Abridged Report

Assessment of Future Human Capital Requirements in Agriculture and Allied Sectors

National Academy of Agricultural Research Management
(NAARM, Hyderabad)

and

Institute of Applied Manpower Research
(IAMR, New Delhi)

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The project could be completed in time mainly due to the contributions made by a number of organizations, individuals, experts, students, farmers and so on. Data has been collected from agricultural universities, colleges, ICAR institutions, industrial establishments, government departments, students, farmers, NGOs, and other experts- we are grateful to all of them. A number of organizations and institutions helped us in organizing Focus Group Discussions across the country, without whose support it would have not been possible for us to complete the project. We thank all of them.

We gratefully acknowledge the contributions made by Dr S.M. Ilyas and Dr P.K. Joshi former directors of NAARM and Shri R. Sridharan, IAS, former director IAMR, Dr Mrutyunjaya former ND, and Dr N.T. Yaduraju former NC in different phases of the execution of the project.

Besides, a number of officials from both the organizations involved in technical, financial, computer applications and administrative operations have continuously helped in executing the project. Consultants at state level were engaged for management of data collection and processing. Nodal officers from the universities helped us from time to time in collection of data. We put on record our sincere gratitude to all of them.

Project Investigators

Foreword

Indian Council of Agricultural Research (ICAR) is striving for the holistic development of agriculture and allied sectors through planning, promoting, conducting and coordinating research, education, extension and training for ensuring sustainable growth and development. ICAR initiated a number of programmes to shift focus of Indian agriculture from input-based to knowledge-based growth. In this paradigm shift, promotion of innovation in application of science and technology in agriculture and dissemination of knowledge plays a critical role. This is essential step to realize the goals envisaged in National Policy on Agriculture to accelerate growth in agriculture and also to generate income and employment opportunities to rural communities.

Over the years Indian agriculture had made tremendous progress, which in a large measure is due to its human resources who could harness the rapid developments in science and technology. Professional education in agriculture is of long gestation, and needs considerable advance planning. Development of technical and vocational skills necessary to support the practical application of knowledge commands equal attention. In the context of national demands and changing global agricultural scenario, identifying and developing quality human resources required at various levels is of strategic importance.

The ICAR has set in motion national projects, from time to time, to assess the future human capital requirements in agriculture and allied sciences in advance so as to put development of agricultural human capacity development on a rational footing. The present project is the latest in this direction, and has been executed by the National Academy for Agricultural Research Management (NAARM), Hyderabad and Institute of Applied Manpower Research (IAMR), New Delhi.

It gives me immense pleasure to present the project report jointly prepared by NAARM and IAMR. The report is timely and useful in preparing the future course of action on human resource development in agriculture and allied sectors. I complement the project team on bringing out such valuable document, and hope it is useful for policy planners and other professionals associated with agricultural education and development.

S. Ayyappan
Secretary, DARE and Director General, ICAR

Preface

Human resource planning is an essential element for achieving sustained growth in any sector. The significant role of agriculture sector in the development and growth of Indian economy is well recognized and well documented. The contribution of this sector to national GDP, food, nutritional and livelihood security has been phenomenal owing mainly to policy initiatives, advances in agricultural research and development aided and supported by an efficient human resource pool built and accumulated over the last five decades. In the wake of global competition in commerce and trade, climate change, natural disasters, population pressure, dynamic social changes in rural areas due to increased urbanization and many other challenges, there has been a paradigm shift in the way the issues confronting agriculture sector need to be addressed. One of the important components of the issues is the need for a qualitative and quantitative change in the human resource that is required to address the challenges. There is, thus, an urgent need to quantitatively and qualitatively assess the current stock size and status of the human resource in agriculture sector with special reference to requirement of personnel for various sub-sectors of agriculture and allied activities. Also, it is imperative to assess the future human resource needs in consonance with the targeted growth rates of the various sub-sectors of agriculture.

The present study attempts to assess the demand emanating from various sectors of employment and supply from educational institutions and project future demand and supply needs. Based on these, certain policy initiatives, strategies and mechanisms are recommended.

The forecasts provide insight into the right quantity and quality of the human resources required to maintain desired sector growth. It is hoped that the results will provoke discussion and further research into the complicated and fascinated area of strategic human resource planning. The study identifies educational strategies to improve employment opportunities in future. The study is useful in preparing the country's human capacity development plans in agriculture and allied sectors. I compliment the investigating team for bringing such a valuable document.

Arvind Kumar

Deputy Director General (Education), ICAR

Contents

Executive Summary

Trained human resource is an essential need in different sectors of agriculture for achieving targeted growth. The sectors are to be serviced by manpower with higher skills than before to ensure technology generation, its transfer to and more importantly its application at the grass root level. Further, manpower with diverse skills is today required by a wide-ranging and fast expanding food processing industry, corporate and unorganized sector. In this context, forecasting of future agricultural manpower requirements assumes considerable significance in identifying the trends and visualizing the emerging technologies and the corresponding needs for the appropriate manpower mix. The assessment of existing manpower, the sectoral growth, capacity utilisation of qualified graduates is indispensable to envisage the future agricultural education needs. The NAIP supported project entitled "Assessment of Future Human Capital Requirements in Agriculture and Allied Sectors" was visualized in this context.

The objectives of the project are:

- To assess the trend in supply-demand of trained manpower in agriculture
- To evaluate institutional set up and the impact of diversification of agriculture on skill requirements
- To develop a system dynamics model for forecasting and evolve prospective human resource development strategies.

To meet the above objectives, quantitative and qualitative data was collected by organization of a series of nationwide surveys and Focus Group Discussions. The issues relating to employment, skills needed for employment in public and private sectors and educational strategies to develop appropriate manpower etc. were addressed. The survey responses were received from all agricultural universities, 4880 employees with degree in agricultural sciences, 2100 alumni, 3500 industrial organizations employing agricultural graduates. About fifty Focus Group Discussions have been organized with various stakeholders. The survey data in conjunction with secondary data were used to forecast future human capital requirement for 2020 and also to draw strategic plans for future educational requirements.

A system dynamics model has been developed for forecasting supply-demand scenario of agricultural manpower requirement in different sectors viz. government, private, academic, financial institutes, non-governmental organizations, self-employment, and others (non-agriculture) in India. The model results have been compared with the actual values to validate the efficacy and relevance of model simulation to depict the reality.

The broad results point to a shift in demand for agricultural human resources from public to private sector. In 2010, the shares of various segments by employment are: 33 per cent in government, 44 per cent in private, 10 per cent in financial, 4 per cent in research and academic and 9 per cent in others. The major shift in the past three decades is decline in the share of public sector in employment, which may be due to freezing employment in government sector as well expansion of opportunities in the private sector. This is in tune with the emergence of commercialisation as well as diversification.

The results show that there were substantial gaps between demand and supply of manpower in agricultural and allied sciences to the tune of 50 per cent . The shortfall is high in the case of rapidly growing sectors such as horticulture, dairy, veterinary and fisheries. These sectors are also the potential future engines of growth that would require substantial trained manpower to achieve targeted growth.

At present, the existing education system is producing about 24,000 graduates per year of which two-third are in crop sciences stream. The projections indicate that by 2020 the annual outturn required would have to be about 54,000, i.e., the demand supply gap would be 30,000. Discipline wise, the additional annual requirements of outturns are expected to be: Agriculture-9335; Horticulture 7153; Forestry 1116; Dairy 3005; Veterinary & Animal Husbandry 4989; Fishery 2181; Agricultural Engineering 1749; and Agricultural Biotechnology 305. **During the last decade, outturn of graduates and above grew at the rate of 5 per cent and in the coming decade it is projected to grow at twice the growth observed in the last decade to meet the demand.**

To handle a variety of day to day jobs of counselling and rendering routine assistance to the farmer, there should be 'bare foot technicians' who need to be equipped with multiple skills – not only in regard to farm practices, simple and routine veterinary services, routine testing services, and various other rural occupations but also on aspects like agro-processing, marketing, escort services, etc. Such skills need to be developed among the rural youth themselves, preferably targeting school drop-outs, as youth from urban areas or with higher education shy away from working in rural areas. **Special effort is needed to promote diploma level education on the lines of engineering education. Initiatives for the future demand-driven growth in agricultural education at the diploma and undergraduate levels should be left to the private sector or should be taken in a public- private partnership mode.**

An important aspect of educational planning is to ensure availability of faculty in adequate numbers and quality with institutional arrangements for systematic up-gradation of their knowledge and skills. About 40 per cent of the faculty positions in the agricultural universities have remained vacant for long periods of time raising questions about the quality of education.

Results indicate the need for skill up-gradation in the light of technological innovations as well as skill development in the emerging areas in the sector. An indicative list of skills to be developed has been provided in the report. There is a strong demand from all the stakeholders for skill-specific education with clarity of basics as well as hands-on technical expertise. In other words, **there is a need to develop functional skills among the students in educational institutions almost in all the sectors of agriculture.**

Proper database management is vital for educational planning. The databases like NISAGENET should be updated regularly. The database - PERMISNET should be made accessible to outside researchers in a restrictive manner. **A centralized data-centre may be established that will serve as storehouse of all information relating to skilled human resource capital in various components of Agriculture sector to facilitate planners and administrators for informed policy making and optimum utilization and management of available human resources.**

Agriculture has to meet the needs of the society at various levels. It has to serve the requirements of the farmers as well as of the industries. It also has to keep pace with youth aspirations. It is the sole agent to ensure food security. Appropriate policy interventions for developing skills needed as per labour market indicators should be given a serious thought along with a revamp in educational expansion and its structure.

Chapter-1

Introduction

1.1 Agriculture Scenario

Agriculture sector is the mainstay of Indian economy ensuring food security and providing livelihood to millions involved either directly or indirectly with this sector. This sector has a strong mutually beneficial interface with the industry sector. Notwithstanding its declining share in country's GDP, agriculture continues and will continue to be the key to nation's growth and development. Considerable efforts are needed to evolve strategies to accelerate development through research, transfer of solutions to the masses. and skill development as well as adequate skill up gradation. **Hence, the need for assessment of human resources required at various levels.**

1.2 Agriculture Education

In the public system, agricultural research and education activities are coordinated by ICAR at national level and State Agricultural Universities (SAUs**)** at state level. Today, there are about 61 agricultural universities, which include one Central Agricultural University and four research institutes in agriculture and allied sciences with the status of deemed-to-be universities. In all, there are more than 436 colleges in the country (383 in SAUs, 53 colleges in 25 other universities) which impart education in the field of agriculture and allied sciences. All these institutions together have annual intake capacity of about 35000 graduates and produce about 24,000 in agricultural and allied sciences. Thus, India has a large network of education in agriculture by having facilities for education in 13 disciplines at undergraduate level and more than 95 subjects at postgraduate level through constituent and affiliated colleges/faculties. Two-year diploma and short duration certificate courses are also offered by some agricultural universities.

1.3 Overview of the Present Study

The present study has been commissioned by ICAR as a NAIP project. The project has been implemented by NAARM Hyderabad, and IAMR, New Delhi as partners over the period 2009-2011. The study is aimed at assessment of human capital requirements in agriculture and allied sectors, namely, agriculture, horticulture, forestry, veterinary, fishery, dairy, agri-engineering and agri-biotechnology. Separate projections have been made for sub-sectors of each sector.

1.3.1 Objectives

Skill needs are dynamic and change with time and situation. It is therefore required to analyze the skill gaps, the institutional mechanism in imparting education and assess the future requirements of the sector in relation to the human capital. Keeping this in view the present study is carried out with the following objectives.

- To assess the trend in supply-demand of trained manpower in agriculture
- To evaluate institutional set up and the impact of diversification of agriculture on skill requirements
- To develop a system dynamics model for forecasting and evolve prospective human resource development strategies.

1.3.2 Conceptual Framework

The broad conceptual framework of the study, comprising supply-demand process is schematically presented in Fig-1.1.

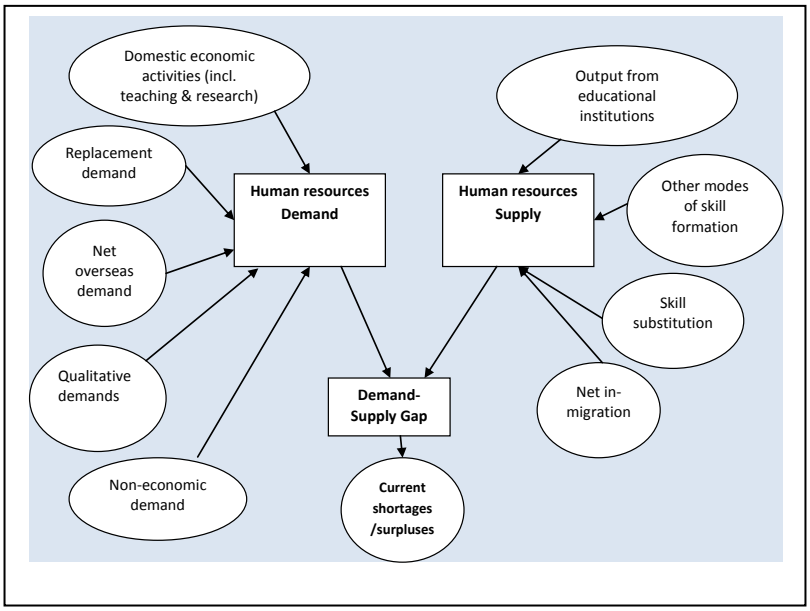

Fig-1.1: Supply-Demand Process

1.3.3 Approach for Demand Forecast

The two basic issues to be addressed through this project are a) to make a forecast of the number of graduates, postgraduates and doctorates (collectively called high level human resources), b) to assess the needs of human capital at sub-graduate level, the number likely to be available over the next ten years, and the quantitative and qualitative skill gaps. With 2009-10 as the base year, the forecast horizon is taken as 2009-10 to 2019-20.

1.3.3.1 Forecast of Demand

In view the massive and diverse nature of the system of human capital utilization in agricultural and allied sectors and the data availability constraints, the **Parnes' approach** (with certain adaptations) has generally been adopted for generating quantitative forecasts. This is supplemented by use of **normative approach** where necessary. The projections have been derived through the following steps:

a) Important sub-sectors have been identified in each sector of the agriculture and allied disciplines (such as crops, horticulture, etc.). Such sub-sectors, for instance, include government services, finance, processing industry, research and education, etc.
b) The target reference points (such as growth rates) in each of these sub-sectors are considered as specified in Plan and other official documents or, where such targets are not available, have been derived on the basis of growth in the recent past.
c) Total employment in each sub-sector in the base year (2009-10) has been estimated, if not available from the existing sources, using either normative approach or trend analysis.
d) The total employment has been broken down into educational requirements of stock on the basis of primary data specially collected in the Project. It is generally assumed that the current pattern of employment holds good for future years also. However, wherever deemed necessary on the basis of expert views expressed in Focus Group Discussions, a judgmental approach has been followed to slightly modify the proportions.
e) The stock projections have been converted to flow projections. The flow projections consist of Annual increment in the stock.
f) The replacement needs (due to factors such as retirements, deaths, migration, etc.) taken as 3 per cent of the previous years' stock.
g) The requirements of higher education. This component takes into account the fact that the alumni at any level do not all enter the labour market straightaway and a significant proportion of them pursue higher education and become available to economic activity only after certain number of years.

