CHAPTER - I

INTRODUCTION

CONTENTS: -

The Background Of Indian Agriculture
Increasing Production
Historical Perspective
Present Status
SAUs Development
Agricultural Education Outside The SAUs
Role Of Indian Council Of Agricultural Research (ICAR)
Need For Reorientation
Adequate Financial Support
Distance Education
Vocationalization
Commercialization Of Agriculture
Assessing The Requirements For Trained Human Resource
Evaluation Of Students Performance
Courses And Curricula
Quality Of Research At Postgraduate Level
International Agriculture
University Infrastructure For Teaching
National Agricultural Education Board
Women In Agricultural Education
Key Features Of Open And Distance Learning

Reshaping Agricultural Education

Linkages Among Educational Institutions (National And International)

Objectives

Research Methodology

Chapter wise Schemes
The Background of Indian Agriculture

India is mainly an agricultural country. Agriculture accounts for approximately 33 percent of India's GDP and employs nearly 62 percent of the population. It accounts for 8.56% of India's exports. About 43% of India's geographical area is used for agricultural activity. In the past, India had to import most of its food. But improved farming techniques, use of irrigation and high-yielding crops have greatly increased our food production through the post-independent decades. Since most of the cropped area does not have any assured irrigation even now, the monsoon assumes a crucial role in influencing agricultural production.

India's agricultural exports (excluding tea, coffee, marine products and raw cotton) during 1994-95 accounted for Rs 70,490 million. The important items of agricultural export include rice, cashew nuts, coffee, tea, horticulture and floriculture products, etc.

Increasing Production

One of the main challenges facing India was producing enough food for the increasing population. As not more than the existing land is fit for cultivation, India has to strive to augment the productivity of the existing land. Over the past four decades, India more than tripled its food production. The high yielding varieties of wheat and rice in the mid-1960s led to this dramatic increase. Although 30 percent of this production growth (known as the Green Revolution) came from expanding the farmland area, most of the increase since the late 1970s, has come from increased average yields. In other words, farmers using the new varieties of grain were growing more food on the same amount of land.

India has the world's largest cattle population (193 million), large numbers of sheep and goats, and more water buffalo and camels than any other country.
This has placed heavy demands on the grazing lands. Both grasslands and forest areas suffer as a result.

Growth in milk and egg production also increased dramatically. Dairy and poultry enterprises now provide substantially higher financial returns per hectare than crop farming. Such enterprises create new jobs and bring about health and nutritional improvements.

Increased use of irrigation has helped India increase average yields. About one third of the cropland in India is irrigated, but rain-fed agriculture is central to the economy. Harvests and national prosperity have traditionally depended on a successful southwest monsoon, the source of about three fourths of India's annual rainfall. The timing and intensity of the monsoon varies from year to year. About one fourth of the cropland is prone to flooding.

Though irrigation is a reliable source of water and helps increase productivity, it may also damage the soil making it less productive. The soil tends to become saline when the water evaporates and leaves salt deposits. Sometimes irrigation leads to waterlogging of the soil, lowering crop yields and hastening the loss of soil nutrients. Irrigation also leads to loss of soil nutrients (such as zinc, copper, and iron) that plants need to grow. Soil degradation seriously affects agricultural production. About 210 million acres (85 million hectares) of India's farmland are affected by salinity problem.

Despite its great progress in increasing agricultural production, India's average yield of cereal crops is less than half that of China and the United States. However, production must be increased without destroying the basic resources of soil and water if it is to be sustainable.

Improved irrigation techniques have the potential to increase food production. Improved farming techniques in areas that rely on rainfall also could improve yield. Improving the use of fertilizer, especially on rain-fed land, also would help production. India is trying a variety of strategies, from sophisticated water management techniques to traditional farming practices.
Rural transformation is a goal which most of our great statesmen, politicians, intellectuals, scientists and people at large have been striving to achieve for our country. Information is the most important element that can bring this transformation. People should be continuously communicated about the information pertaining to materials and methodologies involved in modern agriculture, hygiene, health, horticulture, diary, poultry & fisheries etc. People need to be informed of the appropriate information about value addition to the produces generated by the farmers and the efficient marketing system. Agricultural farming should become a source of attraction to the young generation of our country. It has to be made so attractive that the young educated graduates confidently take to it as a prestigious profession. It should drive the young graduates for practicing agriculture and allied activities in the rural areas. Success on this line will become a milestone in rural transformation.

Our past heritage placed agriculture on a high pedestal. During the Vedic period also farming was given a very high position. The Chanakya’s ArthaNiti lauds the role of agriculture as “Vinijaya Vasati Laxmi, Tadardham Krishi kshetrani, Tadardham Rajakarmeshu, Bhikshyam Naibacha, Naibacha” Thus, kheti(farming) has always been given a higher status than the service to the state. In contrast, the present age agricultural graduates who are the products of prestigious agricultural universities are desperately searching for any available jobs in cities. Surprisingly therefore, modern agricultural education has not given them enough confidence to go back to their farms and apply the modern technologies and knowledge acquired by them. Thus our present education system has got to be changed to a more farm-oriented system to bring about transformations in the rural scenario.

