 Of the highly qualified scientific and technical manpower which is about 19.9 percent of Indian workforce abroad, 30.6 percent are in U.S.A., 23.3 percent in West Asia, 11.7 percent in West Europe and 10.3 percent in Canada. Smaller proportions are in other countries.

7.2 Participation Rate of Immigrants of Indian Origin in Labour Force: 1985

Sl. No.	Country	Total immigrants ('000)	Immigrants in Labour Force ('000)	Immigrants in Labour Force as percentage of total immigrants
1.	U.S.A	263.6	127.6	48.4
2.	U.K.	400.0	168.0	42.0
3.	Australia	46.3	22.4	48.4
4.	Canada	148.7	63.5	42.7
5.	West Europe	104.5	50.6	48.4
6.	West Asia	1313.8	829.0	63.1
7.	Malaysia	490.6	235.0	47.9
8.	Singapore	72.9	35.0	48.0
9.	Hong-Kong	16.8	7.0	41.7
10.	Nigeria	28.0	12.6	45.0
11.	Others	189.8	79.7	42.0
Total		3075.0	1630.4	53.0

Source : UNCTAD Documents Nos. (i) TD/B/AC/11/25/Rev1, (ii) TD/B/C-6/7 & (ii) TD/B/C-47.

7.3 Migration of Highly Qualified Scientific and Technical Manpower - 1985

Country/Region	Number ('000)	Percent to total Brain-Drain	Percent to total Indian Workforce in that country
U.S.A.	98.7	30.6	77.4
U.K.	25.3	7.8	15.1
Australia	17.4	5.4	77.7
Canada	33.4	10.3	52.6
West Europe	37.9	11.7	74.9
West Asia	75.4	23.3	9.1
Malaysia	15.5	4.8	6.6
Singapore	2.8	0.9	8.0
Hong-Kong	0.8	0.2	11.4
Nigeria	7.8	2.2	55.6
Others	9.8	3.0	12.3
Total	324.0	100.0	19.9

Source: UNCTAD Documents Nos. (i) TD/B/AC/11/Rev1, (ii) TD/B/C-6/7 & (iii) TD/B/C-47.

7.3 Composition

7.3.1 It will be observed from table 7.3 that a large proportion of Indian workforce in USA consists of highly qualified scientific and technical manpower. These account for 77.4 percent of total Indian workforce in that country. In Australia also their share is about 77.7 percent. In West Europe highly skilled scientific and technical persons account for 74.9 percent of total Indian workforce. This proportion is 55.6 percent in Nigeria, 15.1 percent in U.K. and a smaller percentage in other countries.

7.3.2 Occupational composition of highly qualified manpower presented in table 7.5 shows that 32.8 percent of these are engineers and technologists, 20.2 percent are physicians and Surgeons, 20.5 percent scientists and 26.5 percent are other technical professionals.

7.4 Share of Different Professional Categories in labour force of Indian Origin:1985 (in percent)

Sl. No.	Country	Professional & kindred workers	Managers & Administrators	Salesmen & Craftsmen	Labour & Service workers	N ('000)
1.	U.S.A.	77.4	6.5	11.8	4.3	127.6
2.	U.K.	15.1	0.9	50.0	34.0	168.0
3.	Australia	77.7	6.3	11.6	4.4	22.4
4.	Canada	52.6	5.0	34.8	7.6	63.5
5.	W.Europe	74.9	6.3	11.7	7.1	50.6
6.	West Asia	9.1	0.9	50.0	40.0	829.0
7.	Malaysia	6.6	1.5	35.9	56.0	235.0
8.	Singapore	8.0	2.0	40.0	50.0	35.0
9.	Hong-Kong	11.4	1.4	60.0	27.2	7.0
10.	Nigeria	55.6	0.0	11.1	33.3	12.6
11.	Others	12.3	3.5	36.3	47.9	79.7
	Total	19.9	2.0	41.5	36.6	1630.0

Source: UNCTAD Documents, Nos. (i) TD/B/AC/25/Rev1 (ii) TD/B/C-6/7 & (iii) TD/B/C-47.

7.5 Occupational Composition of Highly Qualified Indian Manpower Abroad : 1985 (in percent)

Category	USA	UK	Canada	West-Europe	West-Asia	Other	Total
Engineers & Technologists	49.6	24.6	34.8	44.9	16.5	18.6	32.8
Physicians & Surgeons	16.9	46.9	14.2	15.5	19.6	21.5	20.2
Scientists	10.7	8.9	29.5	20.8	21.4	20.1	20.5
Other Technical Professionals	13.8	19.6	21.5	18.8	42.5	39.8	26.5
All Categories	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N ('000)	98.7	25.3	33.4	37.9	75.4	53.3	324

7.3.3 Table 7.6 presents the trends in relative share of skilled migrants to different countries in the world since 1961. There has been tremendous increase in the magnitude of brain drain since 1961. While only 8.9 thousand skilled professionals migrated from India during the period 1962-65, the number has been rising since then & maximum increase

was during 1970-73 when it was double that of previous four years period. In 1982-85 the number has reached 84.2 thousand. In 1961, maximum share of immigrants were in England. However, due to restrictive immigration policies, this share came down to only 1.5 percent in 1982-85. Recently, maximum number of immigrants have migrated to U.S.A.

**7.6 Trends in the Relative Share of Skilled
Immigration from India to various
countries 1961 - 1985**

(in percent)

Year	USA	UK	Canada	West- Asia	Others	Total	N ('000)
Upto 1961	9.4	64.2	4.4	n.a.	22.0	100.0	16.0
1962-1965	14.7	40.5	14.2	4.7	25.9	100.0	8.9
1966-1969	25.3	16.6	18.4	3.2	36.5	100.0	23.3
1970-1973	40.2	6.2	8.6	22.5	22.5	100.0	46.8
1974-1977	31.6	2.8	8.6	28.5	28.5	100.0	69.6
1978-1981	30.9	1.9	10.5	29.9	26.8	100.0	75.2
1982-1985	30.8	1.5	10.9	25.4	31.4	100.0	84.2
Total	30.5	7.8	10.3	23.3	28.1	100.0	324.0

7.3.4 Occupational Composition of Indian Immigrants to USA during 1966 to 1985 shows that over this period there was considerable change in occupational distribution. While in 1966, 72.9 percent of Indian immigrants were either Engineers or technologists, their percentage share gradually came down to 41.6 percent by 1981. However, their share increased thereafter to 49.6 percent by 1985. Doctors who formed only 5.9 percent in 1966 increased to 19.1 percent in 1974 and thereafter it declined to 11.7 percent in 1981. However, in 1985 it increased to 16.9 percent again. Scientists' share is more or less constant at around 20 percent.