In all the sectors of agriculture, forecasts have been made over two scenarios - one (low) considering the current growth of the sector and sub sector and another (high) relatively higher growth envisaged by planning commission, their schemes and flag ship programmes, vision of various sectors, etc. The study after providing the forecasts on the basis of these two scenarios, recommends average of the two.

In addition, qualitative aspects of human capital needs have been captured through **Focus Group Discussions** with various stakeholders, experts and opinion surveys of employed and unemployed agricultural human resources.

1.3.3.2 Forecast of Supply

The supply of agricultural human resources is assessed based on the annual institutional output over the years. In the absence of a comprehensive database on output from agricultural institutions, special efforts became necessary to collect the relevant data from all the academic institutions besides taking data from NISAGENET, IASRI.

To assess the base year (2009-10) stock, active span of 37 years and annual attrition of one per cent are assumed. For the base year supply stock of agricultural human capital in the country is done indirectly through cumulating of institutional outturns for the period 1973-74 onwards. The estimates of supply have been projected till 2019-20 under assumption that the outturn levels will grow at the same rate as the growth observed during last five years (i.e., 2005-06 to 2009-10) beginning with average outturn during that period.

1.4 Study Activities

In the light of set of objectives and the data needs indicated above, the following activities were organized as a part of the Project:

i. Establishment survey – 3439 establishments in 103 districts
ii. Survey of all SAUs
iii. Tracer Surveys – 2105 alumni
iv. Individual Experts Survey - 4881 experts
v. Focus Group Discussions – 50 Nos
vi. System Dynamics Model

1.5 Educational Strategies

The projections comprise several components, namely, current stock, future need by sector and occupation. For each occupation there is an estimate of current employment and future development trend. Experts' views are taken into consideration while validating the final projections. Educational strategies are then developed from these outcomes. Educational strategies were tested as various policy options in the simulation model.

Assumptions

- **Implementation of various flagship programmes of the Government of India in terms of like Horticulture Mission, watershed, there would be a need for professionally qualified personnel.**
- **To meet the target of agricultural growth, government will adopt pro-active policies and their implementation.**
- **The booming allied sectors of agriculture such as horticulture, dairy, etc., will continue the pace of development which would have positive impact upon human capital needs.**
- **The vacant positions will be filled up at a faster rate to meet the needs of agriculture sector.**
- **Government and other state-level organizations will take pro-active measures to establish a network of institutions that would cater to the requirement of technically trained human capital needs.**

Chapter - 2

Opinions of Stakeholders on Agriculture Issues

To develop a basis for estimation of agricultural human resources, both quantitative and qualitative data was collected from **Focus Group Discussions** with experts, agricultural establishments, individual agricultural graduates in such establishments, and agricultural graduates in recent years. Major observations, issues and perceptions that emanated from these efforts are given below.

- Overall unemployment rate of agri-graduates is low (4 to 5 per cent) for fresh graduates. More than 90 per cent graduates get employment within six months of their graduation and the remaining in a year's time.

- Employment in government, research and academics are the most preferred. However, due to near zero recruitment in these sectors in recent years, a large number of the graduates are looking for employment in the non-government sectors, where the opportunities are growing. This scenario is expected to continue as the government establishments do not foresee much growth.

- Most of the industrial / private establishments indicated expansion plans to diversify products, introduce technological changes and modernize the organizations. It is envisaged that the employment of graduates is likely to increase by seven per cent over the next 10 years.

- A major concern has been raised about the frequent change of job by the agricultural graduates. It adversely affects the business. As a result, for various field related work and other operations, industry is employing general degree holders and diploma holders, even in positions requiring agricultural graduates.

- It is widely experienced that the quality of graduating students is continually declining affecting their employability. This phenomenon is attributed to unplanned growth of institutes, poor intake quality, shortage of teaching staff, inadequate infrastructure, lack of practical orientation, poor industry interaction, less exposure to recent advances, and lack of soft skills.

- Most of the students join the agriculture stream not by choice but out of compulsion affecting their performance at a later stage. Initiatives, are therefore, required to introduce agriculture as a subject at school level so that students with real aptitude for the sector would develop interest and opt for this sector later. Media can play an important role in this endeavour.

- Industries, in general, prefer diploma / certificate holders as more job opportunities are at lower and middle levels requiring skill specific to them. Bulk of the students completing +2 stage and those who do not opt for higher education (about 88 per cent), can be targeted for these short-term courses which are crop-specific,

technology-specific and agro-industries-specific. The SAUs could provide support and guidance to such initiatives.

- Some sub-sectors like retail, seed and processing industry are growing at a faster rate, and this momentum is expected to be retained under new order of economic development in coming years. This in tandem with other emerging areas such as information technology, quality management, technology management etc., would impart pressure on demand of skill specific human resources in related disciplines.

- There is a greater demand for practice-oriented agricultural education from industries as well as from students. Teaching strategies should be modified and programmes like farm-industry linkages and university-industry-farm linkages are to be emphasized. In this regard emphasis on Public Private Partnership is necessary**.**

- Entrepreneurship development has to begin at college. The students coming out of the universities/colleges should be helped and linked with government schemes especially those who are interested and have aptitude to start their own enterprises. To facilitate this, courses like project planning, finance, etc., need to be included in curriculum.

- Industry employs women graduates preferably for desk and research work. A greater proportion of female graduates, therefore, go in for higher studies.

- Veterinary and animal husbandry subjects may be treated differently as two different disciplines as in developed countries. This may to some extent meet the requirement of the trained human resources in this sector facilitating higher intake for the animal husbandry stream.

The qualitative inputs from the experts as given above were considered while framing the future requirements.

Chapter - 3

Human Capital Assessment in Agriculture (Crops) Sector

3.1 Introduction

The Crop sector constituted nearly 60 per cent of agricultural GDP and contributes 14 per cent to the national economy. Crop sector is the largest sector in agriculture and is key to nation's food security and stimulate agricultural growth. For this sector projections of human capital have been made for development departments (Government), extension, research, academic sub- sector, seed sub- sector, fertilizer industry, pesticide industry, financial services, insurance, processing, agricultural marketing and others.

3.2 Supply of Graduates

Though the term agriculture includes all allied sectors, it is often used to refer to the crop or plant sciences. There are 184 colleges (including 83 in SAUs, 68 affiliated to SAUs and 33 others) providing education in agriculture (i.e., crop science or plant science). The Admitted strength of various agriculture colleges in SAUs and general universities is about 4350 in diploma and 21300 in UG and above (Table-3.1). The annual out turn from all the colleges is about 3230 in diploma and 16000 in graduate courses. More than 40 per cent under-graduate students come from the private colleges, whereas PG/PhD is largely confined to public system.

Table-3.1: Students Admitted and Passed in Agriculture Courses During 2009-10

System	Diploma		UG		PG		PhD		UG & above	
	Adm	Pass	Adm	Pass	Adm	Pass	Adm	Pass	Adm	Pass
SAU's	4348	3235	10429	8136	4373	2809	1125	583	15927	11528
Other	-	-	4476	3716	898	705	-	-	5374	4421
Total	4348	3235	14905	11852	5271	3514	1125	583	21301	15949

3.2.1 Current Stock of Human Resources in Crop Sciences

The stock from supply side is estimated from the outturn of graduates in the past 37 years. The total stock of graduates and above in agricultural (crop) sciences, estimated from annual supplies, is about 1,88,708 in 2010.

3.3 Demand Projections of Stock

The overall stock requirement for different sub-sectors considering average growth scenario is given in Table-3.2.

The overall stocks of crop science human resources required to meet the demands of various segments of crop sciences have been added up to give overall projections for various years up to 2019-20. Education level wise distribution of total stock is presented in Table-3.3.

Table-3.2: Stock Requirement for Human Resources in Crop Sciences

Sub-sector	2009-10		2019-20	
	Diploma	UG & above	Diploma	UG & above
Development Depts.	27600	78000	31280	88400
Extension	4580	32421	5182	40891
Research	-	1700	-	2200
Academic	-	4000	-	4794
Seed	327	5810	690	12266
Fertilisers	508	6875	590	7987
Pesticides	217	1943	252	2257
Finance	2454	37928	3227	49872
Insurance	-	2125	-	2250
Processing	41430	92516	48134	107486
Agri-marketing	2000	3000	12000	13000
Others	7911	26242	10135	32675
All	87028	292549	111489	364064

The stock of diploma holders would grow from 87000 in 2010 to about 111500 in 2020. On the other hand the requirement for graduates and above would grow from about 2,92,550 in 2010 to about 3,64,060 in 2020.

3.3.1 Demand – Supply Gap in Stock

In 2010, the actual stock from supply is 1,88,708. Assuming outturn levels will grow at the same growth rate as observed during the last five years (i.e.,, 5.3per cent during 2006-10), the estimated demand – supply scenario in 2020 will be

Supply: 2,64,280
Demand: 3,64,064
Gap: 99,785 (27.4 per cent of demand)

3.4 Demand Projections of Annual Flow

The overall annual flow required at various educational levels of crop sciences is shown in Fig-3.1. The projections suggest that by 2020, the annual outturn from the agricultural crop

science education system should be about 5800 diploma holders, 18,660 under-graduates, 5,420 post-graduates and 1200 doctorates.

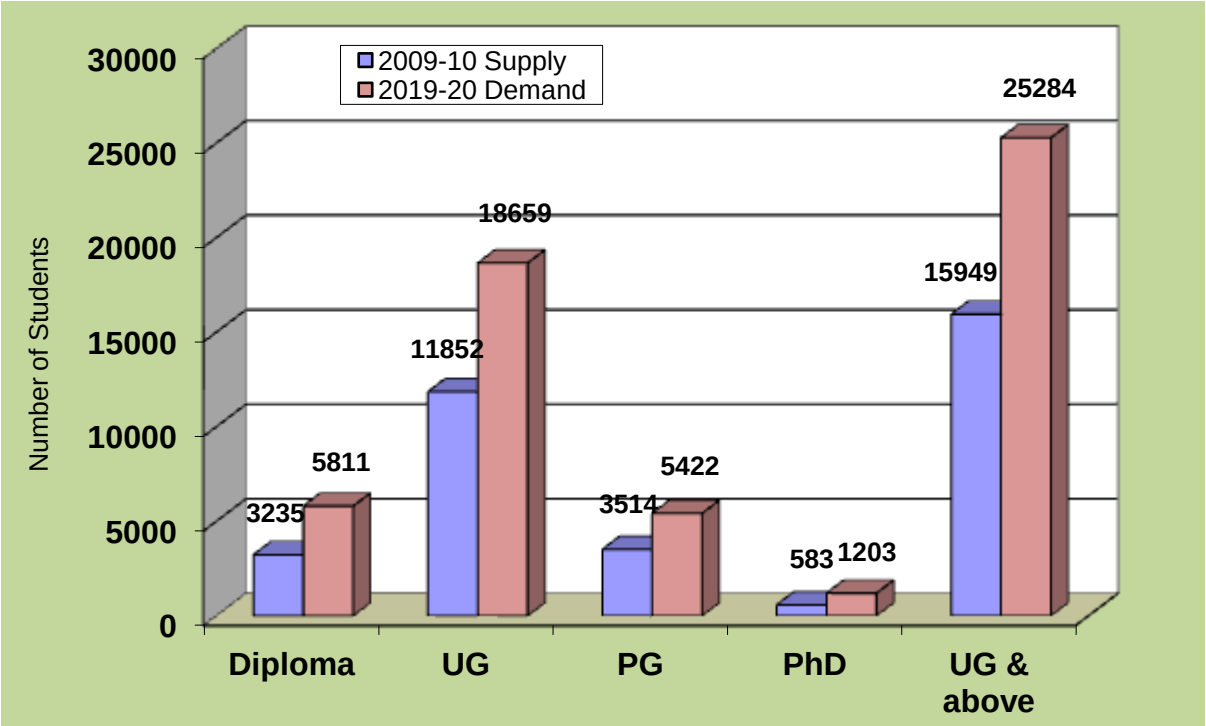

Fig-3.1: Current (2010) and Projected Outturn Required (2020) in Crop Sciences

3.5 Summary

Current annual out turn of about 16,000 graduates is less than the requirement of 25,300 by 2020. There is need to expand agri-education to produce additionally 9,330 graduates (6810 UG; 1900 PG and 620 PhD) per year by 2020. This needs opening up of number of additional colleges across the country. Taking the experience of private sector colleges in Maharashtra and Tamil Nadu, there is need for more serious dialogue on entry of private sector to maintain quality in agri-education. The issues relating to course syllabus, effective teaching strategies, functional skill development and quality of teachers need appropriate policy interventions while considering expansion of agricultural education.

The annual supply for diploma holders is about 3230 in 2010 and the requirement would grow to 5810 by 2020. However, as bulk of private sector is keen to have more diploma level persons, the requirement would be much more if more diploma holders are available. In such case, diploma holders would be preferred in place of general graduates now being employed by many employers, especially for some field based rural jobs. Bulk of the diploma holders are needed for micro-level organizations and this requirement is being reflected separately.

Chapter - 4

Human Capital Assessment in Horticulture Sector

4.1 Introduction

The horticulture sector constituted nearly 20 per cent of agricultural GDP and contributes 4 per cent to the national economy. It is one of the fastest growing sectors in agriculture and is a thrust area to stimulate agricultural growth, spurred by the changing domestic food habits towards more nutritious food and increasing overseas demand. In horticulture sector projections for human capital requirements have been worked out for nurseries, seed sector, production, cold storages, processing, dev. & extension., banks, research and others.

4.2 Supply of Graduates

Horticulture education is offered at 46 colleges (35 in SAUs, 8 affiliated to SAUs and 3 others). 14 SAUs have facilities for education in this field at graduation level and 32 at post-graduation level. At post-graduate and doctoral level courses are open not only to the graduates in horticulture but also to graduates from a number of other disciplines such as general life sciences and plant sciences. Current admitted strength in horticulture education is given in Table-4.1. The intake capacity has sharply increased from about 1100 in 2000-01 to about 3000 in 2009-10 with expansion of intake in SAUs, including entry of private colleges affiliated to SAUs and other general universities. Against actual admitted strength of about 2383 during 2009-10, 1465 passed.

Table-4.1: Students Admitted and Passed in Horticulture Courses During 2009-10

Diploma		UG		PG		PhD		UG & above	
Adm	Pass	Adm	Pass	Adm	Pass	Adm	Pass	Adm	Pass
172	10	1602	1001	653	409	128	55	2383	1465

4.2.1 Current Stock of Human Resource in Horticulture Sciences

The total stock of graduates and above in horticulture sciences, estimated from annual supplies, is about 14,179 in 2010.