The Indian Council of Agricultural Research (Imperial Council of Agricultural Research, established in 1929) and the State Agricultural University
System have a massive infrastructure spread all over the country. The ICAR itself has got more than 6000 scientists and about 10000 highly qualified technical personnel in its rolls. The State Agricultural Universities have got more than 50000 scientists. The ICAR & SAUs have created one of the best national facilities for research, education and extension in the field of agriculture and allied activities. There are about 300 Krishi Vigyan Kendras (Farm Science Centres) engaged in the activities of non-formal training by the well-known methods of 'Learning by Doing'. Several technologies have been developed through research over the years.

India has been and is an agricultural economy over the ages. It has got tremendous scope for the development of agriculture since it has vast and unique varieties of agro climatic zones and natural resources in different parts of the country. The balanced and rational exploitation of these resources and their management for yielding better results and to conserve them for the future generations warrant suitable scientific and technical manpower as the basic tool.

The rate at which the population is growing is leading our country towards further challenges. It is necessary to accelerate our food production to meet our growing food requirement for the population. About 70 percent of our population depends upon agriculture and allied activities. Out of them only 15 percent are big farmers and 85 percent are small farmers, marginal farmers and landless agricultural labor. Agricultural production in the country depends upon inter-alia the hard work of the farmers. However, The socio-economic conditions of these farmers are deplorable.

We have developed/ improved varieties and related production technologies for almost all the essential crops. But these technologies are not reaching the farmers in a desired manner. Thus there remains a big gap.
The network of the State Agricultural University System and the agricultural research, education and extension system have already proved their worth by providing effective technologies and manpower development support to the food production efforts during the last 5 decades. However, it is important to critically review our approaches to the system of agricultural education, extension and research, as it requires an appropriate policy framework, instruments and finances. Presently ICAR is providing funds for the promotion of education research, and training in the SAU’s. Almost all the states have been brought under the agricultural University system including the North Eastern Hill Region (NEHR) (by establishing a Central University). The establishment of institutions is a long drawn process and needs huge investments that take years to bear the fruit. Such activities, if not well conceived and properly planned would result in wasteful expenditure at the cost of quality. Thus there is need for the judicious use of scarce resources at our disposal and qualitative management in the standard of education and research. Our Agricultural Universities need to produce graduates, postgraduates, doctorates and scientists who should excel in their own respective spheres. The curriculum committees and the accreditation boards need to rigorously review the curricula and update them in accordance with the progressive changes in technologies and packages of practices. Issues like National Eligibility Test and Fellowship Examinations have already been streamlined. There is need for greater emphasis on practical contents in terms of rigorous fieldwork to gain considerable handsome experience. The ICAR, which plays the role of the UGC for the SAU System, and armed with a vast range of research programmes and projects yield considerable power and authority for the furtherance of quality education in agriculture. The SAUs which are the major instruments of agricultural education in India, have made valuable contributions in terms of location specific and need based research resulting in the decentralization of agricultural research from their main campus to various regional research stations within their respective jurisdictions. Such a strong network of agricultural education, extension and research provides excellent linkages and mutualism to all the 120 agro climatic zones in the country. A total
of 343 Zonal Research stations and sub stations have been established under the National Agricultural Research Project (NARP). This NARP has supported the Universities not only financially but also helped in the development of infrastructure facilities and manpower growth. Our efforts in the next five years should be to consolidate and improve the quality of education by ensuring that financial constraints do not impede progress in this regard.

**Historical Perspective:**

The history of agricultural education could be traced back to the ancient times when agriculture was included in the curricula of the Nalanda and Takshila Universities as one of the 18 arts. However, organized courses in agricultural education started only in the beginning of the 20th century when six agricultural colleges were established at Kanpur, Lyalpur, Coimbatore and Nagpur in 1905, at Pune in 1907 and at Sabhor in 1908. Thereafter more colleges were established. At the time of independence we had 17 colleges for agriculture and allied sciences.

Soon after independence the urgency of bringing about rapid increase in food grain production necessitated re-examination of the existing pattern of agricultural education. Need was also felt for establishing closer inter-relationship between research, extension and teaching programmes which was not possible under the general university education system. It was realized that the key to increased and more efficient agricultural production was a coordinated system of agricultural education, research and extension suiting to the unique needs and aspirations of our farmers. This is the background under which the concept of agricultural universities emerged. By and large, before the establishment of agricultural universities, the department staff at different locations in the states was carrying out instruction, research and extension activities in agriculture and animal husbandry with very little coordination among them. College teachers, on the other hand, neither did much research nor had contacts with the problems of
the farmers. In fact, most agriculture colleges did not have any strong programmes of scientific research and extension.

After independence, the Govt. of India appointed an University Education Commission under the chairmanship of Dr. S. Radhakrishnan to review higher agricultural education with a view to suggesting measures for meeting the future requirements of the country. The Commission recommended that agricultural education be recognized as a major national priority so that the country is able to feed itself. The Commission recommended the establishment of autonomous rural universities and according to them the same facilities as were available to other universities, including substantial grant-in-aid from the center for their development. The agricultural training programme in vogue at that time invited much criticism, as they were divorced from agricultural research and extension organizations. Important bodies such as the University Education Commission, the Joint Indo American Teams and the Nalagarh Committee opined that unless the educational programmes were reorganized and reoriented, they would not be able to meet the needs of the farmers. For effecting significant increase in agricultural production it was essential to take full advantage of the benefits of science and technology. Additionally, the curricula under the then existing university system was rigid, out-dated and lacked practical skill and expertise development. It was also recognized that the agriculture sector had certain distinct features that distinguished it from other sectors of economy, and therefore, justified a different kind of treatment than the other branches of learning.