7.3.5 A study of change in composition of manpower in UK suggests a fall in share of Physicians & Surgeons which has gradually moved down from about 50.8 percent in 1961 to about 46.9 percent in 1982-85. The share of scientists has been approximately constant. Other technical professionals has moved up from 11.3 percent in 1961 to about 31 percent and above during 1962-

**7.7 Occupational Composition of Indian
immigrants to USA - 1966 to 1985**
(In percent)

Year	Engin- Tech- nologists	Physi- cians & Sur- geons	Scien- tists	Other Tech. Profe- ssional	All Cate- gories
1966	72.9	5.9	18.4	2.8	100.0
1970	64.6	7.7	23.1	4.6	100.0
1974	46.6	19.1	20.8	13.5	100.0
1978	45.5	12.7	20.7	21.1	100.0
1981	41.6	11.7	20.5	26.2	100.0
1985	49.6	16.9	19.7	13.8	100.0

70. This share has gradually declined and is now in the range of about 20 percent. As regards Engineers & Technologists who accounted for 29.9 percent in 1961 declined to about 17 to 18 percent over the period 1962 to 1970. Their share has gradually moved up and is presently at about 25 percent of the total skilled Indian manpower in U.K.

7.8 Immigration of Skilled Indian Manpower to U.K. by Occupation 1961-1985

(in percent)

Year	Engin- eers & Tech- nolo- gists	Physi- cian & Sur- geons	Scien- tists	Other Tech. Profe- ssional	All Cate- gories
Upto- 1961	29.9	50.8	8.0	11.3	100.0
1962- 65	17.9	41.7	8.7	31.7	100.0
1966- 69	17.1	42.6	9.7	30.6	100.0
1970- 73	21.9	48.1	10.1	19.9	100.0
1974- 77	25.6	46.0	10.5	17.9	100.0
1978- 81	27.3	41.9	9.5	21.3	100.0
1982- 85	24.6	46.9	8.9	19.6	100.0

7.4 Intensity

7.4.1 When related to domestic stock, the share of Indian personnel abroad works out at 32.8 percent for Engineers & Technologists, 28 percent for Physicians & Surgeons, 5.7 percent for scientists and 21.6 percent for other technical professionals. These shares are also sometimes described as intensity of brain-drain. These figures will suggest that the problem of brain drain in case of Engineers & Technologists and Physicians & Surgeons is quite serious.

7.4.2 Over time also, the intensity of Brain Drain has been increasing from about 5 percent in 1960 to about 9.5 percent in 1985. The intensity of Brain Drain which was stationary at 5 percent till 1970 jumped to about 8 percent in 1975 and 8.8 in 1981.

7.9 Skill outflow in relation to Domestic Manpower (1985)

Category	Domes- tic Stock ('000)	Stock of Indian Personnel Abroad('000)	Intensity of Brain- Drain (in %)
Engineers & Technologists	324.2*	106.2	32.8
Physicians & Surgeons	233.4**	65.4	28.0
Scientists	1161.1	66.3	5.7
Other Tech. Professional	398.3	86.1	21.6
All Categories	2117.0	324.0	15.3

* Does not include Diploma Holders
 ** Does not include Licentiate Doctors
 Source: Data for Stock of S & T manpower is taken from "Research and Development Statistics 1984-85" of DST.

7.10 Trends in Skill out flows in Relation to Domestic Stock of Technical Manpower(1960-85) (in percent)

At the end of Year	Engin- eers & Techno- logists	Physi- cian & Sur- geons	Scien- tists	Other Tech. Profe- ssional	All Cate- gories
1960	3.4	23.4	2.4	7.0	5.0
1965	4.0	13.2	1.8	5.3	3.5
1970	4.9	15.6	2.0	13.2	5.1
1975	8.1	16.2	3.7	24.4	8.0
1981	9.4	23.1	3.8	20.3	8.8
1985	10.5	24.8	3.8	24.1	9.5

Note: See Annexure-7.1

7.4.3 It is observed that developed countries like USA, Canada and UK draw considerable skilled manpower both from developed and developing countries. Whereas the share of UK and Canada in drawing skilled manpower from developing countries is about 26 percent and 22 percent respectively, in case of USA this share averages 61 percent over the period 1961 to 1975. This shows that USA largely draws skilled manpower from developing countries whereas Canada and UK largely draw such manpower from other developed countries.

7.11 Trends in Skilled Migration from Developing Countries to USA, Canada & UK - 1961-76

Year	Share of developing countries in total skilled migration		
	U.S.A	Canada	U.K.
1961-65	37	20	26
1966	49	23	26
1967	52	25	21
1968	50	24	23
1969	64	28	22
1970	69	27	19
1971	85	31	18
1972	86	36	19
1973	77	25	15
1974	80	27	15
1975	72	25	14
1976	-	24	-

Source: United Nations, UNCTAD Document No. TD/B/C.6/47 "The Reverse Transfer of Technology: A survey of its Main Features, causes a Policy Implications".

7.4.4 A study of occupational composition of skilled manpower during the period 1971-76 suggests that 72 percent of all Physicians & Surgeons who immigrated into USA were from developing countries. As against this share of Engineers & Physicians was 58 percent. For Canada, the share of developing countries in supplying physicians and surgeons was 37 percent as against 32 percent for Engineers & Scientists. For UK again, Physicians & Surgeons had higher proportion of 49 percent as against Engineers & Scientists at 17 percent.

7.4.5 A sample estimate of outflows of domestic stock of S & T manpower from selected developing countries shows that Pakistan was losing 50 to 70 percent of its physicians & surgeons in favour of other countries as against 32 percent for India, 40 percent for Syrian Arab

Republic, 30 percent for Iran about 21 percent for Philippines and 20 percent for Sri Lanka. India also lost about 25 percent of Engineers & Scientists. The loss of Engineers & Scientists was about 11 percent for Philippines and 19 percent for Sri Lanka.

7.12 Share of Developing Countries in Total skilled Migration into the USA, Canada & UK and Total - 1971-76

Country/ Category of Tech. Manpower	No. of skilled migrants from		Share of Developi- ing coun- tries in total ski lled mi- grants
	Develop- ing coun- tries	All coun- tries	
United States of America	118.8	190.8	62
Physicians & Surgeons	40.9	56.4	72
Engineers & Scientists	77.3	133.5	58
All Others	.6	.9	74
Canada	81.6	297.2	27
Physicians & Surgeons	4.8	13.0	37
Engineers & Scientists	13.6	42.7	32
All Others	63.2	241.5	26
United Kingdom	84.0	380.8	22
Physicians & Surgeons	15.6	32.1	49
Engineers & Scientists	9.2	54.7	17
All Others	59.2	294.0	20
Total	284.4	868.8	33
Physicians & Surgeons	61.4	101.5	60
Engineers & Scientists	100.1	230.9	43
All Others	123.0	536.4	23

Source: United Nations, UNCTAD Document No. TD/B/C.6/47 "The Reverse Transfer of Technology: A survey of its Main Features, causes & Policy Implications."