4.3 Demand Projections of Stock

Stock estimates for various sub-sectors of horticulture for the year 2009-10 and 2019-20 are given in Table-4.2. The education level wise distribution of the total stock is given in Table 4.3.

Table-4.2: Estimated Stock Requirement of Horticulturists in Various Sub-sectors

Sub-sector	2009-10		2019-20	
	Diploma	UG & above	Diploma	UG & above
Nurseries	1688	9815	2083	11996
Seed Companies	56	1054	83	1560
Production	124373	13805	147615	16385
Cold Stores	-	5478	-	17163
Processing	2064	8373	4557	18235
Development& Extn	4695	15006	4695	15006
Banks	142	1617	365	4139
Research	-	1200	-	2000
Academic	-	600	-	768
Others*	13302	5635	15917	8650
All	**146320**	**62583**	**175315**	**95902**

*Others include NGOs, Agri-services, Agri-clinics, Landscaping and Parks

Table-4.3: Estimated Requirement Stocks of Horticulturists by Education Level

Year	Diploma	UG	PG	PhD	UG & above
2009-10	146320	50005	9325	3254	62583
2019-20	175315	79731	11432	4738	95902

4.3.1 Demand – Supply Gap in Stock

In 2010, the actual stock from supply is 14,179. Assuming the outturn levels will grow at the same growth rate as observed during the last five years (i.e.,, about 15per cent during 2006-10), the estimated demand – supply scenario in 2020 will be

Supply: 26,030
Demand: 95,902
Gap: 69,872 (73per cent of demand)

4.4 Demand Projections of Annual Flow

Considering the current supply (in 2010) and experts' opinions on graduates' aspirations and employee organizations capacity to absorb graduates, the average variant projections for annual flow in 2020 are given in Fig-4.1.

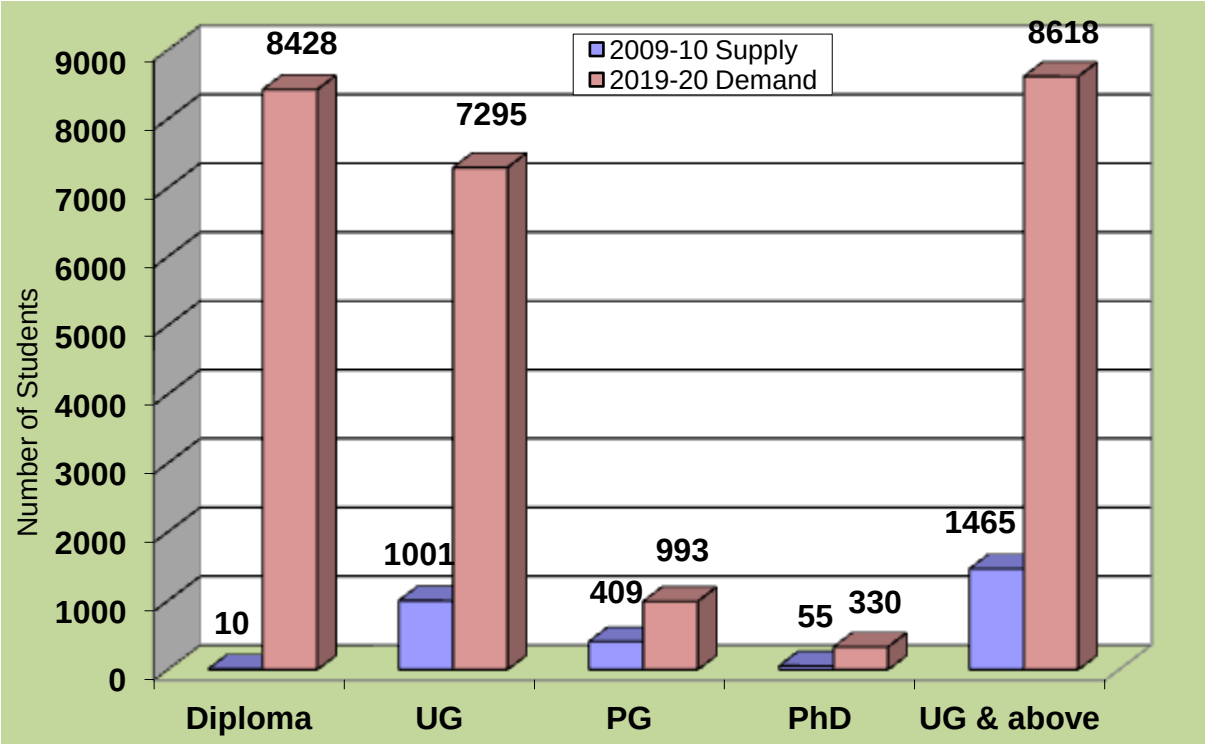

Fig-4.1: Current (2010) and Projected Outturn Required (2020) in Horticulture

The projections suggest that by 2020, the annual outturn from the horticultural education system should be about 8400 diploma holders, 7300 under-graduates, 990 post-graduates and 330 doctorates. Current supply of about 1500 per year is far below the requirement of 8600. However, part of the requirement is met from other graduates – forestry, crop science and general science graduates, especially in the non-government sectors.

4.5 Summary

The sector has capacity to augment the stock of human capital from current level of 14,179 in 2009-10 to about 95,902 by 2020. The annual supply would have to increase from the current level of 1500 to 8600, i.e., 7100 additional graduates (6200 UG; 600 PG and 300 PhD) per annum. The sector promises tremendous opportunity for expansion in education.

Often, graduates in crop sciences, forestry, general life sciences (botany), bio-technology and other streams are employed in jobs seemingly requiring horticultural qualifications. This is so in almost all spheres of horticulture - in both public and private sector, except in research and education. On this consideration, at under-graduate level, the requirements of core horticultural graduates may be about 4,000 by 2019-20. Even on these conservative estimates, there is a need to double the human resources supply in this sector. In other words, the horticulture education needs to expand to produce an additional 2500 under-graduates in the next decade.

Chapter-5

Human Capital Assessment in Forestry Sector

5.1 Introduction

Forests contribute about two per cent to the nation's GDP. More than 100 million rural people depend on the sale of non-timber forest products for their livelihood. It is estimated that small-scale enterprises based on non-timber forest products provide up to 50per cent income for 20per cent-30per cent of the rural labour force. In forestry sector projections for human capital requirements have been worked out for government & extension, Forest Development Corporation, research, academics, forest-based industries and other miscellaneous sectors.

5.2 Supply of Graduates

The Indian Council of Forestry Research and Education, Dehradun, an umbrella organization under the Ministry of Environment and Forests, Government of India, is actively engaged in forestry education, research and knowledge dissemination through its eight research institutes and three advanced centres all over India. At present, there are 37 institutions offering forestry education at various levels – 26 from agricultural universities and 11 institutions from general universities and central institutes.

The current (2009-10) intake and outturn in forestry is given in Table-5.1. Against 1160 admitted to various courses in forestry, the outturn is 716.

Table-5.1: Intake and Outturn of Students in Forestry Courses

System	UG		PG		PhD		UG & above	
	Adm	Pass	Adm	Pass	Adm	Pass	Adm	Pass
AUs	562	386	210	126	57	13	829	525
Others	25	0	196	149	110	42	331	191
Total	587	386	406	275	167	55	1160	716

At below graduate level, the training of foresters and forest guards has always been the responsibility of the State Governments. Currently, there are about 48 training schools in the States for imparting training to the Foresters and Forest Guards.

5.2.1 Current Stock of Human Resource in Forestry Sciences

The total stock of graduates and above in forestry sciences, estimated from annual supplies, is about 5005 in 2010.

5.3 Demand Projections of Stock

For the purpose of projections the forestry sector has been divided into different segments that employ forestry-educated persons on functional basis. The primary areas are for conservation and development of forests by Central and State governments, various industries based on timber and other forest products and NGOs. Estimated stock requirement in various subsectors is given in Table-5.2. The estimated stock requirements for average scenario in 2010 and 2020 are presented in Tables-5.3.

Table-5.2: Estimated Stock Requirement in Various Sub-sectors

Sub sector	2009-10		2019-20	
	Diploma	UG & above	Diploma	UG & above
Development & Extn	12508	8913	13342	11933
Forest Dev Corp	910	649	971	868
Industry	2752	14165	2752	14165
Research	-	125	-	138
Academic	-	244	-	390
Others	809	1363	853	1549
All	16979	25458	17918	29043

Table-5.3: Projected Stock Requirement of Forestry-educated Persons

Year	Diploma	UG	PG	PhD	UG & above
2009-10	16979	17512	4548	3399	25458
2019-20	17918	19788	5450	3806	29043

5.3.1 Demand – Supply Gap in Stock

In 2010, the actual stock from supply is 5005. Assuming the outturn levels will grow at the same growth rate as observed during the last five years (i.e., about 8per cent during 2006-10), the estimated demand-supply scenario in 2020 will be

Supply: 8148
Demand: 29,000
Gap: 83 per cent of the demand

5.4 Demand Projections of Annual Flow

The annual outturns required from the educational institutions to lead to the stock worked out above are presented in Fig-5.1. The outturn required from forestry educational institutions at

graduate and above level is projected to increase from about 386 to 1260 in the case of under-graduates, 275 to 416 in the case of post-graduates and from 55 to 156 in the case of doctorates over the projection period, i.e., 2010 to 2020.

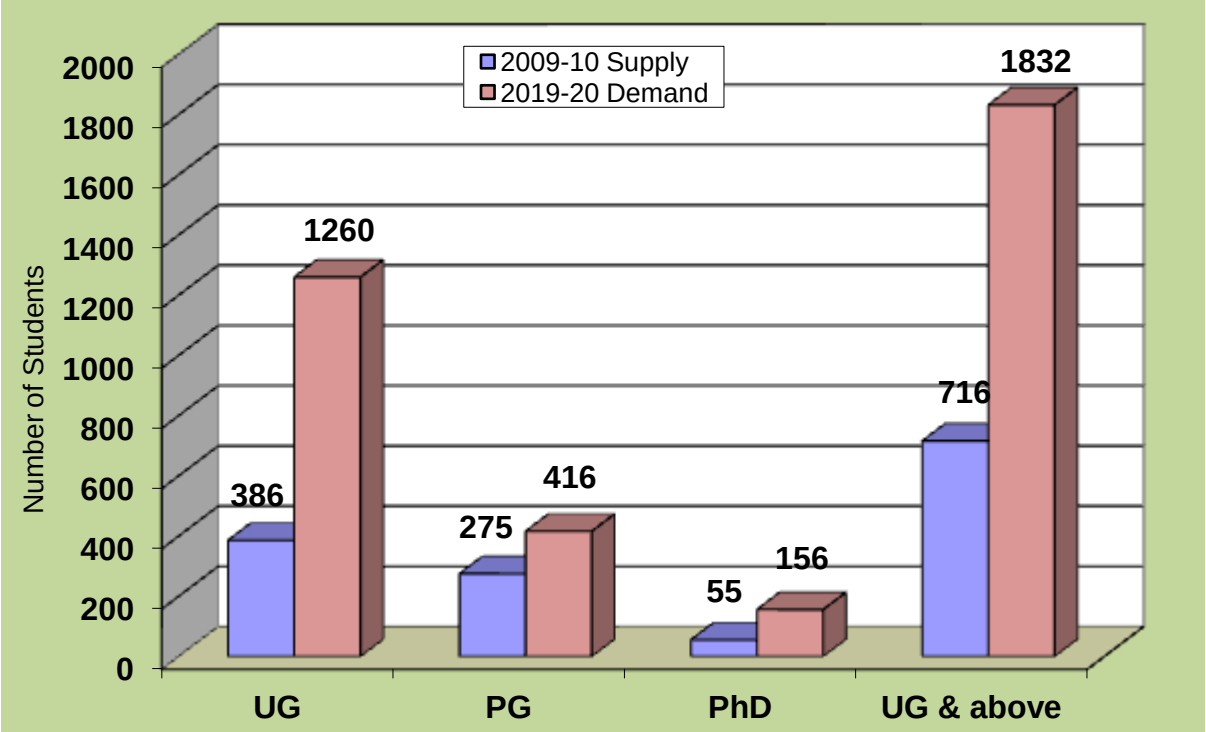

Fig-5.1: Current (2010) and Projected Outturn Required (2020) in Forestry

5.5 Summary

The stock of forestry graduates and above is estimated to increase from about 25,500 in 2010 to 29,000 by 2020. Against the current annual supply of about 720 forestry graduates, the annual demand will increase to about 1830 by 2020, i.e., 1100 additional graduates (860 UG; 140 PG and 100 PhD). In fact, the current intake capacity is about 1300 and students are not readily opting for this course as they are not getting attractive jobs comparable to their colleagues from other streams in SAUs. Apparently there is no economic sub-sector in forestry to absorb the graduates in this discipline, unlike in other disciplines such as horticulture, fishery, etc. In absence of proper initiatives and statutory support, the forestry graduates may not get most jobs and they would shift to various other occupations. In such scenario, further expansion of education is not desirable. As employers are in need of field personnel for technical support, the expansion can be thought of at diploma level. *The rural institutions like Van Vigyan Kendras and Joint Forest Management activities at grass root level and a host of government schemes aimed at forest and tribal areas, need forest trained persons at village level. This requirement can be met by diploma holders*.

Chapter – 6

Human Capital Assessment in Veterinary and Animal Husbandry Sector

6.1. Introduction

Livestock sector has emerged as an important sub-sector of Indian agriculture for ensuring food security and offering livelihood security millions dependent on it. The contribution of the livestock sector to the Gross Domestic Product was 4.2 per cent in 2007-08 at 1999-2000 prices. While the contribution of agriculture as a whole to GDP has halved from about 35 per cent in 1980-81 to about 16per cent in 2007-08, the share of livestock sector ***within agriculture*** doubled from 14 per cent to 26 per cent during the same period. Over the period 2000-01 to 2007-08, the GDP from livestock sector grew at a rate of 4.2 per cent per year, and this has been achieved despite the fact that investment in this sector was not substantial. The projections for human capital requirements have been worked out for public vet. services, private vet. Services, research, academics, animal feed industry, dairy industry, vet. pharmaceuticals, animal breeding, meat processing, financial institutions, para vets. and others.

6.2 Supply of Graduates

Education in the field of Veterinary Science and Animal Husbandry, the undergraduate course is of 5 years' duration and veterinarians have to register with the Veterinary Council of India (VCI), a statutory body constituted by the Government of India.

There are at present 48 colleges offering courses in veterinary sciences and animal husbandry. Of the 48 existing colleges, 46 are part of the Agricultural Universities and ICAR, one under general university, one in the private sector and nine more being established this year in private sector. The intake and pass data is given in Table-6.1. The annual intake and outturn of veterinary graduates is currently about 3521 and 2683, respectively.