Present Status

The SAU system comprises of 30 SAUs, one Central Agricultural University (CAU) for the north-central region and 4 national ICAR research institutes in the rank of Deemed-to-be-Universities (DUs). The SAUs are carrying out both UG and PG studies including doctoral programmes. The UG programmes presently
cover 11 disciplines such as Agriculture, Veterinary Science, Fishery Science, Forestry, Sericulture, Dairy Technology, Food Technology Horticulture, Home Science, Agricultural Engineering and Agricultural Marketing whereas the postgraduate disciplines include as many as 75 different areas of studies and research. Annually SAUs, DUs and CAU admit over 17000 students under the various UG and PG programmes. The proportion of girl students is increasing significantly indicating a definite trend towards progressive women technological empowerment. At present there are 199 agricultural colleges, which include 66 colleges for the agriculture discipline alone. The discipline wise distribution of colleges is shown in fig. I. Some of the universities in Maharashtra and Gujarat states have schools of agriculture also for the training of middle level technical personnel who serve the rural areas through their jobs in the private sector or through self-employment.

SAU’s Development

The development of State Agricultural Universities, despite the adoption of the Model Act and the recommendations of various committees, followed a variable pattern in terms of university governance, organization structure and performance. The whole concept of development of SAUs as mono-campus multi-faculty universities underwent change as off-campus colleges were opened or added to the universities to meet the aspirations of people in various regions and to concentrate on agro-ecological research. As of now all the State Agricultural Universities function as multi campus universities. Three of the universities are discipline oriented namely Y. S. Parmar University of Horticulture & Forestry, Solan; Tamil Nadu Veterinary & Animal Sciences University, Chennai and West Bengal University of Animal & Fishery Sciences, Belgachia. The latest addition to the SAU system is the Rajasthan Agricultural University at Udaipur. Presently Maharashtra has the distinction of having the largest number of universities.
The growth of universities saw a variable pattern of development. While most of our states transferred their research and extension activities, to the SAUs, a few states were reluctant to do this. Even now the Government of West Bengal has not transferred her research and extension activities relating to animal science and fisheries to the university. During the period of their establishment, all state Governments provided tremendous support for the growth of agricultural universities because of the strong conviction and belief that economic benefits could be brought to the farmers only with the application and adoption of new technologies.

**Agricultural Education outside the SAUs**

Concurrent with the growth of SAUs, some states also witnessed the opening of agricultural colleges affiliated to the general academic universities. This eventually adversely affected the development of new system of agricultural education. At present there are 48 colleges of agriculture affiliated to state level traditional academic universities, admitting as many as 2500 students annually at the UG level. Many of these institutions do not have adequate infrastructure or competent faculty to impart necessary skill and training.

**Emerging Issues**

Most of the SAUs at the beginning of their establishment recruited their faculty largely on the basis of national merit. Extensive opportunity of overseas training support by USAID and tie-up with land grant universities of USA, helped development of faculty competence. This was the main reason that the SAUs performed well and developed the human resource that was instrumental in ushering the green revolution. Over the years, the strongest National Agricultural Research System (NARS) developed a strong human resource for the agricultural R&D needs of the country through the SAU system. It is a matter of
great national price that the establishment and growth of the state agricultural universities, which have been instrumental in developing a strong force of scientific and skilled human resource, which played a key role in revolutionizing our agricultural transformation. However, our SAU system does not seem to have kept pace with the fast changing global developments in agricultural technologies especially in biotechnology and genetic engineering. If the reasons behind the slow pace were not addressed in time, we would soon take the back seat as; we march to the next decade. The main concerns that need to be resolved include the following: -

i. Lack of adequate financial resources: - Although the SAUs have been established on the pattern of the land grant colleges in the USA with complete integration of research, teaching and extension, the holistic integration did not take place in all the universities. The opening of a large number of campus colleges without commensurate financial resources or manpower planning has led to considerable erosion in the quality of these institutions.

ii. Extensive Inbreeding- Due to certain introvert state policies and actions during the last several decades, we are today faced with the situation of extensive inbreeding in the SAUs. A majority of the recruitments are basically confined to the region and products of the university. Most of the Universities, as of now, suffer from inbreeding to the extent of even more than 85%. This is hardly conducive to the sustained academic and scientific growth of the universities. It has also led to a great degree of parochialism.

iii. Poor Infrastructure- University functioning requires tremendous financial support. But because of various social commitments institutions have not been able to alter then existing fee structure that is heavily subsidized. Therefore the SAUs have been forced to be largely dependent on the state and central grants. With the passage of time however, severe financial crunch is being experienced by the state governments, are driving infrastructure development to a state of
zero growth. As a result most universities have rather poor infrastructure, libraries and outdated equipments.

iv. Lack of career development plan for faculty - This is one area which has been more or less neglected in most State Agricultural Universities over the last one decade. Most of the Institutions have no career development plans. The kind of opportunities for the training of faculty which existed during the early periods of their establishment, dried up due to lack of donor support. Faculty competence is critical since faculty is the key resource for academic excellence. Unless the faculty keeps abreast with the new developments, it is hardly possible to impart the necessary skills to the graduates. The role of teachers, in fact, is totally changing the world over, therefore, instead of being only an informer of knowledge, the faculty is going to be knowledge navigators in this century, and this would necessitate training on a continued basis.