7.13 Skilled outflows in relation to Domestic Stock of Manpower : Sample Estimates of a Selected number of developing and developed countries.

Country	Skilled migrants as percentage of domestic stock of annual output		
	Physicians & Surgeons	Engineers & Scientists	Total
A. Developing Countries of Emigration:			
Pakistan (1970s)	50-70	-	-
Syrian Arab Republic (1971)	40	-	-
Iran (1971)	30	-	-
India (1975)	32	25	8
Philippines (1975-76)	21	11	10
Sri Lanka (1971-74)	20	19	36
B. Developed Countries Immigration			
U.S.A. (1971-72)	51	26	11
U.K. (1966)	40	5	-

- a. Out flow as a percentage of annual output
- b. Outflow as a percentage of stock in that year
- c. Average annual flow of skilled emigrants as a percentage of annual increase in domestic stock
- d. Inflow of skilled migrants from developing countries as a percentage of annual increments in indigenous stock of manpower in those years.

Source:-

United Nations, UNCTAD Document No. Td/B/C.6/47 "The Reverse Transfer of Technology: A Survey of its Main Future causes & Policy Implications"

7.5 Perspective

7.5.1 Projection of magnitude of brain-drain to different regions of the world for future years has been done on the basis of trends of brain-drain from 1970 to 1985 by using linear and log linear regression equations both for each of the countries to which immigration has taken place. Having taken into account various recent restrictions on emigration of persons to USA, UK etc., these estimates have been adjusted keeping in view recent trend of manpower emigration observed. Thus final estimates are based on projections worked out by log linear regression equation for UK and linear regression equation for other countries. It is estimated that the stock of Indians abroad by various professional categories will be 539.4 thousand by the year 2000. Of these about 34 percent shall be Engineers & Technologists, about 18 percent Physicians & Surgeons, 21 percent scientists and about 27 percent other categories including Management specialists. The stock of Indians abroad is estimated at 474.9 thousand for 1995 and 410.6 thousands for 1990 as against 324 thousands in the year 1985.

8.14 Projected Stock of Indians Abroad by Various Professional Categories

	(in '000)				
At the end of Year	Engineers & Technologists	Physicians & Surgeons	Scientists	Other Tech. Professionals	All Categories
1990	140.2	72.0	86.5	111.9	410.6
1995	161.4	84.1	99.9	129.6	474.9
2000	182.6	96.3	113.1	147.4	539.4
2005	203.8	108.5	126.3	165.1	603.7
2010	225.6	120.7	139.6	182.8	668.7

7.14(a) Distribution of Projected Stock of Indians Abroad by various Professional Categories(in percent)

At the end of Year	Engineers & Technologists	Physicians & Surgeons	Scientists	Other Tech. Professionals	All Categories
1990	34.1	17.5	21.1	27.3	100.0
1995	34.0	17.7	21.0	27.3	100.0
2000	33.9	17.9	21.0	27.3	100.0
2005	33.8	18.0	20.9	27.3	100.0
2010	33.7	18.0	20.9	27.4	100.0

7.5.2 The trends suggest that the share of Engineers & Technologists in the total stock of technical manpower abroad has declined from about 38 percent in 1975 to about 33 percent in 1985. This ratio will be approximately maintained over the future years.

7.5.3 The share of Physicians & Surgeons i.e. medical personnel in total stock of manpower abroad which consistently declined during 1960-1975 from about 43 percent to only 18 percent and then gradually increased to about 21 percent is expected to decline to about 17.5 percent by 1990 and to about 18 percent by the year 2000.

7.5.4 The share of scientists which gradually declined over the period 1960-65 from 19.5 percent to 16.5 percent increased to 18.9 percent in 1970. This share is estimated at 20.5 percent in 1985 and is expected to increase to about 21 percent by the year 2000.

7.5.5 As regards other persons, there has been a gradual increase from only 8.2 percent in 1960 to 12 percent by 1965 and further to 19.4 percent in 1970. Their share was 22.1 percent in 1975 increasing to 26.5 percent in 1985. Their share is expected to marginally increase further to about 27.3 percent by the year 2000 and maintain this share till the year 2010.

7.5.6 Several alternative methods were adopted to project extent of Brain Drain of technical manpower from India. Some of these extrapolations yielded very

high level of outflow of professional and technical manpower from India. This happened because over the 1960s and 1970s considerable technical and professional manpower left the country to seek work abroad. This trend has now been constrained because of the policies of the Govts. importing skilled manpower. As a result, the projections arrived at through trend methods are considered inadequate and need to be corrected keeping in view the exogenous factors including recent policies of the receiving governments.

7.5.7 Keeping these factors in view, it is estimated that total manpower emigration during the period 2002-2005 shall be 67 thousand persons as against 61400 over the period 1998-2001. Considering that these are four years' figures, the average annual outflow will be about 15 thousand persons over the period 1998-2001 as against about 11.3 thousand persons per year for the period 1986-89.

7.15 Projection of Brain-Drain by Countries - Adjusted (in'000)

Four Year Period	U.K.	Canada	USA	West Asia	Others	Total
1986-89	1.2	5.1	12.8	12.5	13.0	44.6
1990-93	0.9	5.9	13.8	14.1	15.5	50.2
1994-97	0.9	6.6	14.9	15.7	17.7	55.8
1998-01	0.9	7.4	15.9	17.3	19.9	61.4
2002-05	0.9	8.5	16.9	18.9	21.7	67.0
Total	4.8	33.5	74.3	78.5	87.8	279.0

7.5.8 Of these, 1.5 percent will go to UK, 12 percent to Canada, 26 percent to USA and 28 percent to West Asia during the period 1998-2001. The respective shares are estimated at 27 percent to UK, 11.4 percent to Canada, 28.8 percent to USA, 28 percent to West Asia and 29 percent to other countries for the period 1986-89.

7.6 Causes

7.6.1 Several causes of Brain Drain have been identified in different studies. These are generally grouped as economic factors and non-economic factors.

7.6.2 The economic factors generally refer to the low rate of economic growth in developing countries. Because of this, the absorption capacity of developing countries for highly skilled Manpower remains limited. Another important factor is inadequate remuneration of Scientific manpower which compares highly unfavourably with the levels of remuneration prevailing abroad.

7.6.3 Also Indian industries have attached inadequate attention to R & D which has a greater capacity to absorb highly skilled manpower. Further there is a degree of monopolisation of senior posts by old timers which leaves little scope for fresh and more qualified entrants.