Table-6.1: Students Admitted and Passed in Veterinary Sciences Courses During 2009-10

Diploma		UG		PG		PhD		UG & above	
Adm	Pass	Adm	Pass	Adm	Pass	Adm	Pass	Adm	Pass
4925	3136	2358	1761	933	797	230	125	3521	2683

6.2.1 Current Stock of Human Resource in Veterinary Sciences

The total stock of graduates and above in veterinary and animal sciences, estimated from annual supplies, is about 40,232 in 2010.

6.3 Demand Projections of Stock

The stock requirement of veterinarians was computed assuming that the demand would grow at the same rate as GDP. The sub-sector wise demand of veterinarians for the year 2009-10 and 2019-20 is given in Table-6.2. The stock requirement by education level is given in Table 6.3.

Table-6.2: Estimated Stock Requirement of Veterinarians in Various Sub-sectors

Sub sector	2009-10		2019-20	
	Diploma	UG & above	Diploma	UG & above
Public services	13068	22000	16718	28192
Private services	6000	4000	12000	10000
Feed Industry	1953	2247	5066	5828
Pharma industry	24	1176	62	3050
Dairy industry	500	500	895	895
Meat processing	161	1020	418	2647
Animal breeding	78	922	156	1785
Finance	-	3500	-	4480
Research	-	1200	-	2000
Academic	-	1944	-	2990
Others	2179	3657	3531	5889
All	23963	42166	38846	67756

Table-6.3 : Overall Projections of Requirements Stocks of Veterinarians

Year	Diploma	UG	PG	PhD	UG & above
2009-10	23963	28772	8873	4521	42166
2019-20	38846	45395	15042	7319	67756

6.3.1 Demand – Supply Gap in Stock

In 2010, the actual stock from supply is 40,232. Assuming the outturn levels will grow at the same growth rate as observed during the last five years (i.e., 4.3per cent during 2006-10), the estimated supply and demand in 2020 would be:

Supply: 48,433
Demand: 67,756
Gap: 28.5 per cent of the demand

6.4 Demand Projections of Annual Flow

The annual outputs required from the educational system to lead to the above stocks are given in Fig-6.1. The current supply (in 2010) of 2683 is thrice less than the estimated flow of 7672 needed by 2020. The annual outturn required from the veterinary science education system by 2020 should be about 5300 under-graduates, 1800 post-graduates and 490 doctorates.

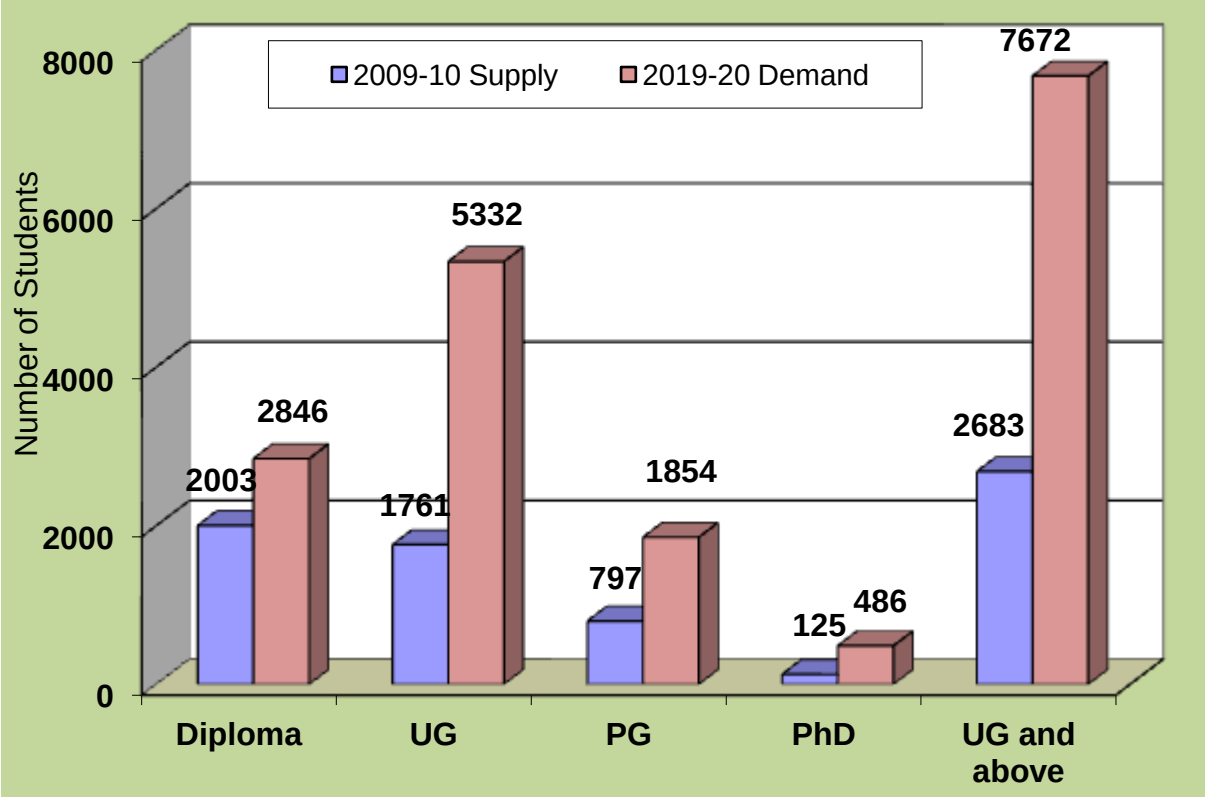

Fig-6.1: Current (2010) and Projected Outturn Required (2020) in Veterinary and Animal Sciences

The requirement of diploma holders would grow from 2000 in 2010 to 2850 in 2020. This excludes requirement for diploma holders in dairy, which is given separately in the dairy sector report. The current supply of diploma holders is about 3136. As the requirement for diploma holders in dairy sector is of order of 6,00,000 in total, there is urgent need to plan and establish large number of polytechnics to develop diploma holders across the country.

6.5 Summary

The stock of veterinary under-graduates, post-graduates and doctorates in the country is projected to go up from 42,000 in 2010 to about 68,000 by 2020, i.e., an increase of about 2500 per year during 2010-20. The required annual outturn of 7670 in 2020 as compared to the current annual supply of about 2700 demands massive expansion in veterinary education, i.e., additionally 5,000 graduates (3600 UG; 1050 PG and 350 PhD) per year.

Considering the demand for veterinary graduates, there is a need to double the intake at UG level. Ten more colleges that are being recently established across the country would not meet the requirement. It may be noted that, the existing colleges are not having sufficient faculty to teach as per the VCI guidelines. Thus, further expansion of education in this sector needs firm commitment on investment towards infrastructure so as to meet VCI requirements. As suggested by some experts, part of the demand can be met from separate course in animal husbandry.

As public system is under-staffed and cannot meet the demand for vets and para-vets, it is necessary to open the education to private sector under PPP mode so as to maintain quality in education. There is a greater demand for functional skills among the students that are coming out of educational system.

The need for para-vets is seen in both in public and private sectors, more in private than public due to expansion of veterinary services in the private sector and also industry demand for low level trained persons at field level. The study recommends more state support for development of para staff under public-private partnership.

Chapter - 7

Human Capital Assessment in Fishery Sector

7.1 Introduction

Fisheries sector plays an important role in the national economy and in the socio-economic development of the country. According to Livestock Census 2003, as many as 14.49 million persons in the country depend on fisheries sector for their livelihood. The sector contributed (in 2007-08) about 0.8 per cent to the total GDP and 4.5 per cent to agricultural GDP. In fisheries sector projections for human capital requirements have been worked out for fish processing, fish seed hatcheries, fish feed industry, aquaculture, deep sea fishing, development and extension, research and academic, financial institutions and others.

7.2 Supply of Graduates

Twenty SAUs, one Central Agricultural University, CIFE-Mumbai, CUST-Cochin and IIT-Kharagpur offer fisheries education in the country through 25 colleges - UG courses are offered in 23 colleges, PG in 18 and PhD in 9 colleges/institutes. The current intake capacity in all the fishery science courses in the country adds up to a total of about 1005. Data on Intakeitted and outturn of students in various fisheries colleges during 2009-10 are given in Table-7.1.

Table-7.1: Intake and Outturn of Students in Fisheries Sciences During 2009-10

Diploma		UG		PG		PhD		UG & above	
Adm	Pass	Adm	Pass	Adm	Pass	Adm	Pass	Adm	Pass
26	NA	552	285	206	109	34	30	792	424

7.2.1 Current Stock of Human Resource in Fisheries Sciences

The total stock of graduates and above in fisheries sciences, estimated from annual supplies, is about 5,144 in 2010.

7.3 Demand Estimation of Stock

Demand projections of fishery human resources have been attempted separately for various sub-sectors of the fisheries sector (Table-7.2). The average stock required by education level is given in Table-7.3.

Table-7.2: Estimated Stock Requirement of Fishery Students in Various Sub-sectors

Sub-sector	2009-10		2019-20	
	Diploma	UG & above	Diploma	UG & above
Processing	1066	4038	2966	11241
Seed Hatcheries	32784	1328	53416	2168
Fish feed industry	-	180	-	500
Aquaculture	90595	2092	178915	4132
Deep sea fishing	900	1950	3000	6500
Development & Extn	547	3816	889	4760
Banks	-	500	-	750
Research & Academic	-	700	-	1200
All	132186	13871	251146	28407

Table-7.3: Projected Stock Requirement of Fisheries Human Resources

Year	Diploma	UG	PG	PhD	UG & above
2009-10	132186	10567	2320	984	13871
2019-20	251146	22288	4651	1468	28407

7.3.1 Demand – Supply Gap in Stock

In 2010, the actual stock from supply is 5,144. Assuming the outturn levels will grow at the same growth rate as observed during the last five years (i.e., 2.6 per cent during 2006-10), the demand-supply scenario in 2020 would be:

Supply: 6,705
Demand: 28,407
Gap: 21,702 (76.4 per cent of the demand)

7.4 Demand Projections of Annual Flow

The annual supply in 2010 and flow demand for graduates in 2020 in fisheries a science is shown in Fig-7.1. The projections suggest that by 2020, the annual outturn required from the fishery science education system should be about 2100 under-graduates, 420 post-graduates and 100 doctorates.

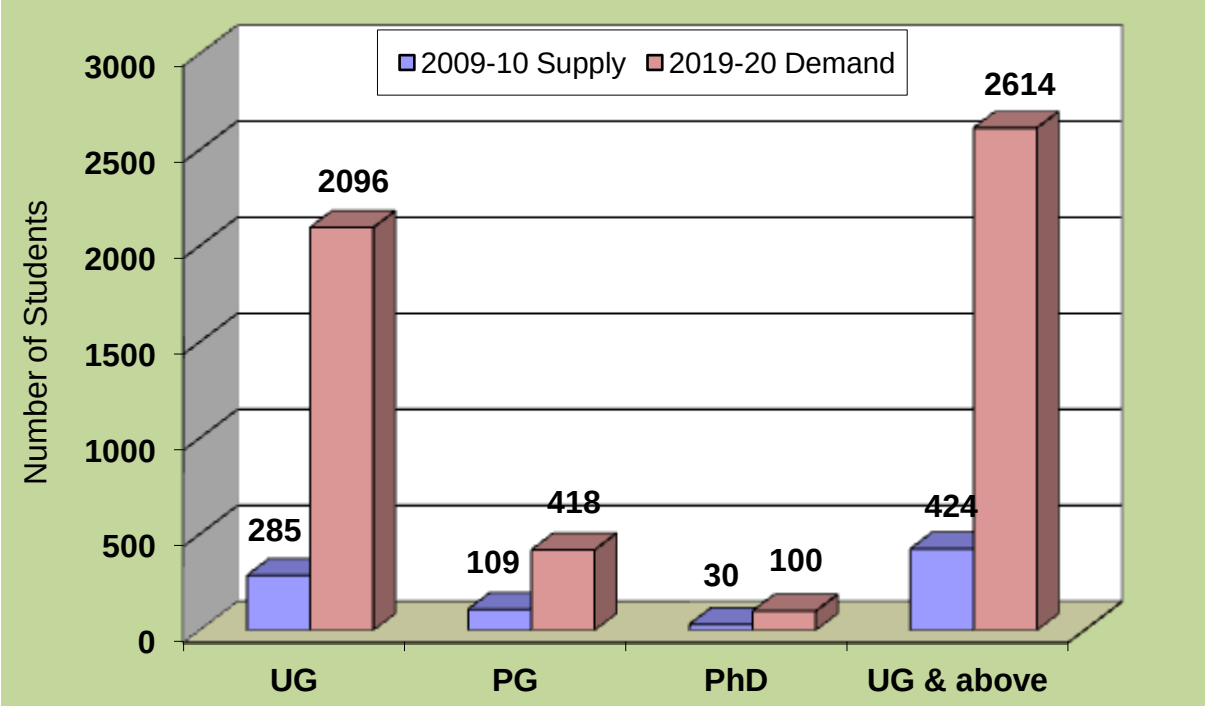

Fig-7.1: Current (2010) and Projected Outturn Required (2020) in Fisheries Sciences

7.5 Summary

The stock required would be 28,410 in 2020, which would grow from 13,870 in 2010. The required addition stock is about 1500 per annum.

The current supply of about 420 graduates per year is too less as compared to the requirement of 2,600 by 2020, i.e., additionally 2,180 graduates (1,800 UG; 310 PG and 70 PhD). The industry needs trained graduates but can't afford to meet the graduates' expectations in terms of wages and working environment. For this reason, industry prefers diploma holders, and there aren't any.

In 2020, the demand for graduates is more in marine (1600) than in aqua (1000) sub-sectors, where as the demand for diploma holders is more in aqua (21,600) as compared to marine (1,100) sub-sector. In other words, marine sub-sector needs more qualified personnel; whereas aqua sub-sector needs more para professionals.

Demand from academic and research sectors is high for PG and PhDs - from current supply of 140 to 520 by 2020. In view of high vacancies in these two knowledge sectors, there is need to increase investments in fisheries research and education so as to increase research opportunities and quality human resource production.

The estimates of demand are subject to a number of variables. Firstly, the base data for 2009-10 in some sub-sectors have been derived on the basis of available norms and might not have been actually realized as the industries do not employ professional graduates as per the norms, and are not likely to employ in future also till there is change in the outlook. Secondly, fishery graduates have competition from graduates from other fields such as life sciences as well as from diploma holders and persons trained informally. Thirdly, the demand for professionals may not grow at the same rate as the production due to technological innovations and productivity gains. Moreover, the present structure of aquaculture industry may not continue in the same manner. For example, if the future production takes place in the smaller farms, such farms may not employ any fishery graduate. Considering all these imponderables the actual demand may be somewhat low. Moreover, substitutability of skills and skill levels by diploma holders or informal training or experience may also depress the demand. As such, the estimates presented above may only be taken as indicative till the sector is given special focus in policies and programmes.