Role of Indian Council of Agricultural Research (ICAR)

Since nutrition and food quality has been the primary concern of the nation over the years, the Central Government through the ICAR has been providing support for the development and growth of agricultural education in the country. Up till 1966, 8 SAUs had come into existence and the financial support provided remained quite inadequate, being less than 2.5 million rupees per University during the Third Five Year Plan. In 1966, the ICAR was re-organized, giving it the expanded role in relation to agricultural education. A full-fledged Division of Education under the DDG (Education) was established to provide necessary funding support to these Universities. In 1973, when the Cabinet took a decision to transfer the mandate of agricultural education from the UGC to the ICAR, the ICAR became for SAUs what the UGC is for the general universities. This change led to the strengthening of the ICAR's educational programmes for providing strong support for the sustained development of the State Agricultural Universities. In order to meet the human resource requirement of the
northeastern region a Central Agricultural University was established in 1993 at Imphal with full infrastructure support for all the UG and PG programmes.

**New Initiatives**

In realization of its role as UGC for the Agricultural Universities, the ICAR initiated a number of reforms for the improvement of quality in education. These include the establishment of an Accreditation Board for quality assurance, course curriculum revision, conduct of All India Competitive Examination for admission to 15% seats at UG and 25% at PG levels in order to reduce inbreeding.

**Need for Reorientation**

Food, nutrition and education hold an important key to both the sustainable human growth and development. We have been able to achieve household food security mainly through the efforts of our strong National Agricultural Research System (NARS) consisting of the ICAR Institutes and the State Agricultural Universities. India's spectacular achievements in agricultural production from a barely 51 million tones in the 1950’s to over 203 million tones in 1998-99 is a great success story. Such an achievement is unparalleled in the history of various nations. The sharp increase in food grain production during late 60s has been ascribed to the Green Revolution. The nation paid compliments to this splendid achievement by the release of a stamp commemorating Green revolution. The new breed of skilled agricultural graduates produced by the SAUs and DUs participated in the growth by being instrumental in not only generating but also in assessment, refinement and dissemination of new technologies. The establishment of a Post Graduate School at IARI to produce human resource for the development of State Agricultural Universities was one of the most important steps. The establishment of the first State Agricultural University at Pantnagar followed the creation of this important school, which in turn heralded the growth of the State Agricultural Universities with at least one SAU in each of the major
states. Today we have 30 State Agricultural Universities, one Central Agricultural University for the northeastern region and four National Institutes in the rank of deemed-to-be-Universities (IARI, NDRI, IVRI and CIFE) associated with the ICAR. In addition, three Central Universities namely the Banaras Hindu University, Vishwa Bharti University and the Aligarh Muslim University have strong agricultural faculties. These institutions together enroll over 10,000 students at the Under-Graduate level in as many as 11 different disciplines and over 6,000 to 7,000 students at the Post-Graduate level for Masters and Ph.D programmes. At any point there are over 55000 students studying in the various SAUs. Additionally 49 private agricultural colleges produce about 3000 graduates annually. The human resource developed by such a strong National Agricultural Research System (NARS) has been playing a very significant role in ushering the green, blue, yellow and white revolutions and bringing prosperity to the farmers and the country.

In retrospect, it must be said that the major role of agriculture in the national economy led the Govt. of India to appoint several committees to critically study the need for all the establishment of a strong agricultural education, research and extension base for the country starting from the first Indo American Joint Team in 1955. This team made a study of agricultural research and education in USA and India and submitted a report with recommendations to strengthen and reorient agricultural education including veterinary education. The team further recommended that the development of rural universities should be assisted by substantial grant-in-aid from the Centre that will ensure autonomy and efficiency of operation. The recommendations included the establishment of rural universities in UP (Tarai), West Bengal (Haringhatta), Bihar (Patna), Orissa (Bhuvneshwar) Travancore - Cochin and the State of Bombay (Anand). The first agricultural university in India was established at Rudrapur in U.P.
The Govt. of India appointed the second Joint Indo American Team in 1960, to assess the progress made during the First and Second Five Year Plans and recommend the course of action for the Third Five Year Plan. The team was also directed to examine the inter-institutional linkages located in 1955 with five Land Grant Universities of USA and whether this should be continued during the Third Five Year Plan. The team recommended that an agricultural education pattern with well-defined objectives be developed to encompass agricultural teaching as a vocational subject through the existing colleges and universities. It emphasized that at the college level there should be complete integration of research, teaching and extension. The team made strong recommendations to strengthen the undergraduate and postgraduate programmes in different institutions.

An Agricultural University Committee headed by Dr. Ralph W. Cummings in 1962, recommended the establishment of State Agricultural Universities in each state with responsibility for work in agriculture including animal science, home science and other allied sciences essentially on the pattern of U.S. Land Grant College system and provided guidelines for developing SAUs. Based on this experience the Indian Council of Agricultural Research (ICAR) developed a Model Act in 1966, which could be adopted by the newly developing agricultural universities. Under the U.S. AID programme eight Indian SAUs, developed linkages with U. S. Land Grant Universities and received assistance in developing teaching, research and extension programmes. During the mid 60s, the Kothari Commission on education also recommended the establishment of at least one agricultural university in each State and bringing all research in agriculture under its jurisdiction. The implementation of these recommendations led to the integration of teaching, research and extension education in the states and the country.