7.6.4 There is considerable differential in prestige, power, responsibility and remuneration as between Scientists & Technologists and those in management in Govt. or in industry. The political culture also does not favour the scientific and technical manpower.

7.6.5 There are political and historical factors which also favour emigration. There is a prestige attached to being abroad or having been abroad. These features are peculiar to developing countries.

7.6.6 Some of the good talent also goes abroad because of inadequate training and educational facilities in native countries.

7.6.7 An important factor in outflow of Skilled Manpower is that immigration laws of the receiving countries are very selective and allow immigration for only the Skilled Manpower. The greater the

skilled capability the greater is the chance of securing immigration.

7.6.8 In view of the above, Brain Drain has to be seen in the context of prevailing scientific and technological matrix. Brain Drain actually is one of the problems thrown up by technology upgradation and we should accept this as an international scheme of things using as much selectivity as necessary in our national interest.

7.7 Cost : Benefit

7.7.1 Brain Drain is sometime defined as reverse transfer of technology. There is a technology embedded in skill and when skills are exported so is technology.

7.7.2 Further, there is investment involved in creating skill and associated technology. This investment goes to benefit another economy when the skills emigrate. If the cost involved in training and development of skilled personnel is treated as a loss on emigration and the contribution made by their skills to the developing economy as a gain then there is considerable benefit : Cost relationship in favour of the receiving country.

7.7.3 Benefits gained by recipient countries amounted to over 67 billion dollars of which 51 billion dollars is gained by USA, 13 billion dollars by Canada and 2.8 billion dollars by U.K.

7.7.4 Benefits lost by India to these countries are 8 billion dollars to USA, 2.6 billion dollars to Canada and 2.2 billion dollars to U.K. Overall loss to these countries amounts to 13 billion dollars. These data refer to the period upto 1985.

7.16 Measures of imputed capital value of skilled flows from India to the USA, Canada and the United Kingdom upto year 1985

Country of immigration and occupational category	Number of migrants (thousand)	Imputed value per migrant (thousand \$)	Total imputed capital value (million \$)
(1)	(2)	(3)	(4)
United States of America	98.7	565	51336
Engineers & Technologists	49.0	431	21114
Physicians & Surgeons	16.7	1017	16955
Scientists	19.4	376	7315
Other-professionals	13.6	437	5952
Canada	33.4	414	12794
Engineers & Technologists	11.6	379	4407
Physicians & Surgeons	4.7	685	3250
Scientists	9.9	329	3245
Other-professionals	7.2	263	1892
United Kingdom	25.3	107	2816
Engineers & Surgeons	6.2	112	698
Physicians & Surgeons	11.9	121	1436
Scientists	2.2	107	241
Other-professionals	4.9	89	441
Grand Total	157.4	348	66946

Source: The Reverse Transfer of Technology: Economic Effects of outflow of Trained Personnel from Developing Countries.

PLAN FORUM

Within CERPA Plan Forum has been set up as a discussion group for free, frank and independent discussion of various developmental issues. Selected **Panelists who are experts in their respective fields** are invited to initiate each discussion. Following subjects has so far been taken up at the earlier plan forum Workshops.

1. Planning for the Poor (May, 1984)
2. Planning for 8 percent Growth (July, 1984)
3. Population and Development (October, 1984)
4. Industrial Policy and Seventh Five Year Plan (December, 1984)
5. National Food Security System Food for All (March, 1985)
6. Economic Benefits from Social Outlays (December, 1985)
7. Role of Economic Planning and Development in National Integration (August, 1989)

(i)

Annexure-1.1

**Example for Estimation of Future Requirements
of S&T Manpower at Different Scenarios**

For Agriculture Manpower

Scenario-I (Investment method)

Sectorwise norms of outlay per standard person year of envisaged employment generation for the country as a whole has been worked out for the year 1985-86 on the basis of total plan outlays and corresponding envisaged employment generation during the plan period in the same sectors. For other years norms have suitably been modified taking into consideration annual growth rate of 3 percent in per capita outlay owing to the growth of the national economy. Sectorwise norms of outlays for employment generation during 1980-81 to 2000-01 have been presented in table below.

**1. Sectorwise norms of employment generation during
1980-81 to 2000-01**

Sector	Norms of outlay (in Rs. at 1987-88 constant prices) per standard person year				
	1980-81	1985-86	1990-91	1995-96	2000-01
Agriculture	10646	11496	12414	13405	14475
Mining & Manufacturing	115997	125255	135252	146047	157703
Transport	13254	14312	15454	16688	18020
Others	68009	73460	79348	85708	92577

Annual addition to employment in each sector for future years has been worked out taking into view (i) total investment/estimated investment during the relevant year (ii) norms/adjusted norms of outlay for generation of additional employment per standard person year and (iii) Success rate realised during 1980-81 to envisaged employment. Estimated investment of future years in different sectors have been worked out at existing 5 percent growth rate as well as at expected growth rate of 8 percent and presented below in table 2(a) & 2(a) respectively. However for estimating addition in employment during a year average of the estimated investment worked out at 2 growth Scenarios for the relevant year have been considered taking into view the financial position of the country as also various other factors influencing the economy.

2(a) Gross Domestic Investment at 1987-88 prices at 5 percent Growth Rate (in Crore Rs.)

Sector	Actual	Projected			
	1980-81	1985-86	1990-91	1995-96	2000-01
Agriculture	9568	12565	16499	21666	28452
Mining & Quarrying	1957	3449	6078	10712	18878
Manufacturing	14114	20738	30471	44772	65785
Construction	960	1417	2092	3088	4558
E G & W	4885	7177	10546	15496	22769
Railways & other					
Transport	4367	6597	9965	15053	22739
Communication	591	952	1533	2469	3976
Other Services	13405	19700	28946	42533	62495
Total	49847	72595	106131	155789	229652

2(b) Gross Domestic Investment at 1987-88 prices at 8 percent Growth Rate (in Crore Rs.)

Sector	Actual	Projected			
	1980-81	1985-86	1990-91	1995-96	2000-01
Agriculture	9568	12565	16499	21666	28451
Mining & Quarrying	1957	2669	3639	4963	6767
Manufacturing	14114	18709	24802	32880	42588
Construction	960	1417	2092	3088	4558
E G & W	4885	6662	9084	12388	16893
Railways & other					
Transport	4367	5212	6220	7423	8859
Communication	591	952	1533	2469	3976
Other Services	13405	16546	20422	25208	31114
Total	49847	64732	84291	110085	144206

Annual estimated addition in employment potential for different years has been worked out from estimated investment for the relevant year in a particular sector and norms of outlay for the year in that sector by using the following formula :

$$\text{Envisaged Addition in employment} = \frac{\text{Investment} \times 85 \%}{\text{Norms of outlay per standard person}}$$

as 85 percent of the investment has been considered as outlay equivalent.