Chapter - 8

Human Capital Assessment in Dairy Sector

8.1 Introduction

India is the largest producer of milk in the world. The growth of dairy sector in India during the last three decades had been impressive at more than five per cent per annum. In dairy sector, projections for human capital requirements have been worked out for milk procurement, milk processing, dev. & extension, financial institutions, research, academics and others.

8.2 Supply of Graduates

Dairy education is offered in 19 colleges / institutes. Total intake of Dairy science students in the country is about 750 per year (487 in UG, 174 in PG and 90 in PhD). Besides degree programmes, in this discipline short-term diploma courses ranging from one year to two years are also offered by various universities. During 2009-10, number of students admited and passed out in degree programmes is about 751 and 310, respectively (Table-8.1).

Table-8.1: Intake and Outturn in Dairy Science Colleges During 2009-10

Diploma		UG		PG		PhD		UG & above	
Adm	Pass	Adm	Pass	Adm	Pass	Adm	Pass	Adm	Pass
131	67	487	255	174	30	90	25	751	310

8.2.1 Current Stock of Human Resource in Dairy Sciences

The total stock of graduates and above in dairy sciences, estimated from annual supplies, is about 6062 in 2010.

8.3 Demand Projections of Stock

The demand projections were made considering requirements in various subsectors such as milk procurement, processing, Academic, Financial Institutes and state departments. The demand for different sub-sectors is given in Table-8.2. The education level wise break-up of total demand is given in Table-8.3.

Table-8.2: Subsector-wise Demand of Human Resources in Dairy Sector

Sub-sector	2009-10		2019-20	
	Diploma	UG & above	Diploma	UG & above
Milk procurement	20040	20	600400	200
Milk processing	4708	14809	7723	24295
Research	-	500	-	1500
Academic	-	200	-	500
State Departments	-	500	-	500
Financial Institutions	-	950	-	1500
Others	195	828	30407	1425
Total	24943	17807	638530	29920

Table-8.3: Education level wise Projections of Aggregate Stock Demand for Dairy Science Personnel up to 2020

Year	Diploma	UG	PG	PhD	UG & above
2009-10	4943	14813	1930	1064	17807
2019-20	638530	24457	3181	2282	29920

8.3.1 Demand – Supply Gap in Stock

In 2010, the actual stock from supply is 6,062. Assuming the outturn levels will grow at the same growth rate as observed during the last five years (i.e., 9.5 per cent during 2006-10), the demand-supply scenario in 2020 would be:

Supply: 7,269
Demand: 29,920
Gap: 22,651(76 per cent of demand)

8.4 Demand Projections of Annual Flow

The annual flow for the years 2009-10 and estimates for 2019-20 is shown in Fig-8.1. The required outturn of dairy science and technology professionals (graduates and above) from educational institutions would increase to 3300 by 2020. The current out turn of about 310 per year is far below the requirement.

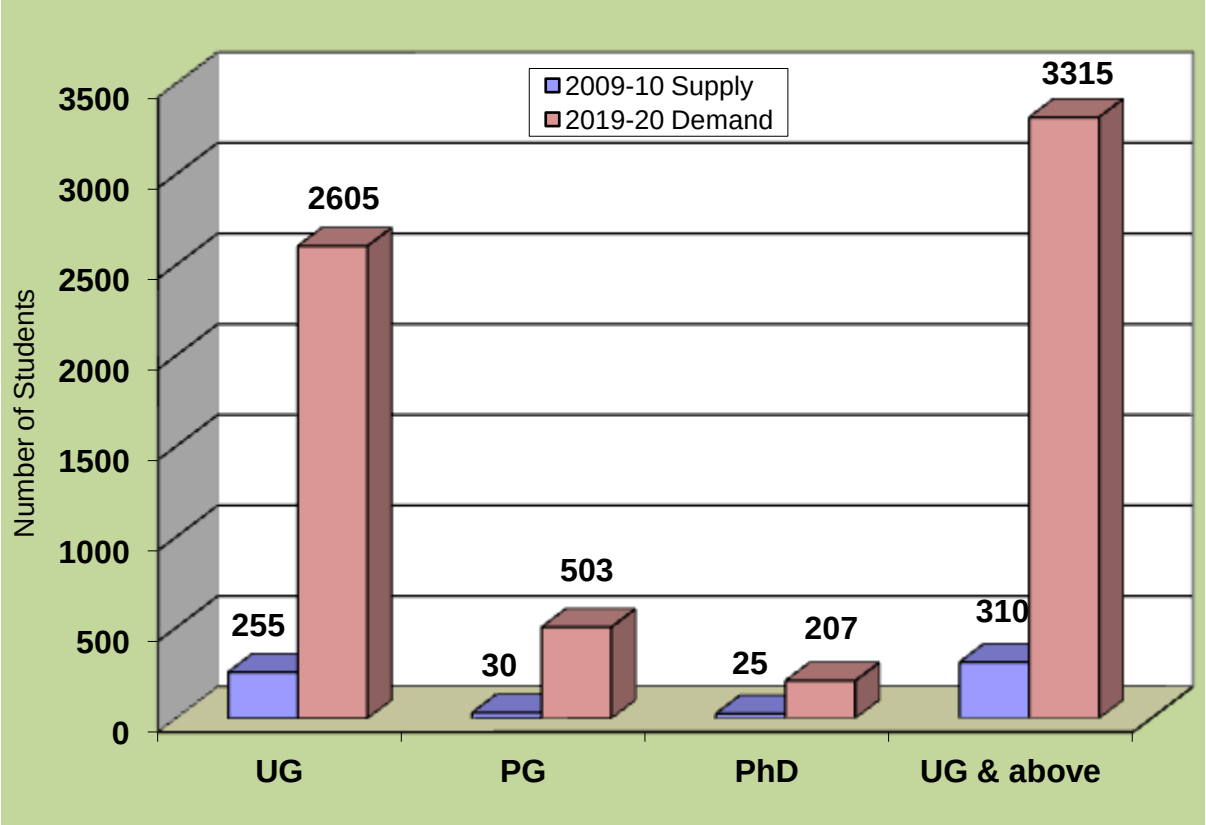

Fig-8.1: Current (2010) and Projected Outturn Required (2020) in Dairy Sciences

8.5 Summary

The demand of graduates and above in dairy science and technology has been projected to grow from 17,807 in 2010 to 29,920 by 2020, with annual increase of nearly 1,200. A large demand for diploma and certificate holders has been projected to cater to the needs of quality milk procurement by the organized sector.

The supply- demand gap in this sector is very high. The current supply of about 310 graduates can only meet less than 15 per cent of estimated demand. Therefore, at present unorganized sector is hiring people on a low salary from other streams and providing on the job training. To meet the demand of graduates, annual out turn need to be increased to about 3,300 by 2020, i.e., additionally 3,000 graduates (2350 UG; 470 PG and 180 PhD).

The requirement for diploma holders is highest in this sector. There is potential requirement to train about 60,000 diploma holders annually so as to meet the large requirement for these persons in the area of dairy production and management in the rural sector.

Chapter - 9

Human Capital Assessment in Agricultural Engineering Sector

9.1 Introduction

In order to achieve efficiency and higher productivity of Indian agriculture, interventions from the agricultural engineering discipline are critical in the form of agricultural mechanization, irrigation and drainage and soil conservation engineering, agricultural processing, energy in agriculture and transfer of technology. In general, the farm machinery sector is growing at about 10 per cent per annum. In agriculture engineering sector projections for human capital requirements have been worked out for development and promotion, equipment manufacturing, education and research and others.

9.2 Supply of Graduates

Agricultural engineering education is now provided in 40 colleges – 34 in SAUs, 5 affiliated to SAUs and IIT-Kharagpur. About 37 colleges are now offering Bachelor degree, 27 colleges offering Master degree and about 13 institutions offering PhD. The annual intake and outturn is estimated to be 2490 and 1510, respectively in the year 2009-10 (Table-9.1).

Table-9.1: Intake and Outturn of Students in Agricultural Engineering During 2009-10

Diploma		UG		PG		PhD		UG & above	
Adm	Pass	Adm	Pass	Adm	Pass	Adm	Pass	Adm	Pass
31	NA	1954	1218	475	262	58	27	2487	1507

9.2.1 Current Stock of Human Resource in Agricultural Engineering

The total stock of graduates and above in agricultural engineering, estimated from annual supplies, is about 23,207 in 2010.

9.3 Demand Projections of Stock

The projection of stock of agricultural engineering manpower to meet the needs of various segments of the economy and the consequential flows required from the educational system are summarized in Table-9.2 and Table-9.3, respectively.

9.3.1 Demand – Supply Gap in Stock

In 2010, the actual stock from supply is 23,207. Assuming the outturn levels will grow at the same growth rate as observed during the last five years (i.e.,, 9.7per cent during 2006-10), the demand-supply scenario in 2020 would be:

Supply: 33,859
Demand: 28,484

With the supply exceeding demand, it would lead to unemployment in this sector.
However, the projected demand can be met by restricting the outturn growth rate to about two per cent per annum in the coming decade.

Table-9.2: Stock Requirement for Agricultural Engineering in Various Sub-sectors

Sub sector	2009-10		2019-20	
	Diploma	UG & above	Diploma	UG & above
Development Depts.	305	2443	375	3003
Research	-	500	-	552
Academic		654		796
Machinery	1533	12300	2685	21543
Others	184	2189	306	2591
All	2022	18086	3366	28485

Table-9.3: Overall Stock Projection for Agricultural Engineering by Education

Year	Diploma	UG	PG	PhD	UG & above
2009-10	2022	11654	3800	2033	18086
2019-20	3366	19405	6201	2880	28485

9.4 Demand Projections of Annual Flow

The annual output required from the educational institutions to meet the above demand is shown in Fig-9.1. To meet the requirement, the educational institutions need to produce annually about 3,260 agricultural engineering under-graduates, post-graduates and doctorates by 2020.

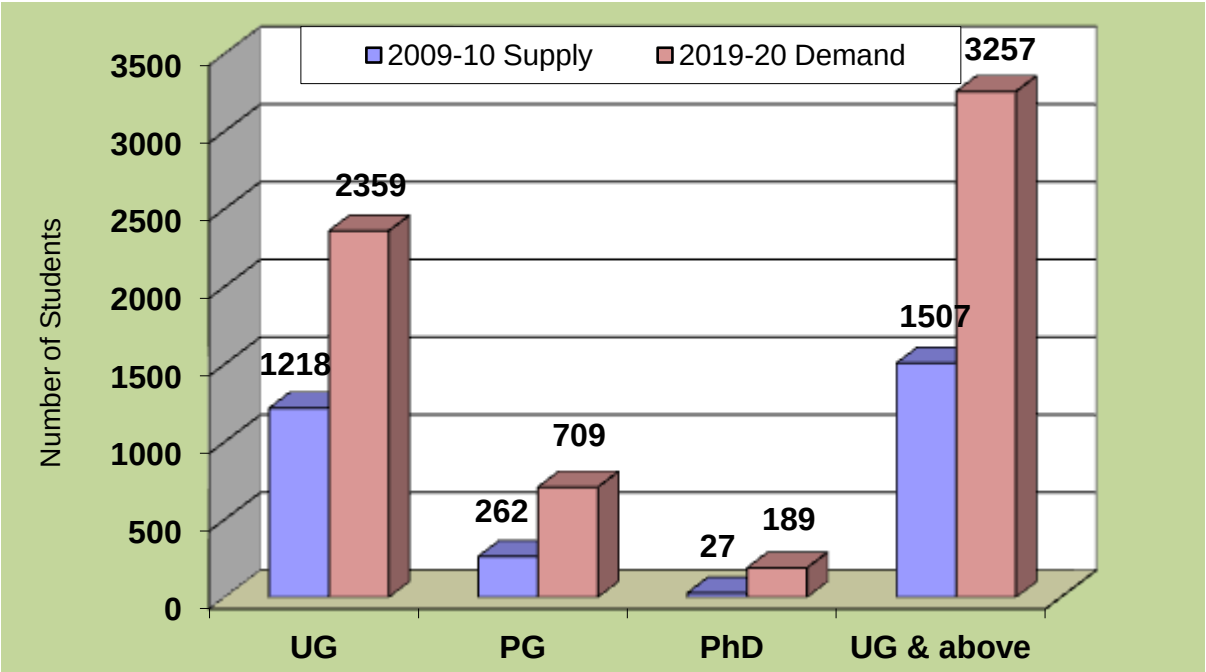

Fig-9.1: Current (2010) and Projected Outturn Required (2020) in Agricultural Engineering

9.5 Summary

The requirement of number of agricultural engineering graduates, post-graduates and doctorates has been projected to grow from about 18,000 in 2009-10 to 28,500 by 2019-20. The current stock from supply of 23,207 is in excess of demand by about 5,200.

Considering the growth in the last decade, the project forecasts indicate 50per cent increase in the outturn of students by 2020- from about 1500 per year now to about 3,200 per year by 2020, i.e., additionally 1,750 graduates (1,140 UG; 450 PG and 160 PhD). However, the simulation results have shown that demand supply would balance if the future increase in annual supply is limited to 10 per cent in place of 50 per cent seen now. As the intake capacity is already available for about 2,500 students, the needed requirement can be met by capacity utilization, to large extent.

Selective expansion of education is needed to produce another 500 graduates by 2020. There is need to increase PG/PhD holders by three times (Pg/PhDs of 300 in 2010 to 900 by 2020) so as to meet the national requirement. As human resource development at PhD level is related to research, the academic programs demand strengthening research.

Number of government programmes on agriculture and rural development envisage promotion of farm mechanization and precision agriculture, which requires large number of diploma holders and vocationally trained persons. This needs diploma holders at least in the ratio of three for every graduate, at the minimum. This norm translates to large requirement. This aspect is discussed in detail in chapter on human resource requirement at micro level. Automation in agriculture can provide boost to the sector and can provide hope for a number of problems in Indian agriculture like small land holdings, low productivity, shortage of labour etc. The need is to identify, adapt, and develop machines and equipments suitable to Indian conditions. This would require quality human resource with specific skills.

Chapter – 10

Human Capital Assessment in Agricultural Biotechnology Sector

10.1 Introduction

Importance of biotechnology as a catalyst to growth of agricultural and health sectors is well recognized as early as in 1980s. Indian Bio-Technology industry is growing at a rate of 17 per cent in the recent past. Agricultural Biotechnology Sector is about two decades old with about 30 per cent share in total Biotechnology industry in the country. In this sector human capital requirements have been projected in the sub- sectors like development departments, research, tissue culture, seed sector, veterinary pharma sub- sector, academics and others.