Although we could develop one of the best HRD system for agriculture in view of the current and emerging challenges, reorientation of the present system of agricultural education seems timely so in order to enable the farm graduates to
become job providers rather than job seekers. This necessitates an agricultural education of very high practical content duly supported by subsequent institutional financing, where needed, for the agricultural graduates to venture into various agribusiness activities. Such an approach only could address the current problems of the farming sector effectively. Towards this concerned Institutions need to develop appropriate farming technologies suited mainly to medium, small and marginal farmers. There should also be significant improvement in the quality of inputs and managerial practices. It is well recognized that growth in agriculture propels higher industrial growth and brings economic transformation for vast segments of our population. The revolutionary developments in farm sciences need to be harnessed to bring economic benefits to our people. This is possible only if necessary structural changes are introduced to convert the current realities and the challenges into opportunities. The institutional system must be made more relevant to the real issues and concerns in order to reinvigorate its commitment to the linkages among teaching, research and public service. These components need to be reorganized so that the programmes become really capable of fulfilling the national requirements in agriculture.

It is however, forty years since we established the first state agricultural university. While the SAUs have performed well in general, global developments in technologies warrant them to be more competitive so as to boost the country's agricultural export performance. During the early phases of our agricultural academic programmes the emphasis was on a structure that produced graduates who became primarily technology agents. In the present era of specialization and sophisticated technological developments in agriculture it is necessary that we restructure our agricultural education in a manner that the farm graduates are able to meet the challenges of this new millennium to propel the Indian agricultural economy with determination, zeal and commitment. It is only then that India could become a developed nation with in the time frame of next 20 years. For this to happen, the universities must further strengthen both formal
and non-formal programmes to bring in academic excellence into our agricultural education and make it more relevant to our real needs. The following suggestions are made towards the realization of these objectives.

**Skill and entrepreneurship development**

In order to develop entrepreneurship skills and confidence, it is important that students serve internship in any of the wide range of settings representing diverse career opportunities. For this purpose, in the revised course curriculum "RAWE / In-plant training has been introduced for 6 months. This programme should be strengthened and reoriented to give students confidence of working in actual farming systems and agribusinesses.

**Adequate Financial support**

As has been said earlier, food and nutrition security is the nation's greatest concern and therefore, our Governments need to provide strong supports to the SAUs. In the US, the Federal Govt. support is 30% to the Land Grant Universities while the State support is 51% with the rest coming in from private sector. In contrast the SAUs in India receive a meagre 7-8% support from the ICAR with State Governments contributing 80-90%. Therefore, the support from the ICAR needs to be stepped up. Adequate Central support would lead to strengthening the academic institutions for meeting the challenges of the new millennium. The support will also promote national integration and address issues of national relevance.

**Distance education**

Distance education is becoming a reality. The distance education technologies could be used effectively to share the under-graduate and graduate level courses, extension programmes and research findings with farmers and
unemployed youths to gain from this important source of knowledge. Current
distant education technologies take advantage of audio-video, multimedia via
satellite and computer systems and provide global environment through Internet.
Programmes could be structured for various credit courses, short courses,
workshops, certificate courses, conferences etc. In fact, computer aided
instructions consist of text, graphics, photographs, animated images, video,
audio and mixing real time information on various issues like weather forecast,
insect-pest development, land use planning, etc. Internet-based courses promote
continuing education by adding enormous content substance and meaning to it. It
is estimated that 75% of the students drop out at the 10 + 2 stage and this is the
major work force in rural India with, no access to modem technologies. Through
distance education, it is possible to reach those un-reached as well as ensure
technological empowerment of women for accelerating the pace of agricultural
development.

Vocationalization

The major lacuna in the field of agricultural education is the neglect of middle
level skill and manpower development that was also highlighted by the National
Commission on Agriculture (1976). The absence of agricultural vocational
education has created a communication gap in the effective transfer of
technology from lab to land. Vocational training on a large scale in various
fields/subjects can partly bridge this gap. Students unable to pursue higher
education, college dropouts, women in agriculture who have no facilities of higher
education and unemployed youths etc. can easily be oriented towards
agricultural vocations as per their traditional occupations. There is good scope for
vocations in animal husbandry and dairy technology, fisheries, horticulture, food
preservation, processing, sericulture, agribusiness, farm machineries, etc.
Vocational training must provide in the contents of its curriculum a very strong
practical training component. To meet the immediate manpower needs of
agribusinesses, certificate courses (3 to 6 months) and diploma programmes (one year) could be taken up to bridge the gap in different key areas.

**Commercialization of Agriculture**

In the past, we have not granted industry status to agriculture but with economic liberalization in the post GATT scenario, it is important to commercialize various agricultural commodities and add substantial value to these products. Our training and educational programmes must gear up in developing the human resource for these new challenges of trade taking advantage of the technologies in the frontier areas of science including biotechnology. This would result in our farms receiving higher economic returns by cornering a greater share of the export market.

**Information Networking and Management**

Knowledge is growing at the rate of 3,000 words per minute and the gap between the developed and the developing countries is widening simultaneously. Information is knowledge and knowledge leads to power and wealth. Our farmers and scientists have to keep pace with newer developments. This is possible only if our institutions are connected to international networking and have access to international database and information on emerging technologies.