Percentage of actual employment during 1980-81 to estimated envisaged employment has been considered as success rate and this target rate has been used for estimating annual addition in employment potential for future years also. Estimated annual addition in employment potential for 1980-81 to 2000-01 has been presented in Table 3.

3. Estimated Annual Additional Employment (Standard person year) During 1980-81 to 2000-01 on the basis of Estimated Investment

Sector	1980-81		1985-86		1990-91		1995-96		2000-01	
	Envis- aged Employ- ment as per norms (Lacs)	Actual Employ- ment (Lacs)	Envis- aged Employ- ment as per norms (Lacs)	Actual Employ- ment (Lacs)	Envis- aged Employ- ment as per norms (Lacs)	Actual Employ- ment (Lacs)	Envis- aged Employ- ment as per norms (Lacs)	Actual Employ- ment (Lacs)	Envis- aged Employ- ment as per norms (Lacs)	Actual Employ- ment (Lacs)
Agriculture	76.39	30.56	40	37.16	112.96	45.18	137.36	54.94	167.01	66.80
Mining, Quar- rying & Manu- facturing	11.77	10.00	85	13.10	20.46	17.40	27.15	23.07	35.40	30.09
Transport	28.00	1.96	7	2.44	44.79	3.13	56.77	3.98	74.38	5.20
Others	25.74	10.54	41	13.50	42.98	17.43	556.05	22.62	73.48	29.53
Total	141.90	53.06	-	66.20	221.19	83.14	777.33	104.61	350.27	131.62

Note :- (i) 85 percent of the Investment has been considered as outlay, equivalent.

(ii) Success rate has been worked out as percentage of actual addition in employment in 1980-81 to envisaged employment in 1990-91 as per estimated norms of outlay for the year.

(iii) Realised success rate in 1980-81 has been utilised for estimating additional employment generation for future years.

Sector wise future addition to employment potential for degree holders in Agriculture Science have been estimated on the basis of estimated addition to total employment in each sector and expected share of Agriculture Scientists in total employment in the corresponding sector. Sector wise expected share of degree holders in Agricultural Science in total manpower requirement has been worked out on the basis of ratio of total degree holders in Agriculture Science to total main workers in each Sector as per 1981 Census and expected growth of requirement of degree holders in Agriculture Science in comparison to total estimated manpower requirement in different years owing to adoption of more and more modern techniques and implements in Agricultural practices needing more and more Agriculture Scientists. Annual addition to employment potential during 1980-81 to 2000-01 is presented in Table 4.

4. Annual Addition of Employment Potential During 1980-81 to 2000-01
(At average growth rate of economy)

Sl. Sector No.	1980-81		1985-86		1990-91		1995-96		2000-01	
	Total Agri- culture Scientists (Lacs)(in'00)	4.03	Total Agri- culture Scientists (Lacs) (in'00)	5.53	Total Agri- culture Scientists (Lacs)(in'00)	8.53	Total Agri- culture Scientists (Lacs) (in'00)	11.62	Total Agri- culture Scientists (Lacs) (in'00)	16.40
1. Agriculture	30.56	4.03	37.16	5.53	45.18	8.53	54.94	11.62	66.80	16.40
2. Mining, Quarrying & Manufacturing	10.00	1.44	13.10	2.02	17.40	2.91	23.07	4.14	30.09	6.11
3. Transport	1.96	0.38	2.44	0.53	3.13	0.76	3.98	1.07	5.20	1.57
4. Others	10.54	13.54	13.50	20.07	17.43	29.54	22.62	43.41	29.53	63.62
Total	53.06	17.31	66.20	25.29	83.14	39.97	104.61	53.99	131.62	79.18

Total addition in different 5 year periods starting from 1980-81 to 1985-86 upto 1995-96 to 2000-01, estimated from annual additions during the corresponding periods by using the formula :

Estimated addition during t₁ to t₂ period = 5 x $\frac{\text{Addition during t}_1 \times \text{addition during t}_2}{2}$

where t₁ and t₂ are the years between which addition in employment potential is to be estimated.

**5. Addition in Employment Potential for Agriculture
Scientists during 1980-81 to 2000-01 (in '00)**

Sector	Addition in Employment Potential			
	1980-81 to 1985-86	1985-86 to 1990-91	1990-91 to 1995-96	1995-96 to 2000-01
Agriculture	25.2	36.7	53.1	73.7
Mining & Manu- facturing	343.9	488.6	700.0	1015.2
Transport	89.8	126.9	180.4	258.8
Others	1129.5	2031.5	2987.5	4384.2
Total	1588.4	2683.7	3921.0	5731.9

Sector wise estimated requirements of total degree holders in Agriculture Science at five year interval during 1980-81 to 2000-01 have been worked out on the basis of total Agricultural Scientists employed in the corresponding sectors as per 1981 Census and five yearly addition in employment potential as estimated above is presented below.

**6. Estimated Requirement of Degree Holders in Agriculture
Science during 1985-86 to 2000-01 (in '00)**

Sector	Requirement during				
	Actual 1980-81	Estimated			
		1985-86	1990-91	1995-96	2000-01
Agriculture	216.7	241.9	278.5	331.7	405.4
Mining & Manu- facturing	1476.6	1820.5	2309.1	3009.1	4024.3
Transport	447.0	536.8	663.7	844.1	1102.9
Others	5974.8	7104.3	9135.8	12123.3	16507.5
Total	8115.1	9703.5	12387.2	16308.2	22040.1

Scenario-II (Output method)

Employment of Agriculture Scientists per crore Rs. of output for different sectors of economy for the year 1980-81 have been worked out by dividing the GDP (in Crore Rs.) at factor cost at 1970-71 prices for each sector by number of main workers having Agriculture Science degree employed in the corresponding sector during the year. For subsequent years, these norms have suitably been modified taking into consideration annual growth of per capita income due to growth of national income realised during recent past and envisaged in future. Sector wise estimated employment of Agriculture Scientists per Crore Rs. of output for the years 1980-81 to 2000-01 and estimated GDP at 1970-71 prices for the corresponding years are presented in Tables 7 and 8 respectively.