10.2 Supply of Graduates

General biotechnology courses are offered by about 400 educational institutions (100 in public and 300 private) in the country producing 14,000-15,000 students every year. The contribution of the State Agricultural Universities in biotechnology education is limited to about 10 per cent. 27 colleges in SAUs are providing education in agri-biotechnology. The intake in 2010 for under-graduate, post-graduate and doctoral programmes are presented in the Table-10.1. In SAUs, the intake at UG level is for B.Tech (Biotechnology) and at PG level it is for MSc/PhD in plant and animal biotechnology sciences. Where as, in affiliated colleges UG refers to B.Sc (Biotechnology) course. As SAUs are producing about 730 students per year, their share in out turn of bio-technology students in the country is less than 10 per cent.

Table-10.1: SAUs Intake in Agri-biotechnology in 2010

UG		PG		PhD		UG & above	
Adm	Pass	Adm	Pass	Adm	Pass	Adm	Pass
592	558	195	156	35	20	822	734

10.2.1 Current Stock of Human Resource in Agricultural Biotechnology

The total stock of graduates and above estimated from annual supplies is about 1,697 in 2010.

10.3 Demand Projections of Stock

The general approach adopted for manpower projections in different segments of the agri-biotechnology sector is that embodied in Parnes model with replacement needs taken as one per cent of the previous years' stock. The sub-sector wise demand is given in Table-10.2 and the consequent level wise flows required from the educational system are presented in Table-10.3.

Table-10.2: Required Stock Projections for the Year 2019-20

Sub-sector	2009-10		2019-20	
	Diploma	UG & above	Diploma	UG &above
Development Depts.	-	100	-	200
Research	-	300	-	500
Academic	-	200	-	400
Tissue Culture	180	60	597	200
Seed Business	175	1625	370	3430
Veterinary Pharma	-	450	-	950
Others	36	253	97	528
All	391	2988	1064	6208

Table-10.3: Overall Projections of Requirements Stocks of Agri-biotechnologists

Year	Diploma	UG	PG	PhD	UG & above
2009-10	391	1150	887	951	2988
2019-20	1064	2467	1879	1862	6208

10.3.1 Demand – Supply Gap in Stock

In 2010, the actual stock from supply is 1,697. Assuming the outturn levels will grow at the same growth rate as observed during the last five years (i.e., 25per cent during 2006-10), the supply in 2020 would grow to 13,383. The estimated demand of 6,208 would be met by increasing the out turn by about 20 percent per annum

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10.4 Demand Projections of Annual Flow

The corresponding annual output required from the educational system to lead to the annual flow demand is presented in Fig-10.1. The projections suggest that by 2020, the annual outturn required in the agricultural biotechnology should be about 580 under-graduates, 320 post-graduates and 130 doctorates, rising from 560 under-graduates, 150 post-graduates and 20 doctorates in 2009-10.

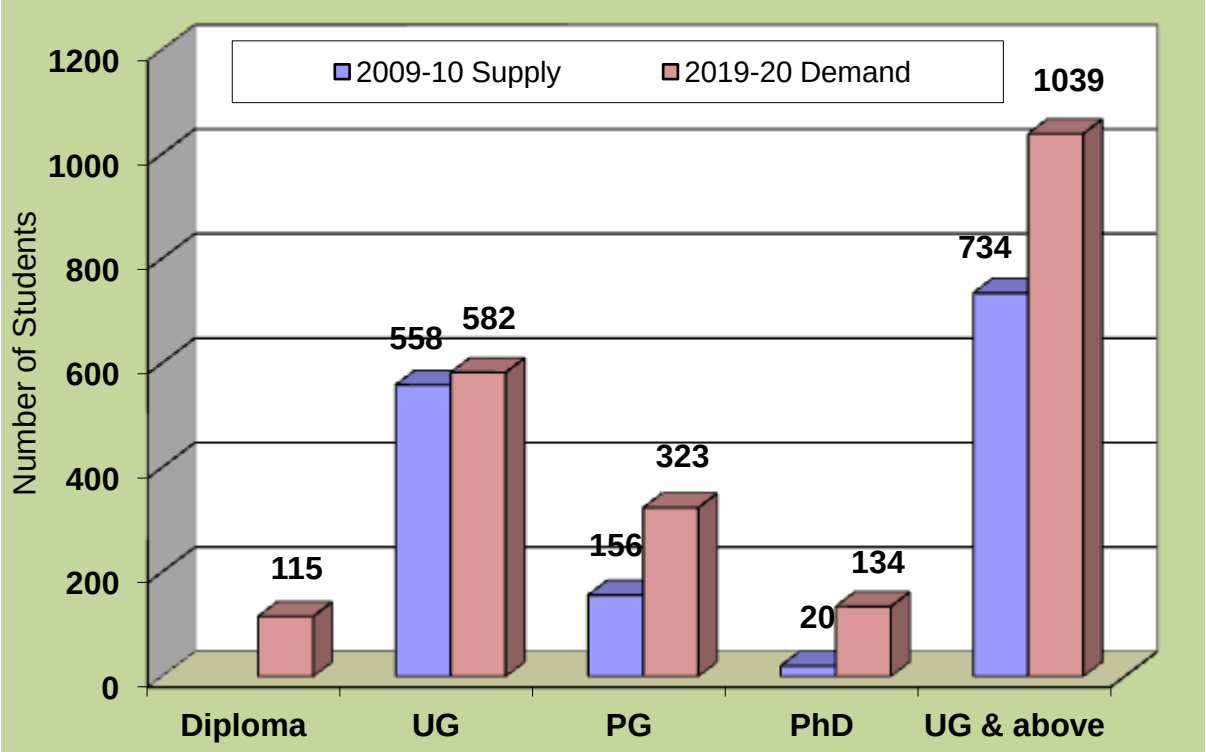

Fig-10.1: Current (2010) and Projected Outturn Required (2020) in Agri-biotechnology

10.5 Summary

The total stock of agri-biotech manpower is projected to grow from 3,000 in 2009-10 to 6,200 by 2019-20. The stock of graduates is expected to double in the next ten years.The annual supply of graduates would have to increase from current 730 to about 1,040 by 2020, i.e., additionally 280 graduates (170 PG and 110 PhD).

The supply of PG and PhD holders is a concern. Employers are not happy with the quality of graduates. Besides, the current annual supply of 156 PGs and 20 PhDs is too low compared to requirement of 320 PGs and 130 PhDs by 2020. Emphasis be given to expand PG and PhD courses. This in turn would strengthen research and academic sectors. Moreover, ICAR also need to have a long term strategy to develop strong R&D progamme in partnership with industry so as to meet global challenges.

No expansion is projected at UG level. In fact, there is need for review of UG education in this area. Various national S&T bodies and eminent biotech educationists strongly recommend not offering biotechnology at under-graduate level.

At lower level, there is need to have large number of finishing schools to provide skills in areas like tissue culture, micro-propagation techniques and other such areas to attract rural youth, particularly women, to establish enterprises. Both academic and research institutions can be mandated to develop such entrepreneurs and also provide technical support in the initial stages of enterprise development. This can be best served through a separate national scheme with priority funding to establish such enterprises.

Chapter-11

Human Capital Requirements at Micro Level

11.1 Introduction

Micro-level here refers to organizations at grass roots, bulk of which may not be organized. A number of activities that are unorganized and do not get covered by established institutional systems. At lower level the requirements are at operational level i.e., persons with specific skills who can be termed as **'bare foot technicians'**. Their requirements are large and have been indicated through focus group discussions and nationwide survey. Considering this, an assessment for trained para-workers for various services at micro level is made following a normative approach.

11.2 Demand Estimates

Agri- Clinics /Agribusiness are being established (about 700 per year) to provide expert services and advice to farmers. They are evolving as strong micro level organizations in the unorganized sector. These micro organizations would also function as intermediaries for corporate and govt. departments in agribusiness operations. Considering the future potential for such opportunities and growth of more than 1000 such units per annum, the country would need, on a conservative estimate, about 5000 graduates and 2-4 times this number of para staff for such enterprises.

It is proposed that a Village Service Centre can be established for every 10-15 villages, if not in each revenue village. Each Village Service Centre may have one technical expert each in various sub-sectors of agriculture supported by technicians/ para staff. Agro-Service Centre that include Agro-processing enterprises and Service centres for repair and maintenance of agricultural machinery in the rural areas would be major focus in the coming years as government of India envisages promoting such enterprises. Ideally every village would need one. Therefore, the study envisages beginning with establishment of 2-3 in each in a block in the 12^{th} plan and there after increasing their number to one per village.

Farmers as group can seek expert / technical counseling services through these centres. As agriculture is getting feminized, the centres can provide services specific to women.

Skill Areas: In general, self-employment generating areas are application of advances in technology like genetically improved seeds, modern agricultural practices including micro-irrigation, plasticulture, nursery, organic and inorganic fertilizer production, post harvest technology, testing of agricultural produce, soil, water, fertilizer, waste and waste water analysis, bio-fertilizers, pesticide, veterinary services, livestock production, fishery production, agro ecotourism, environmental impact methods and analysis, renewable and non-renewable energy, bio-technology, marketing, etc. Knowledge in weather forecast, water management, satellite imagery, commercial information, market information, Govt. schemes, policy on agriculture and agri-business can be made available through agri-clinics, agri-business centres, bio-technology parks, food processing parks, veterinary pharmaceuticals, computer aided rural knowledge centres, testing labs, etc.

The skills can be developed through a variety of approaches like providing diploma level courses, vocational education and training and finishing school training. Skill development can also be had under 'Modular Skill Development Scheme' initiated by government of India.

11.2.1 Human Resource Supply Dynamics

Large number of executives in both public and private sector expressed need for below graduate level students for jobs within district, mostly in villages. In absence of such personnel ready to work in villages, private sector is employing other general science graduates and school drop outs and training them on the job for the specific work they need to do. **Considering the number of rural youth, such institutions need to be established at medium size towns and block level across the country providing skills needed in their area.** It would be an opportunity to develop chain of rural institutions close to grass roots for training rural youth.

Estimates for human capital are based on the following considerations:

- *Of the six lakh villages, the ideal requirement would be 1,00,000 Village Services Centers (5-7 villages per center).*
- *Agri, veterinary, machine maintenance/repair technician, and nutritionist will be needed in all the centers.*
- *At least 10,000 Village Centers should have fishery technicians. (The proportion of fishermen population to total population being 1/60).*
- *At least 10,000 Village Centers should have forestry technicians/ (Green India Mission envisages one lakh Van Samrakshna Samities, It is proposed that at least 10 per cent would have forestry technicians*
- *The above would be accomplished by 2020 in a phased manner with about increment of 10 per cent per year.*
- ***Requirement of para staff needed for organized sectors given in respective chapters is not covered here. Dairy sector requirement is indicated in the sector report and hence not covered here.***

The estimated requirements of para-professionals for micro level organizations are given in Table-11.1.

Table-11.1: Need of Para Staff for Micro-level in Agriculture and Allied Sectors

Sector	2010-11	2019-20	Annual increment
Agriculture	10000	100000	10000
Veterinary & AH	10000	100000	10000
Horticulture	10000	100000	10000
Farm Machines	10000	100000	10000
Nutritionist	10000	100000	10000
Fisheries	1000	10000	1000
Forestry	1000	10000	1000
Total	52000	520000	

11.2.2 Demand for Para Staff in Organized Sector

The sector wise reports indicate requirement of about 4,13,000 para staff (diploma holders) in 2010, which is likely to grow to 12,38,000 by 2020. Although the requirement of these two categories emanate from different perspectives, the capacity development of these two streams may be complementary. Thus, the capacity building efforts need to plan for developing para-staff stock of 4,66,000 in 2010, which would increase to about 17,58,000 by 2020. Considering the desirable ratio of graduates and para staff (1:3), and estimated graduate stock of 6,50,000 in 2020, the above estimate of para staff requirement is justified.

11.2.3 Mechanism for Training

The para-professionals can be trained in agriculture schools cum polytechnics, finishing schools imparting specific skills and vocational training organisations. Some already trained personnel would require certification. **Need a more flexi-methodology to train the people at large as per their local needs.** **N**ational Skill Development Corporation has initiated the development of human capital including in agriculture and allied sectors in their Modular Skill Development programme. Bulk of the training envisaged for micro level in agriculture and allied sectors can become part of this.

11.3 Summary

Conservative estimate of human resource needed at the micro level and the organized sector, the annual demand for para professionals would be about 1,00,000 per year during the period 2010-2020. Few programmes of this nature are already in place. For example, MAFSU produces annually about 3,500 para professionals in dairy and animal husbandry area in Maharashtra alone. Thus, it is possible and desirable to produce about 1,00,000 para-professionals annually.

Large number of government programmes aimed at agriculture and rural development need para professionals for service at village level. However, a host of public and private institutions need to undertake their identification as per local and regional needs and develop them.

This report recommends mandating every plan programme to identify area specific needs of trained personnel and include capacity building as a part of such planned activities.

Chapter - 12

System Dynamics Model

12.1 Introduction

Forecasts of human capital requirement in agriculture and allied sectors were made using system dynamics model with different policy scenarios and to suggest prospective human resource development strategies.

12.2 Supply-Demand Projections (all Sectors Combined)

12.2.1 Policy Scenarios

Projections were made for the following three policy propositions, namely,

1) Policy-1: with the intakes frozen at 2009-10 levels and at 4 per cent sector growth.
2) Policy-2: with 50 per cent increase in the intakes from 2009-10 and 4 per cent sector growth.
3) Policy-3 : with 50 per cent increase in the intakes from 2009-10 and 3per cent sector growth.

The actual growth rates will be determined endogenously by the system dynamics model on the basis of considerations of attritions and supply-demand gaps.

12.2.2 Supply Projections of Overall Agriculture and Allied Sectors

The intakes and out-turn ratios are important considerations in this regard. When Supply-Demand gap becomes negative, the attractiveness of the sector increases, and the out-turn ratio improves and so are the intakes. The out-turn ratios are considered to be varying from 60 per cent to 90 per cent on the basis of supply-demand gaps. When the supply is less than the demand, the out-turn ratios will be on the higher side. Table-12.1 shows the supply projections of overall agriculture sector for the base year 2010 and for 2020 under different policy scenarios, viz. policy-1, policy-2 and policy-3 at various target growth rates.

Table-12.1: Supply Projections Under Different Policy Scenarios

Scenario	Year	Diploma	UG	PG	PhD	Total
Base year	**2009-10**	390461	317837	84482	38632	831412
Policy-1	**2019-20**	377836	336873	101456	44799	860964
Policy-2	**2019-20**	401519	353634	113378	49559	918090
Policy-3	**2019-20**	400377	353198	112784	49323	915682

12.2.3 Demand Projections of Overall Agriculture and Allied Sectors

The estimated demand projections for degree holders are depicted in Figs-12.1 and 12.2 for Policy-2 and Policy-3.