**Reorienting Instruction**

There is need to broaden the curricula being followed so as to reflect a more comprehensively national and global vision of the food and agricultural farming systems. Teaching programmes must remain relevant to the various production issues facing the farmers. There is scope to enhance the efficiency of instructional delivery systems by reducing unnecessary replication and allowing Universities to develop more depth in specialized fields. This calls for right sizing.
down sizing or restructuring the educational programmes in the SAUs. It is not necessary that all SAUs have post-graduate programmes in all fields or for that matter all colleges need not duplicate the efforts. The restructuring would allow sharing and optimization of limited financial resources. The SAUs need to focus on high priority research and information needs of the region. The advances in science are leading to the restructuring of agricultural research, redefining educational needs and technological opportunities and realigning roles for public and private research.

Although at present private research is rather small compared to public research, but the latter is bound to increase in the new millennium. Therefore there is need to develop new partnerships.

**Continuing Food Security**

Although we have achieved food grain self-sufficiency, there is a need to have an evergreen revolution in view of expanding population. Nutrition and food security entails access to food at reasonable prices. Responding to national and global issues for India to play a dominant role requires integration of the physical, biological and social sciences to address the requirements of the new millennium. As the economy grows, consumer preferences also change and shape the demands. This necessitates training in the development of fast foods, value addition and marketing.

**Ecosystem Accountability**

There is growing awareness about the inevitable need for protecting the environment. In fact, agricultural farming systems have been targeted and increasingly asked for the conservation of national resources such as water, soil, forest land, fossil fuels, and for protection of environmental amenities spanning wildlife, habitat, water and air. Farmers will be increasingly asked to be effective
national resources and ecosystem managers. They face a highly complex policy and regulatory environment. Therefore, they require new knowledge and expertise in both management and technological innovations that can help them manage diseases, pests, and farm inputs in order to be profitable, competitive and accountable to a wide range of public concerns.

Economic Inequities
Our farming system is characterized by economic inequities. Despite 'green revolution' resulting in increase in production and productivity, we still have very large number of small and marginal farmers to whom the benefits of technology revolutions have not reached to the desired level. This has resulted in inadequate access to food and substandard nutritional status to a large proportion of our population. The limited resource farmers are confronted with poverty and few economic alternatives. Our SAU system needs to address the problems of this segment on priority basis to help reduce economic inequities.

The development of human resource based on land grant system has served the nation well. We are living in a technology driven world. As we march ahead in the new millennium, it is essential that the economic benefits are brought to small and marginal farmers and landless labours through the use of modern science and technology. This calls for changes and reorienting our SAU system in a manner that reflects the challenges as well as the new opportunities. The new system must address the issues and concerns of the new millennium by ensuring nutritional and food security, maintaining sustainability of the farming system, protecting environment, optimizing farm inputs especially, water, fertilizer and chemicals. In the context of economic liberalization and opening of world market, it is essential that we garner a major share of world agricultural exports to bring economic benefits to farmers through value addition. New technologies need to be developed, refined, assessed and transferred to farmers without further loss of time. New partnership with different stakeholders would lead to synergies. The Central funding should be a catalyst for institution innovation that responds to
contemporary and future social issues and realities. Let us build our future programmes on the strong foundation already laid through dedicated efforts, with focussed research and academic programmes involving partnership through institutions, private sectors, NGOs and farmers.

Assessing the requirements for trained human resource

There is need to undertake systematic exercises for a precise assessment of the requirement of trained personnel possessing undergraduate and postgraduate degrees in various fields of agriculture/animal husbandry and Fisheries sciences and extension services. Indiscriminate enrolment of students has led to overproduction of graduates in certain areas leading to unemployment whereas there is a shortfall of trained personnel in newly emerging sciences such as Information Technology, Agro-business Management and Biotechnology. There is need to have a well structured National Committee having linkages with farmers' organizations, government developmental agencies, state agricultural/animal husbandry/fisheries departments, R&D organizations, agro-processing industry, food processing industry, dairy industry and veterinary pharmaceutical industry both in public and private sectors, with the mandate to assess the requirement for trained human resource on a regular basis. Such assessment will help in developing guidelines for subject wise and region wise requirements of under-graduates and post-graduates in various disciplines of agricultural sciences. The SAUs and DUs could then provide necessary number of seats to meet the national requirements for trained human resources. This would avoid the problems of over - or under - production of trained manpower. Right sizing is important for achieving excellence.
Debeurocratization

All our SAUs and DUs follow an administrative system adopted from Govt. departments. Unfortunately such a setup is not suited to promote excellence in teaching and research. Debeurocratised institutions such as the Indian Institute of Science have progressed by leaps and bounds and achieved international competitiveness. While we adopted the American system of teaching (semester, continuous assessment and GPA) we have stayed put with the colonial administrative system that can't support the American system of education. Therefore, there is an urgent need to develop an altogether new administrative setup for all agricultural Institutions, rather than tinker with the existing outdated system. A national debate involving teachers/scientists/farmers at various levels must be initiated to develop our administrative machinery that supports and promotes excellence in teaching and research. By developing such a system SAUs/DUs could be role models for excellence in education.