7. Employment of Degree Holders in Science per Crore Rs. of Output during the years 1980-81 to 2000-01

Sector	1980-81	1985-86	1990-91	1995-96	2000-01
Agriculture	1.0596029	1.0347982	1.0105842	0.9868359	0.9638418
Mining & Quarrying	9.0932358	8.8804535	8.6725958	8.469711	8.2715198
Industry	17.893905	17.475186	17.066267	16.666916	16.276909
Construction	5.430131	5.3030658	5.1789744	5.0577865	4.9394237
Trade & Commerce	20.816866	20.329751	19.854034	19.389449	18.935735
Transport, Storage & Communication	13.17954	12.871137	12.569952	12.275814	11.98856
Other services	58.770833	57.3954	56.052537	54.740906	53.459968

8. Estimated Gross GDP at Factor Cost by Industry of Origin (in Crore Rs.)

Sector	1980-81	1985-86	1990-91	1995-96	2000-01
Agriculture	20452	24692	29811	35991	43453
Mining & Quarrying	547	838	1283	1965	3010
Industry	7974	11716	17215	25294	37165
Construction	2290	2479	2684	2906	3146
Trade & Commerce	9403	11617	14353	17733	21909
Transport & Communication	3392	4569	6155	8291	11169
Other Services	6624	8823	11753	15659	20866
Total	50682	64732	83254	107839	140718

* Source : National Accounts Statistics

Applying the employment norms for different sectors during different years on the estimated GDP at factor cost for the corresponding years estimated requirement Agriculture Scientists for relevant years have been estimated by using the formula :

$$R_t = \frac{O_{st}}{N_{st}}$$

where R_t = requirement of Agriculture Scientists for the year.

O_{st} = estimated GDP for s Sector in t year.

N_{st} = employment of Agriculture Scientists per Crore Rs. of output for s Sector in t year.

Estimated requirements of Agriculture Scientists during 1985-86 to 2000-01 thus worked out are presented in Table 9.

**9. Requirement of Agriculture Scientists during
1985-86 to 2000-01 at Scenario-II**

(in '000)

Sector	Estimated Requirements			
	1985-86	1990-91	1995-96	2000-01
Agriculture	24.4	26.2	28.1	30.4
Mining & Quarrying	0.1	0.2	0.3	0.4
Industry	5.4	7.1	9.3	12.2
Construction	0.2	0.2	0.2	0.2
Trade & Commerce	16.7	18.4	20.2	22.3
Transport & Communi- cation	1.6	2.0	2.3	2.8
Others	44.9	53.5	63.3	75.2
Total	93.3	107.6	123.7	143.5

Scenario-III (Manpower Norms Method)

The Seventh Five year Plan envisaged to generation of additional employment of the order of 40.36 million standard person years during the plan period with an implied growth rate of 3.99 percent per annum. Projected growth rates of employment between 1984-85 to 1989-90 for different Sectors as per Planning Commission are presented in Table 10.

**10. Projected Growth of Employment during
1984-85 to 1989-90**

Sector	Employment in million standard person years		Annual growth of employment
	1984-85	1989-90	
Agriculture	96.108	114.092	3.49
Mining & Quarrying	1.153	1.494	5.32
Manufacturing	26.790	33.466	4.55
Construction	10.427	12.624	3.90
Electricity	1.031	1.498	7.76
Railway	1.544	1.688	1.80
Other Transport	9.440	11.810	4.58
Communication	0.951	1.224	5.18
Other Services	39.261	49.165	4.60
Total	186.705	227.061	3.99

Source :- Seventh Five Year Plan

It is assumed that, growth rates of employment for different Sectors, as envisaged by the Planning Commission for the Seventh Plan Period are expected to be realised upto the end of the Century, overall employment for 1985-86 to 2000-01 have accordingly been estimated and presented in Table 11.

**11. Estimated Employment During 1985-86 to 2000-01
(in million standard person years)**

Sector	1984-85	1985-86	1990-91	1995-96	2000-01
Agriculture	96.108	99.46	118.07	140.16	166.39
Mining & Quarrying	1.153	1.21	1.57	2.03	2.63
Manufacturing	26.790	28.01	34.99	43.71	54.60
Construction	10.427	10.83	13.11	15.87	19.22
Electricity	1.031	1.11	1.61	2.34	3.40
Railways	1.544	1.67	1.83	2.00	2.18
Other Transport	9.440	9.87	12.35	15.45	19.33
Communication	0.951	1.00	1.29	1.66	2.13
Other Services	39.261	41.07	51.43	64.40	80.65
Total	186.705	194.23	236.25	287.62	4350.53

By relating overall employment of degree holders in Agriculture Science with total estimated labour force in different sectors, estimated employment of degree holders in Agriculture Science for the years 1985-86 to 2000-01 have been worked out.

**12 Requirement of Agriculture Scientists
during 1985-86 to 2000-01 at Scenario-III
(in '000)**

Sector	Estimated Requirement			
	1985-86	1990-91	1995-96	2000-01
1. Agriculture	24.0	28.5	33.8	40.1
2. Mining & Quarrying	0.1	0.2	0.2	0.3
3. Manufacturing	4.6	5.8	7.2	9.0
4. Construction	0.2	0.3	0.4	0.4
5. Trade & Commerce	16.9	21.2	26.5	33.2
6. T & C	1.5	1.8	2.3	2.8
7. Others	42.2	52.8	66.2	82.8
Total	89.5	110.6	136.6	168.6

Annexure - 2.1

Estimated Gross Domestic Product at Factor Cost
by Industry of Origin

		(Crores)				
Sl. No.	Sector	1980-81*	1985-86	1990-91	1995-96	2000-01
1.	Agriculture	20452	24692	29811	35991	43453
2.	Mining & Quarrying	547	838	1283	1965	3010
3.	Industry	7974	11716	17215	25294	37165
4.	Construction	2290	2479	2684	2906	3146
5.	Trade & Commerce	9403	11617	14353	17733	21909
6.	Transport & Communication	3392	4569	6155	8291	11169
7.	Other Services	6624	8823	11753	15659	20866
Total		50682	64734	83254	107839	140718

* Source :- National Accounts Statistics

Note : Estimated GDP for future years have been worked out from base figure 1980-81 and expected growth rate of GDP.

**Stock of Allopathic Doctors for Selected States/UTs
in India : 1980**

(in '00)

Sl. No.	State/UT	Stock as per Medical Council (Nos.)	Economically Active	Employed	Surplus(+)/ Deficit(-)
1.	Andhra Pradesh	21487	186.9	116.5	70.4
2.	Bihar	17063	148.5	112.2	36.3.
3.	Gujarat	13881	120.8	138.5	-17.7
4.	Karnataka	18959	165.0	122.3	42.7
5.	Kerala	11092	96.5	73.9	22.6
6.	Madhya Pradesh	11091	96.5	111.5	-15.0
7.	Maharashtra	39062	339.8	307.1	32.7
8.	Orissa	7704	67.0	42.1	24.9
9.	Punjab	20012	174.1	98.3	75.8
10.	Rajasthan	8124	70.7	89.3	-18.6
11.	Tamil Nadu	30299	263.6	175.3	88.3
12.	Uttar Pradesh	22610	196.7	284.5	-87.8
13.	West Bengal	31623	275.1	192.3	82.8
14.	Delhi	-	-	93.4	-93.4
15.	Other States/UTs	2495	21.7	119.2	-97.5
INDIA *		255502	2222.9	2076.4	146.5

* Excluding Assam

Source:- (a) For Stock-Medical Council of India
(b) For employed - B.Series Tables, Census - 1981.