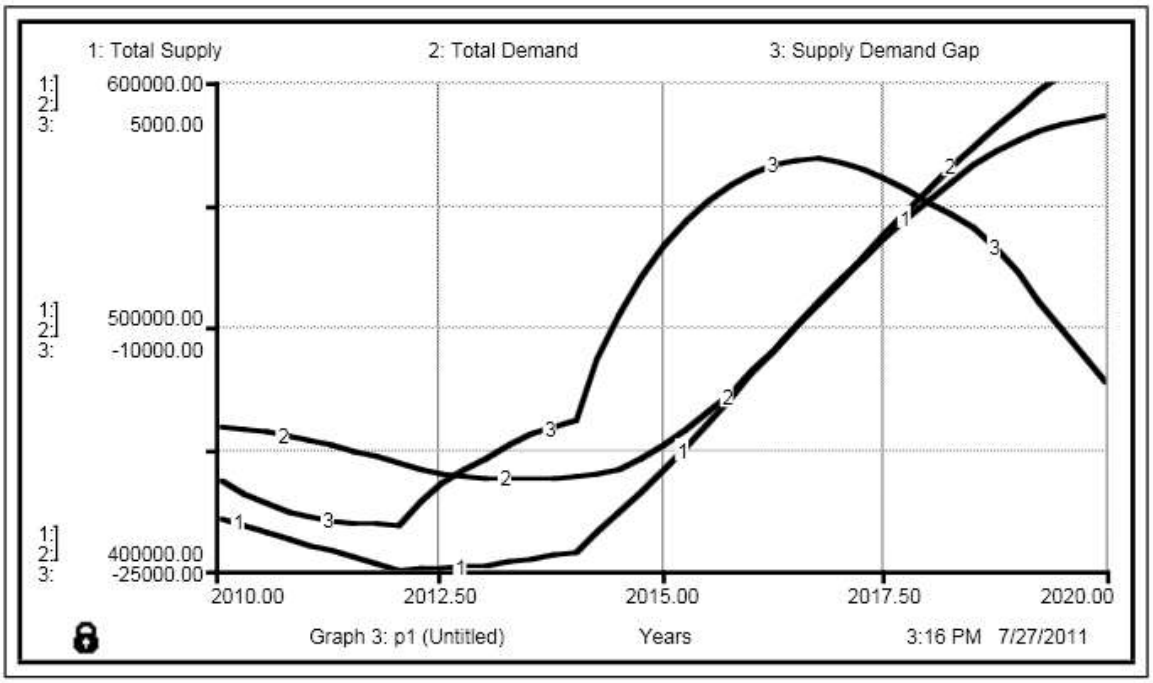

Fig-12.1: Overall Agriculture Supply-Demand Plot for Degree Holders for Policy-2 with four per cent Growth Rate and 50per cent Increase in the Intakes

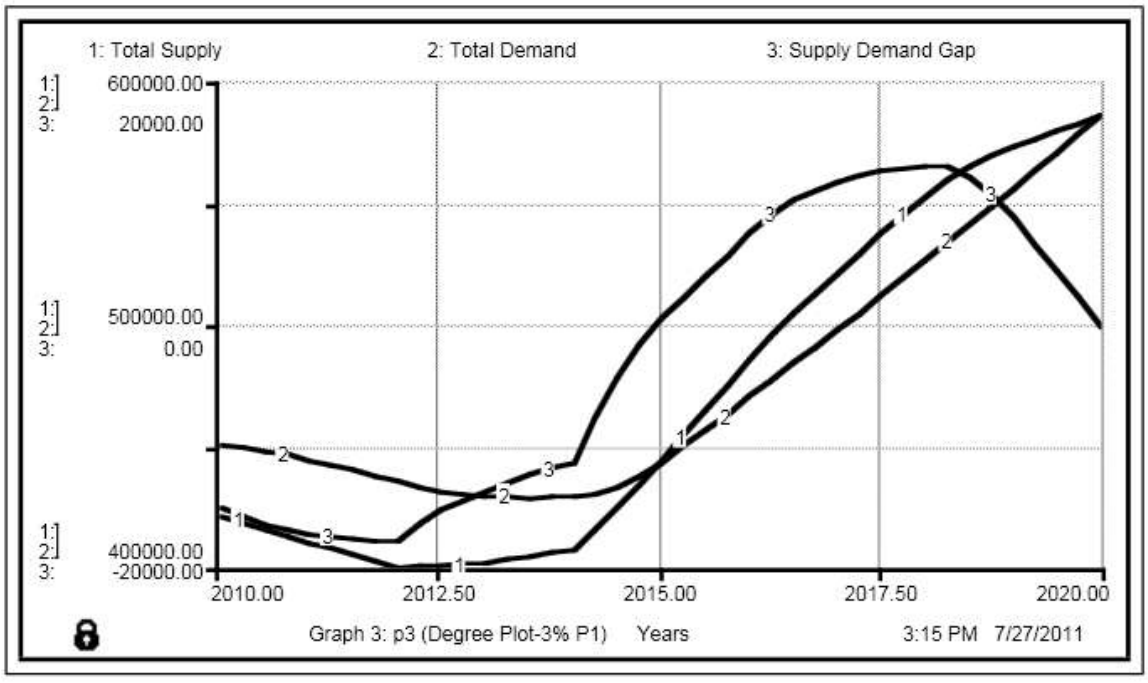

Fig-12.2: Overall Agriculture Supply-Demand Plot for Degree Holders for Policy-3 with three per cent Growth Rate and 50per cent Increase in the Intakes

The supply-demand gap is shown to be negative most of the times even with a 50 per cent increase in the intake. The estimated growth rate is found to be just above 2.5 per cent for the policy with 50 per cent increase in the intakes although the target growth rate is considered to be four per cent.

12.3 Supply-Demand Projections (Sector wise)

Current stock supply projections by education level for the eight sectors of the study were taken from the respective sector reports presented in preceding chapters of this report.

12.3.1 Scenario Analysis

Taking into account the growth rate of each of the sub sectors in Agriculture from the current trend and expert opinion, the supply-demand gap for graduates and above under the three policy scenarios was simulated and the results are summarized in Table-12.2.

Table-12.2: Supply-Demand Gap in the Year 2020 for Graduates and Above

S No	Sector	Supply-Demand Gap		
		Policy-1	Policy-2	Policy-3
1	Crop Science	-6531	-3893	-707
2	Horticulture	-2328	-1886	-1286
3	Veterinary	-1635	-1144	-679
4	Fishery	-567	-438	-272
5	Dairy	-652	-524	-355
6	Agri-Biotechnology	1874	2932	3375
7	Agri-Engineering	4137	7756	9742
8	Forestry	-489	12	1439

The demand of human capital in crop science, horticulture, veterinary, dairy and fishery sectors is more than the supply under the three policy scenarios. In these, the intake capacity needs to be increased over 50 per cent of the current level.

In forestry, the supply demand gap is small. In Agri-biotechnology and Agri-engineering, supply exceeds demand. However, the simulation carried out with 10 per cent increase in intake has shown a balanced demand –supply situation in these three sectors. Thus, in these three sectors, modest increase in the current intake capacity would be sufficient to meet the projected demand in 2020.

12.4 Conclusions

The results from the system dynamics model are in conformity with the overall trend of manpower supply-demand scenario from other forecasting techniques. In the assumed scenario, 50 percent increase in intake of graduates would not be sufficient to meet the demand for low level of sector growth of 3 per cent in agriculture, horticulture, veterinary, dairy and fishery sectors. Where as in Forestry, Agricultural biotechnology and Agricultural engineering, with 10 per cent increase in intake would be sufficient to meet the required demand in 2020. On the whole, special efforts, therefore, are necessary to sustain the growth in the agriculture sector with improvements in the intakes as well as in the out-turn ratios.

Chapter – 13

Conclusions and Recommendations

13.1 Introduction

The present project relates to forecasting of human capital needs in agricultural and allied sectors. The results of forecasts were made on the basis of growth pattern in each sector and sub-sectors in the light of various developmental programmes and the vision for each sector. A primary survey undertaken as a part of the project has provided the basic inputs needed to finalise the human capital needs according to various educational levels. The project analysed the human capital requirements not only in quantitative terms but on issues relating to quality as well. It also considered the institutional mechanisms for imparting education in agriculture and its allied sectors and addressed skill related issues in the context of changing labour market scenario as required in one of the objectives of the project.

A brief summary of certain key results, conclusions and future demand are presented below:

13.2 Employment Profile

The results in Fig-13.1 (all disciplines put together) and Fig-13.2 (discipline-wise) show the sector-wise deployment of agricultural human resources in 2010. The shares of various segments by employment are : 33 per cent in government, 44 per cent in private, 10 per cent in financial, 4 per cent in research and academic and nine per cent in others. The major shift in the past three decades is decline in the share of public sector in employment, which may be due to freezing employment in government sector as well expansion of opportunities in the private sector. This is in tune with the emergence of commercialisation as well as diversification.

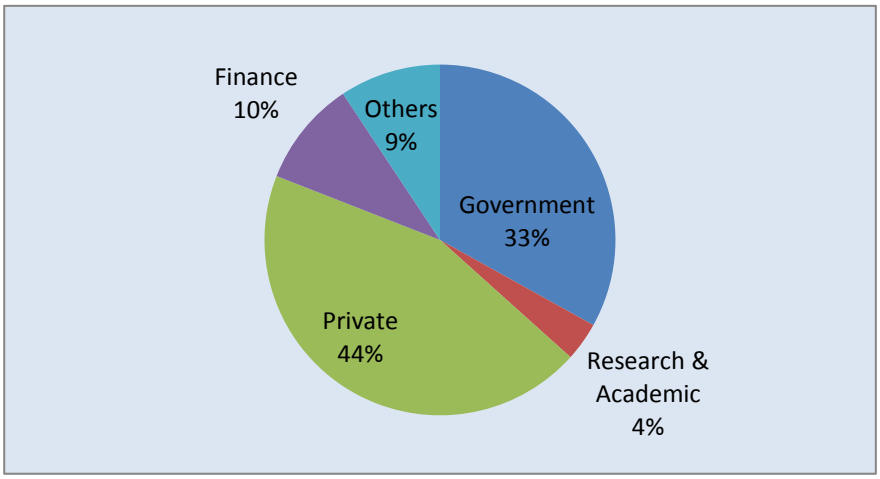

Fig.-13.1: Pattern of Agriculture Human Resources Deployment

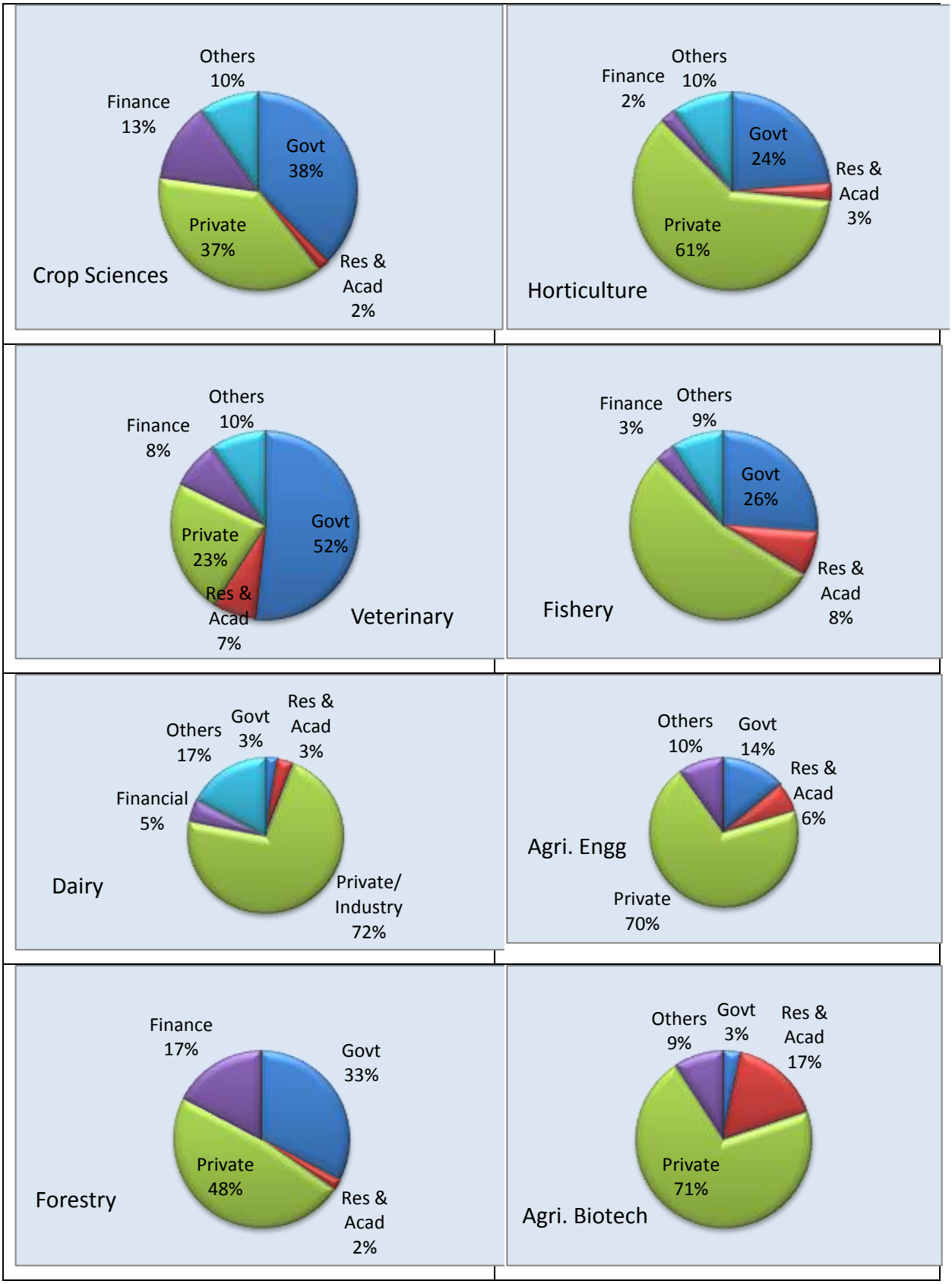

Fig.-13.2: Profile of Deployment of Agriculture Human Resources in Different Sectors

13.3 Annual Flow of Supply-Demand

With the above demand projection the required annual outturn for the year 2020 in comparison to the same during 2010 is given in Table-13.1.