Faculty competence

The most important component of education is teaching. For excellence in teaching, one needs competent teachers. One of the major reasons for the decline in the quality of teaching in the recent years is the decline in the quality of teachers. This has happened for many reasons. First, there has been an undesirable inbreeding in the Universities and second, promotions have not been based entirely on merit, and third, education has not been given due weightage in appointments and assessment.
Recruitment and career development of teachers

There is need to change the system of recruitment of teachers. Emphasis should be given to scientific research and teaching aptitude, commitment and psychological orientation. To test these traits a test format needs to be developed for inclusion in eligibility requirements. In future, all the teachers recruited by the Universities should come through National Entrance Test (NET) on All India basis with no domicile restrictions. The NET qualified candidates interested in a particular job should be called for interview by an Expert Committee that will have the responsibility of shortlisting 3 to 5 candidates for each job. The shortlisted candidates should be asked to give a seminar in the area of their interest to the Faculty and the Expert Committee. The seminars should be graded, particularly by the scientists and teachers of the concerned departments, to form an important basis for the final selection.

With such recruitment procedures, the Universities should be able to attract the best teachers but the University will have the responsibility for their career development. Every faculty member should undergo a training programme in the area of his or her discipline at least once in 5 years. Out of those faculty members who have undergone training, and have excelled in teaching, 25% should be given an opportunity for overseas training. This incentive will be very important to motivate the teachers for good teaching. Training should also be provided to the Professors, Heads of the Departments, Deans and Vice-Chancellors, for efficient management of education. The sabbatical leave provision should be made more attractive so that this mechanism of improving competence is utilized by a larger section of teachers than at present.

Pedagogical training

For a teacher to be effective, he must be well acquainted with all the latest teaching technologies. One develops his or her own technology for teaching but
a formal training in pedagogy immediately after induction into the faculty will help
the teachers in learning the latest technologies which could be used in their
teaching. This will have a singular effect in improving teaching and academic
leadership. The teachers must develop instructional materials including practical
manuals and teaching aids. Curriculum delivery must improve utilizing
technological developments in multimedia projections.

Assessment of teachers

At present, no credit is given for excellence in teaching, albeit some universities
have started recognizing teachers by giving 'Best Teacher Award'. The teachers
must be infused with the sense of pride in teaching. For this, the teachers should
be asked to make a self-appraisal of their teaching. The teachers should also
have access to the evaluation of their teaching by the students. The Professor,
Head of the Department, and the Dean of the Faculty should comment upon both
the self-appraisal and student assessment of the teacher. The evaluation
procedure should be objective rather than subjective. The teachers who are
found good should be encouraged and motivated for further improvement in their
teaching.

The motivation could be in the form of overseas training, award of additional
contingency grant of Rs. 50,000 per annum for the purchase of books,
preparation of audio-visual aids and purchase of consumables for student
research. Such outstanding teachers would be accountable for improving
teaching to be monitored by the Dean. For postgraduate teaching, the teachers
should also excel in research so that the teachers become a role model for the
students.

For the exemplary teachers provision should be made to provide merit
increments and accelerated promotion based on publications from students
research work in high impact journals. The courses at the postgraduate level
should be constantly upgraded. The details of contents should be determined by the teachers based on the latest developments in a subject. Should determine the contents of introductory courses and should be taken by good senior teachers who should be adequately rewarded for their exemplary teaching. At the M.Sc. level, students should be given good grinding on the basic aspects of their major discipline. The selection of minor discipline and courses should be very flexible. At the Ph.D. level, there should be minimum emphasis on course load and maximum on research. The courses to be taken should be determined by the Advisory Committee to bridge the deficient areas and their relevance to the area of specialization the student intends to pursue. For effective teaching empowerment of faculty through decentralization is essential.

The largest administrative group within a University system consists of mid level administrators who can significantly influence the tone, manner and style of entire organization and their morale is important for the performance of an institution.

The Department Chairs are a group of mid level administrators who are under stress. They cope with the stress resulting from 1) meeting the requirements of student population, 2) dealing with fund shortages, 3) increasing demand for quality education, 4) downsizing the departments and 5) balancing between academic and administrative roles through a variety of recreational mechanism. Department Heads in Indian Universities also face such high demands of their positions and need due attention to avoid undue stress. The experiences of Australian Department Chairs/Heads and US reveal that there are many potentially limitless resources that remain virtually untapped. Proper exploitation of these resources carries the potential to reduce stress among the teaching community.

Evaluation of students performance
At present the SAUs have adopted the American pattern of internal evaluation with some Indianization. A number of reports indicate declining standards of undergraduate education that is not based on systematic studies except for transcript analysis. The data revealed mixed trend, i.e., gains in some respects and losses in others. So, some foolproof method of evaluation or a combination of different methods can be used to evaluate the UG education system. Introduction of 50% external evaluation is desirable.

The quality of higher education can be assessed through 'Out-come based assessment'. Ecclestone (1999) is of the view that this method can enhance the student's motivation and autonomy and have beneficial impact on curriculum development but if taken too far, it can endanger more critical open-ended notions of student-centered learning. It may not foster intellectual independence and could undermine critical learning and autonomy. It may also reduce the desire to do anything challenging or cognitively difficult. However, for desirable standard of education, some assessment is needed.