Annexure-4.2

Stock of Employed Para-medical Personnel in Selected States/UTs : 1981

(in '000)

Sl. No.	State/UT	Nurses	Pharmacists	Vaccinators	Midwives/ Health Visitors	X-Ray Technicians, Optometrists, Physiotherapists	Pharmacists	Others
		(084)	(076)	(086)	(085)	(086,087,088)	(083)	(077,081,089)
1.	Andhra Pradesh	11.0	13.2	1.2	6.1	0.9	1.2	1.2
2.	Bihar	9.5	17.0	5.9	2.0	0.6	0.1	9.3
3.	Gujarat	8.7	9.6	2.0	1.8	0.4	0.1	14.5
4.	Karnataka	10.2	6.9	1.2	4.0	0.4	0.3	10.8
5.	Kerala	15.2	7.3	0.2	2.4	0.5	0.4	11.0
6.	Madhya Pradesh	12.7	11.1	7.0	1.8	0.8	-	21.2
7.	Maharashtra	26.9	15.0	5.7	5.0	1.6	1.3	32.7
8.	Punjab	4.1	10.3	0.8	2.0	0.3	-	3.1
9.	Rajasthan	8.5	8.3	3.7	1.2	0.5	0.2	5.5
10.	Tamil Nadu	15.9	9.6	1.3	5.6	1.3	0.6	26.2
11.	Uttar Pradesh	9.8	36.3	7.4	8.5	1.2	0.4	16.7
12.	West Bengal	16.0	14.9	5.4	1.9	0.9	2.1	26.6
13.	Delhi	4.8	3.7	0.4	0.5	0.5	-	3.9
14.	Other States/UTs	13.6	15.0	4.7	6.8	1.9	0.6	51.2
	INDIA*	166.9	178.2	46.9	49.6	11.8	7.3	233.9

* Excluding Assam

Note :- Figures in brackets indicate NCO Codes of the activities

Source :- 1981 Census

Annexure-4.3

Para-medical Practitioners per Million Population
in Selected States/UTs : 1981

(in Nos.)

Sl. No.	State/Ut	Nurses	Pharmacist	Vaccinators- Inoculators, Medical Asstts.	Midwives/ Health Visitors	X-Ray Technicians, Optometrists, Physio- Therapists	Pharma- ceutical Asstts.	Others
1.	Andhra Pradesh	205	246	22	114	17	22	22
2.	Bihar	136	243	84	29	9	1	133
3.	Gujarat	255	282	59	53	12	3	425
4.	Karnataka	275	186	32	108	10	8	291
5.	Kerala	597	287	8	94	20	16	432
6.	Madhya Pradesh	243	213	134	34	15	-	406
7.	Maharashtra	428	239	91	80	25	21	521
8.	Punjab	244	613	48	119	18	-	185
9.	Rajasthan	248	242	108	35	15	6	160
10.	Tamil Nadu	328	198	27	116	27	12	541
11.	Uttar Pradesh	88	327	67	77	11	4	151
12.	West Bengal	293	273	99	35	16	38	487
13.	Delhi	772	595	64	80	80	-	627
14.	Other- States/UTs	172	190	59	86	24	8	648
	INDIA *	295	315	83	88	21	13	413

* Excluding Assam

Note :- Estimated on the basis of Census data on employed Para-medical personnel and population of the respective States.

Annexure-4.4

Estimated Population of Selected States/UTs during
1986 to 2001 at medium growth rate

Sl. No.	State/UT	Population 1981 @ (Million)	Growth-rate realised (1981-86)	Population (1986)** (Million)	Expected Growth-rate (1986-91)	Population (1991) (Million)	Expected Growth-rate (1991-96)	Population (1996) (Million)	Growth-rate (1996-2000)	Population (2001) (Million)
1.	Andhra Pradesh	53.55	2.05	59.27	1.85	64.96	1.65	70.50	1.45	75.76
2.	Bihar	69.91	2.38	78.63	2.18	87.58	1.98	96.60	1.78	105.51
3.	Gujarat	34.08	2.23	38.05	2.03	42.07	1.83	46.06	1.63	49.94
4.	Karnataka	37.13	2.04	41.07	1.84	44.99	1.64	48.80	1.44	52.42
5.	Kerala	25.45	1.70	26.69	1.50	28.75	1.30	30.67	1.10	32.69
6.	Madhya Pradesh	52.18	2.41	58.78	2.21	65.57	2.01	72.43	1.81	79.23
7.	Maharashtra	62.78	2.12	69.72	1.92	76.67	1.72	83.49	1.52	90.03
8.	Punjab	16.79	2.05	18.58	1.85	20.36	1.65	22.10	1.45	23.75
9.	Rajasthan	34.26	2.58	38.99	2.38	43.77	2.18	48.75	1.98	53.77
10.	Tamil Nadu	48.41	1.57	52.33	1.37	56.01	1.17	59.36	0.97	62.29
11.	Uttar Pradesh	110.86	2.20	123.60	2.00	136.46	1.80	149.19	1.60	161.51
12.	West Bengal	54.58	2.06	60.44	1.86	66.27	1.66	71.96	1.46	77.37
13.	Delhi	6.22	2.25	6.95	2.05	7.69	1.85	8.43	1.65	9.15
14.	Other States/UT's	59.09	2.52	66.93	2.32	75.05	2.12	83.35	1.92	91.66
	INDIA*	665.29	2.15	739.95	1.98	816.20	1.78	891.68	1.59	965.08

@ Source: 1981 Census

* Excluding Assam

** Source: Registrar General of India

Annexure - 5.1

Employment per Crore Output of Degree Holders

Sl. No.	Sectors	Employment (No's)		Employment per Crore of Output				
		1980-81	1980-81	1980-81	1985-86	1990-91	1995-96	2000-0
1.	Agriculture	21671	20452	1.0596029	1.0347982	1.0105842	0.9869359	0.9638418
2.	Mining & Quarrying	4974	547	9.0932358	8.8804535	8.6725958	8.469711	8.2715198
3.	Industry	142686	7974	17.893905	17.475186	17.066267	16.666916	16.276909
4.	Construction	12435	2290	5.430131	5.3030658	5.1789744	5.0577865	4.9394237
5.	Trade & Commerce	195741	9403	20.316866	20.329751	19.854034	19.389449	18.935735
6.	Transport, Storage & Communication	44705	3392	13.17954	12.871137	12.569952	12.275814	11.98856
7.	Other Services	389298	6624	58.770833	57.395594	56.052537	54.740906	53.459968

Note : 1. Norms for 1980-81 = $\frac{\text{Employment}}{\text{Output}}$

2. Norms for other years have been obtained after adjusting Norms for 1980-81 taking into account expected per capita income during the year in relation to per capita income during 1980-81.