Table-13.1: Required Annual Outturn by Education-level in 2010 (Supply) & 2020 (Demand)

Discipline	UG		PG		PhD		UG & above	
	2010	2020	2010	2020	2010	2020	2010	2020
Crop Science	11852	18659	3514	5422	583	1203	15949	25284
Horticulture	1001	7295	409	993	55	330	1465	8618
Veterinary	1761	5332	797	1854	125	486	2683	7672
Fisheries	285	2096	109	418	30	100	424	2614
Dairy	255	2605	30	503	25	207	310	3315
Agri-Biotech	558	582	156	323	20	134	734	1039
Agri-Engg	1218	2359	262	709	27	189	1507	3256
Forestry	386	1260	275	416	55	156	716	1832
Total	17316	40188	5553	10638	920	2805	23788	53630

The average outturn during the last decade grew at the rate of five per cent per annum and in the coming decade it is projected to grow at above five per cent to meet the demands.

At present, the existing education system is producing about 24,000 per year with crop sciences contributing two-third of it. The projections indicate that by 2020 the annual outturn required would have to be about 54,000. Based on the current supply the demand supply gap would be 30,000. ***Discipline wise, the additional annual requirements of outturns are expected to be: Agriculture 9,335; Horticulture 7,153; Forestry 1,116.; Dairy 3,005; Veterinary & AH 4,989; Fishery 2,181; Agricultural Engineering 1,749; and Agricultural Biotechnology 305***.

13.3.1 Degree-wise Requirement by 2020

The required annual increase in outturn by 2020 by education level and discipline is given in Table-13.2. The current level of graduate, postgraduate and PhD output need to be increased by 2.3, 1.9 and 3.0 times respectively.

Table-13.2: Required Annual Increase in Outturn of Graduates by 2020

Discipline	UG	PG	PhD	UG & above
Crop Science	6807	1908	620	9335
Horticulture	6294	584	275	7153
Forestry	874	140	101	1115
Veterinary &AH	3571	1057	361	4989
Fisheries	1811	309	70	2190
Dairy	2350	473	182	3005
Agri Engineering	1141	447	162	1750
Agri-Biotechnology	24	167	114	305
All above	22872	5085	1885	29842

13.3.2 Additional Colleges to be Established

At the current rate of outturn is less than 65 per cent of the intake capacity. Though full capacity utilization is not possible, the system efficiency can be improved to produce another 15-20 per cent additional manpower from the existing system. The expansion may have to consider this factor.

The demand of professionals at PG and PhD level would be met through increase in number of sanctioned seats in existing colleges. At UG level, considering the current intake capacity and large gap in demand-supply, there is a need to establish about 150 new colleges. Discipline-wise new colleges needed are given in Table-13.3.

Table-13.3: Additional Colleges Needed at UG Level

Discipline	Additional number of colleges needed
Crop Science	30
Horticulture	50
Veterinary & AH	25
Fisheries	15
Dairy	20
Agri-Engineering	5
Forestry	5
Total	150

The new colleges would also require adequate infrastructure and qualified teachers to ensure quality of education. To meet the projected demand and required outturn growth and various issues pertaining to education quality and management important observations and conclusions are given below under various components.

13.4 Educational Planning

1. The results show that there are at present substantial gaps between demand and supply of manpower in agricultural and allied sciences even to the tune of 50 per cent or more. This is true across the board, though the shortfall is high in the case of rapidly growing horticulture, dairy and fisheries sectors and less serious in others. Dairy, fisheries and horticulture are the future engines of growth in the agricultural sector, and are important from the point of view of food security of the nation. Their growth, in particular, should not be hampered by manpower unavailability snags. No doubt, there has been some acceleration in the outturn of high level agricultural manpower in recent years, but it has been shown that even this belated accelerated growth would hardly make a dent on the seriousness of the problem. **The study recommends 2-3 times increase in UG intake and strengthening research as a precursor to expand intake in PG/PhD programmes in the existing colleges.**

2. The study also shows that the present educational facilities at their current levels of output will not be able to cope with the demand pressures likely to emerge in the next decade and substantial step up is required even to contain or slightly reduce the current and future demand-supply gap. **The situation demands pro-active policies to encourage private sector in agricultural education.**

3. It is obvious conclusion that the increase in outturn could be achieved through corresponding increase in intake capacity. However, review of the available outturn data suggests that the average outturn is around 50 percent of the sanctioned capacity. This is because some students leave the course after admission or midway to join other programmes or take-up employment. Besides increasing the intake capacity, **initiatives may be taken to improve the current outturn ratio**. **Dual and integrated degree programmes may be explored.**

4. Considering the preference of the students, mere increasing the intake might lead to lowering the intake quality. This would not be a desirable scenario, as it would affect the employability of these graduating students. In turn, **attempt may be made to make the courses attractive and demand driven**.

5. The demand estimates presented in this report are on the presumption that all jobs requiring agriculture and its allied sciences would in fact be filled by agriculture qualified personnel. This, in practice, is not always so, with people from general science streams and even unrelated fields accessing such jobs**. Some initiatives may be required to ensure proper matching of skills and job requirements.**

6. Initiatives for the future demand-driven growth in agricultural education at the **diploma and undergraduate levels should be left to the private sector** or should be taken in a public-private partnership mode, subject to quality assurance systems being in place. **Post-graduate and doctoral educations should continue to be the preserve of the public sector institutions.**

7. An important aspect of educational planning is to ensure availability of faculty in adequate numbers and quality with institutional arrangements for systematic up-gradation of their knowledge and skills. It has been observed that about 40per cent of the faculty positions in the agricultural universities have remained vacant for long periods of time raising questions about the quality of education. **It has been observed that at post graduate level the intake per course is very low as compared to other fields of technical and professional education. There is a need to consolidate the postgraduate courses to conserve the resources for optimum utilisation.**

8. Research is key to future agricultural growth and nation's food security system. It becomes more important today than ever in the context of emerging problems like limits on soil availability, degradation of available soil, declining responses to inputs, climate change and phenomenon like globalization. The research function is more likely to become directly production and productivity oriented and performed by the private sector as well. ICAR institutions and other public sector institutions in the central and state governments will continue to engage themselves in high level quality research. Here again, vacancies to the tune of 30 per cent in the positions of scientists does not auger well. The high quality research again calls for appropriate infrastructure as well as quality researchers. Researches need to be percolated at ground level. **ICAR may support research on educational technology, planning and human resources development.** Some of the indicative areas for research are employment pattern among the alumni, migration, area-specific skill needs, effective teaching strategies, sector-specific and state specific in depth studies for human capital assessment, etc.

9. Planning for agricultural education in the next decade has to look at the structure of the system. Till recently, the emphasis in the system has been more or less exclusively on the generation of graduates, post-graduates and doctorates and very little effort has been put in generation of intermediary skills at diploma level. Even though there have been some corrective steps on the part of some SAUs and colleges lately, a far greater effort is needed to promote diploma level education on the lines of engineering education. This is urgent in view of the expressed preference of the private sector, which is the future hope for increased absorption of agricultural human capital, for diploma level personnel to handle most of the routine jobs, leaving only management and research functions to the higher level manpower. A diploma in agriculture as an add-on to general education would also be helpful**. Efforts are required in generation of intermediary skills at diploma level.**

10. One of the critical factors in Indian agriculture dominated by small and marginal farmers is one of inadequate transfer of technology and consequently low productivity. Consultations as a part of the project pointed to the need for creating/strengthening local institutional mechanisms for providing day-to-day counselling and other escort services to the farmers at their doorstep. **To handle a variety of day to day jobs at grass root level, the 'bare foot technicians' need to be developed with multiple skills** – not only in regard to farm practices, simple and routine veterinary services, routine testing services, and various other rural occupations but also on aspects like agro-processing, marketing, escort services, etc. Such skills need to be developed among the rural youth themselves, preferably targeting school dropouts, as youth from urban areas or with higher education shy away from working in rural areas.

11. The industry survey results indicate that there is more demand for skilled personnel at lower level. These to great extend could be met by diploma / certificate holders. **The SAUs should provide guidance and necessary support to these specialized diploma / certificate programmes**.

12. These multi-skill development programmes can be dove-tailed with government's Skill Development Mission or an integrated course can be started through existing institutional systems. The para-staff can be trained in agriculture schools, finishing schools imparting specific skills and vocational training institutions. **There is a need for certification and promotion of programmes for para staff.**

13. Large number of government programmes aimed at agriculture and rural development need trained human resources for services at village level. A number of government programmes aimed at rural industrialisation and farm mechanisation would attract youth to such programmes. **This report recommends mandating every plan programme to identify area-specific needs of trained personnel and include capacity building as part of such planned activities.**

14. An important development in agricultural education in recent years has been the increasing participation of girls, with their share of enrolment reaching 30 per cent overall and even over 50 per cent in some universities. **Girls hostels and other facilities, specially in rural areas, may be created to encourage increase enrolment of girl students.**

15. Some finishing schools can be started either for girls alone or certain per cent mandated for girls. **The development of soft skills and other entrepreneurship skill courses can be imparted to girls so that they could be economically active.**

16. Proper database management is vital for educational planning. ICAR has no doubt taken useful steps in this direction by establishing databases like NISAGENET and PERMISNET, but there are serious operational issues. NISAGENET is not up-dated regularly by the SAUs, while PERMISNET has no provision for maintaining data on a historical basis. Nor does it allow access to outside researchers. ICAR could consider throwing open limited aspects of the system that are read-only and those that do not reveal individual's details to general researchers. SAUs may be encouraged to place their academic data and yearly placement details on their websites. **ICAR may institute a special scheme to create and maintain agricultural human resource database of the country.**

17. It is important that labour market signals for agricultural manpower are monitored on a regular basis to analyse the employment and unemployment situation among them that may unfold from time to time and work on corrective measures. **A Cell to conduct research in the labour market related issues of agricultural education may be established in the education division of ICAR**.

13.5 Skill Needs and Instititional Mechanism

18. Survey indicates towards the need for skill up-gradation in the light of technological innovations as well as skill development in the emerging areas in the sector. An indicative list for skills to be developed has been provided in the full version of the report.

19. Quality of education is directly related to the employability. Consultations with industry and academicians as well as students suggested a large gap between the skills imparted in the institutions and skills required in the employment market. This calls for a re- look into the curriculum, teaching strategies and establishing forward and backward linkages. Although the Fourth Deans' Committee recommended a strong practical orientation to agricultural education, actual implementation is evident only at some places. There is a strong demand from all the stakeholders for skill-specific education with clarity of basics as well as hands-on technical expertise. In other words, there is a need to develop functional skills among the students in educational institutions almost in all the sectors of agriculture. The issues relating to course syllabus, effective teaching strategies, and quality of teachers need serious thinking and policy interventions while considering expansion of agriculture education as well as meeting the labour market challenges. **Educational reforms may be linked to effective human capacity development plans.**

20. The results of the study show that manpower supply in almost all the sectors of agriculture is less than the demand. However, it is widely felt that agri-education is not considered as a professional course at par with other professional courses, especially at graduate level. **Pro-active policies are needed to give agriculture its proper dignity and place.** This would also facilitate in attracting youth to join the sector not as a compulsion but as a choice.

21. Another concern is of quality of teachers. Agriculture is undergoing rapid transformation with the advent of new technologies, commercialisation and globalisation and emergence of issues relating to climate and environment. Teachers have to keep pace with these developments and the resulting need to acquire new knowledge. While some organizations are imparting training in the emerging areas, there is no specific training policy for up-gradation of the skills of teachers. **A plan of action has to be evolved so as to cover all the teachers under capacity development programme in a specific period of time.**

22. At present there are very few institutions such as NAARM and HAU providing teacher training in agriculture. As there are about 25,000 faculty and scientists in the country, to cover all of them under training programmes in a five year cycle, **there is a need for at least six institutes with the sole training responsibility**. International experts may be invited to impart advanced knowledge wherever needed.

23. It is strongly recommended that extension services in the country should be strengthened on priority with adequate infrastructure facilities, staff and other resources to cater to the needs at micro level. Regular follow-ups of the programmes operated under extension services are also needed. Synergies in various organizations such as extension services, NGOs, SHGs, farmers' associations, etc., are extremely essential.

13.6 Other Issues

13.6.1 Financial Support

24. Adequate institutional funding and infrastructure and effective management are some of the areas that directly made an impact on quality of education. Available budgetary resources are far from satisfactory to develop infrastructure or world class laboratories in the colleges and universities. 80per cent budget is spent in meeting the establishment costs leaving little money for developing resources. **Specific budget provision to be made to support SAUs on regular basis for infrastructure development.**

25. A number of private colleges are offering or are keen to offer PG education. They find it difficult to sustain due to lack of support for research infrastructure. At present, these colleges are not in a position to access the limited competitive grants available in the country. **Graduate research through a special scheme can be initiated as is available in AICTE.**

26. Results indicate that a number of private colleges are coming forward to impart agricultural education. There is a need for more serious dialogue on entry of private sector to maintain quality in agricultural education. While initiatives by private sector are welcome as public sector alone cannot meet the increasing demand of the agricultural education sector, the public system should support these institutions to ensure quality in education. Financial support is extremely necessary to attract good and qualified teachers and establish quality research infrastructure**. As agricultural education is not viable on commercial terms, teachers' selection and their salary should come from government so as to encourage private sector.**

13.6.2 Agriculture at School Level

27. Agriculture education at lower level is no one's baby. Very few courses in agriculture subjects are taught in ITIs and Polytechnics and in schools. Agriculture education can be developed in a three-tier system as is being done in engineering. **Agriculture should also be introduced at school-level** as has been done in China and in some other countries so as to motivate students towards agriculture sector as many students are shying away from this sector. Madhya Pradesh has started the subject at school-level and others may follow.

13.6.3 Urbanisation of Agricultural Education

28. Enrolment of urban-based students has been on the rise in agriculture resulting into a continuous decline in share of rural students. The imbalance is due to the fact that urban students have better exposure and facilities and, therefore, have better competitive skills to corner the seats. There is great reluctance of majority of trained manpower to work in rural areas as opportunities in rural areas are less attractive. They sometimes shift from this sector to other types of employment. There is a need to provide better opportunities to them in the sector which can be given a serious thought for further probing. Some alternatives can be considered. One could be to reserve seats for rural students. Another

option can be mechanisation and industrialisation of rural areas to attract qualified youth to work in rural areas. **New colleges/ polytechnics in rural areas be established so that rural youth could join the agricultural courses**.

13.6.4 India as Knowledge Centre

29. There is a general feeling that the country is not having high standard colleges of international standard except for few ICAR institutes and universities. While India is evolving as strong knowledge centre**, it is time to establish few central universities with international quality standards providing education from UG to higher levels in all agricultural disciplines.** The country can have minimum ten such universities, each providing education in growth areas of agriculture. The universities also need to have multidisciplinary focus to include agriculture with biological and social science disciplines and programmes. It is expected that such universities would provide high quality future human resource to teach and train at other institutions.

30. There is a wide spread concern for quality of agricultural education. A regulatory authority with adequate staff and funding would help in improving educational standards. Agriculture has to meet the needs of the society at various levels. It has to serve the requirements of the industries as well as of farmers. It also has to keep pace with youth aspirations. It is the sole agent to ensure food security. **Appropriate policy and regulatory interventions be put in place to revamp educational system.**

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