Annexure-6.1

Projected Expenditure on R&D and related S&T Activities by Source of Funding (At 2 percent of GNP by 2000-01)-Scenario-I
(Rs. in crore at 1987-88 prices)

Sl. No.	Source of Funding	R&D and related S&T expenditure		
		1990-91	1995-96	2000-01
1.	Central govt. (a)	3456	5424	8473
	(b)	3486	5687	9455
	(c)	3486	5822	10146
2.	State govt. (a)	384	603	941
	(b)	387	632	1051
	(c)	387	647	1127
3.	Private Sector (a)	475	745	1164
	(b)	479	781	1299
	(c)	479	800	1393
	Total (a)	4315	6772	10578
	(b)	4352	7100	11805
	(c)	4352	7269	12666

Annexure 6.2

Projected Expenditure on R&D and Related S&T Activities by Source of Funding (At 3 percent of GNP by 2000-01)-Scenario-II
(Rs. in crore at 1987-88 prices)

Sl. No.	Source of Funding	R&D and related S&T expenditure		
		1990-91	1995-96	2000-01
1.	Central govt. (a)	3805	6940	12710
	(b)	3838	7277	14150
	(c)	3838	7450	15218
2.	State govt. (a)	423	771	1412
	(b)	426	809	1572
	(c)	426	828	1691
3.	Private Sector (a)	522	953	1745
	(b)	527	999	1984
	(c)	527	1023	2090
	Total (a)	4750	8664	15867
	(b)	4791	9085	17706
	(c)	4791	9301	18999

Note : (a) At realised growth rate of GNP i.e. at 5 percent growth rate by 2000-01.
 (b) At moderately higher growth rate of GNP in 6 percent growth rate by 2000-01.
 (c) At higher envisaged growth rate of GNP i.e. 7 percent growth rate by 2000-01.

Annexure - 7.1

Trend in Skill Flows in Relation to Domestic Stock of Technical Manpower (1960-1985)

(Figures in '000)

Year	Engineers & Technologists		Physicians & Surgeons		Scientists		Other Professionals		All Categories					
	Domestic Stock of Technicians	Abroad	Domestic Stock of Technicians	Abroad	Domestic Stock of Technicians	Abroad	Domestic Stock of Technicians	Abroad	Domestic Stock of Technicians	Abroad				
1960	137.2	4.7	41.6	6.8	23.4	213.3	3.1	2.4	18.5	1.3	7.0	450.0	15.9	5.0
1965	245.6	9.8	60.6	8.0	13.2	347.2	4.1	1.8	55.2	2.9	5.3	731.5	24.9	3.5
1970	429.8	21.2	97.8	15.3	15.6	559.2	11.2	2.0	86.8	11.5	13.2	1174.3	59.3	5.1
1975	603.2	48.6	143.2	23.2	16.2	741.6	27.4	3.7	115.2	28.2	24.4	1603.2	127.6	8.0
1981	838.0	78.7	216.0	49.8	23.1	1349.0	48.3	3.6	310.0	62.8	20.3	2713.0	239.8	8.8
1985	936.8	106.2	268.2	65.4	24.8	1769.3	66.3	3.8	358.0	86.1	24.1	3139.6	324.0	9.5

Source :- Data for Domestic stock of S & T Manpower is taken from "Research & Development Statistics" 1984-85, Government of India, Department of Science and Technology.

LIST OF ABBREVIATIONS

AD	Anno Domini
Agrl.	Agriculture
AIIMS	All India Institute of Medical Sciences
ANMs	Auxillary Nurses/Midwives
BDS	Bachelor of Dental Surgery
BR	Birth Rate
B.Sc.	Bachelor of Science
B.VSc.	Bachelor of Veterinary Science
CERPA	Centre for Research, Planning & Action
CHS	Community Health Centre
CMO	Chief Medical Officer
CSIR	Council of Scientific and Industrial Research
CSO	Central Statistical Organisation
DGET	Directorate General of Employment & Training
DGHS	Directorate General of Health Services
DHs	Diploma Holders
DHTP	Degree Holders and Technical Personnel
DST	Department of Science & Technology
DSIR	Department of Scientific and Industrial Research
EG & W	Electricity, Gas & Water
ENT	Ear, Nose and Throat
E & T	Engineering & Technology
GDP	Gross Domestic Product
GNP	Gross National Product
Govt.	Government
GR	Growth Rate
Gynae.	Gynaecology
HRD	Human Resource Development
IAMR	Institute of Applied Manpower Research
ICAR	Indian Council of Agricultural Research
ICMR	Indian Council of Medical Research
IRDP	Integrated Rural Development Programme
ISM	Indian System of Medicine
ITI	Industrial Training Institute
LDC	Less Developed Countries
M.B.B.S.	Bachelor of Medicine & Bachelor of Surgery
MCI	Medical Council of India
M.D.	Doctor of Medicine
MH & FW	Ministry of Health & Family Welfare
MHV	Midwives & Health Visitors
M.Phil.	Master of Philosophy
M.S.	Master of Surgery
M.Sc.	Master of Science
M.Tech.	Master of Technology
NCO	National Classification of Occupation
M.V.Sc.	Master of Veterinary Science
NCST	National Committee on Science & Technology
Neg.	Negligible
NSDP	Net State Domestic Product
NSS	National Sample Survey
Obst.	Obstetrics

PC	Planning Commission
PG	Post Graduate
PGI	Post Graduate Institute
PHC	Primary Health Centre
Ph.D	Doctor of Philosophy
R & D	Research & Development
REC	Regional Engineering College
Sc.	Science
SPN	Staffing Pattern Norms
S & T	Science & Technology
T & C	Transport & Communication
TDF	Technology Development Fund
TPIC	Technology Policy Implementation Committee
UG	Under Graduate
UGC	University Grant Commission
UK & US	United Kingdom & United States
UN	United Nations
UNCTAD	United Nations Conference on Trade & Development
UNDP	United Nation Development Programme
UNESCO	United Nations Educational, Social & Cultural Organisation
UNIDO	United Nations Industrial Development Organisations
UPSC	Union Public Service Commission
USA	United States of America
UTs	Union Territories
VIM	Vaccinators, Inoculators & Medical Assistants
WHO	World Health Organisation

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