Inter-University movement

Inter-University movement of faculty is highly desirable for cross-fertilization of ideas. The ICAR has developed a system of sabbatical visits that is not attractive enough to promote movement of competent faculty. In its present form it would serve more as an instrument to obtain placement for 'personal' reasons rather than academics. Similarly, there is a very limited movement on deputation. Both these mechanisms should be improved to draw benefits from them for improvements in teaching programmes. A monthly allowance of Rs. 10,000 to Rs. 15,000 depending on the years of teaching experience may yield expected results. Age limit should also be dispensed with to encourage movement of senior faculty. Provision for furnished suite type accommodation is also required.
Invited faculty

A system needs to be developed for inviting leading scientists and teachers, including superannuated scientists, who should be paid TA/DA as per their entitlement, and honorarium per lecture on the basis of ICAR summer schools/winter schools. Establishment of positions of Adjunct Professors for life, identified on the basis of excellence in teaching, would go a long way in improving education.

Courses and curricula

The courses and curricula of the Universities should be flexible to encourage students for achieving their goals of receiving best training during the period of their studies in the University.

At the under-graduate level there should be uniformity of courses for the first 2 years of studies but during the next 2 years they should take elective courses that should be developed based on the strengths in different disciplines of agricultural sciences in the University. These electives will prepare the graduate students for taking up jobs immediately after completion of their Bachelor's degree and will also lay the foundation for those who want to pursue academics. At the under-graduate level, the students should be empowered to use the latest developments of information technology. This is very important for modernizing agriculture education in the country. The senior faculty must offer at least one course to the under-graduate level in the area of his/her expertise. The teacher-student ratio for theory classes at U.G. level should be 1:40, and for practical 1:20; similarly for P.G. classes it should be 1:20 for theory and 1:10 for practical. However, these ratios should be flexible.
The courses and curricula should have socio-economic relevance so that the new generations of scientists are motivated to take the new and emerging technologies from lab to land.

**Quality of Research at postgraduate level**

The need for doing research at M.Sc level needs careful rethinking. Research at Ph.D. level should inculcate the habit of scholarship of discovery and their new findings should result in good publications in high impact journals. Early success of publication of results builds confidence in the students. To achieve this goal, it is essential that their guides are good research workers and who could play the role of mentors. For this purpose, the Ph.D. students should be allocated to the faculties who have externally funded projects. They must understand that knowledge is continuously expanding and new subject areas are emerging. In the coming years, there will be greater emphasis on collaborative research in a multidisciplinary mode in order to satisfy both the desire for doing basic research and applied research. This would require multidisciplinary knowledge through sound education.

At IARI, submission of at least two scientific papers to refereed journals, before thesis submission, has been made compulsory for Ph.D. students. This has yielded good results.

Gradually we should develop the system of awarding Ph.D. only on the basis of published work as is done by some universities in other countries.

The Ph.D. students should also be involved in the teaching programme of his discipline. This can be achieved by providing a clause in the Sr. Research Fellowship, that the students will provide teaching assistance of 5 hrs. per week in their discipline.
Weekly seminars

The quality of seminar given by the students needs improvement. The seminar should not become just a ritual. The grading of the seminar should be transparent and open so that it also helps the students in future.

Each Department must organize seminars every week to be given by the faculty members of the University or by invited experts to talk on the area of their research. This is important to provide opportunity to the students to interact with the leaders in their fields in the country and if possible outside the country. The students should also have interaction with the farmers/industry through visits under Rural Agriculture Work Experience/Rural Homework Experience/Veterinary Internship.

International Agriculture

With the liberalization of world economies and access to the global markets under WTO regime, a number of changes are expected which will strongly influence the basic agricultural practices for food production, processing, distribution and marketing. Such changes would be coming faster than we in India have been able to appreciate. Some of the early evidences of the impact that would be felt have been evidenced in the financial banking and automobile industry. With the liberalization of world economies, a number of international banks have been recently established in cities all over the country where export and commercial activities predominate. All of a sudden, the demand for MBAs having expertise in financial management has gone up. With only IIM Bangalore having the necessary HRD expertise in international banking and financial management, there was an unprecedented rush from bright students for gaining admission in IIM Bangalore. The faculty specializing in financial management also moved from other IIMs in the country to Bangalore to cope with the newly emerging demand. The salary structure for MBAs qualifying, particularly in
financial management, from IIM Bangalore has gone through a meteoric rise starting from about Rs. 15,000 per month to over Rs. 1,00,000 per month during the past four to five years. Similar things might happen with the growth that is anticipated in agro-processing and in agricultural biotechnology. Another paradigm shift has been evidenced in the automobile industry in India. So long as the automobile industry in our country was protected from international competitive elements, only two or three automobile manufacturers had monopolized the market with consumer having no say in the matter. The joint venture of Indian Govt. with Japan's Suzuki Company led to the establishment of Maruti Udyog. With such foreign participation of technical expertise and marketing skills, automobiles manufactured by Maruti Udyog captured nearly 80 per cent of Indian market in a short span of time. However, with the liberalisation of world economies, and a large segment of middle-income group of Indian population providing lucrative market scope, several automobile giants across the world have entered the Indian market with their eyes on the automobile demand in India anticipated in the year 2010 and beyond. Ingenuity on the part of far-sighted and truly multinational Indian companies such as Ranabaxy Pharmaceutical Company have developed effective strategies to cope with the newly emerging global scenario to provide effective competitiveness with indigenously developed R&D. Ranbaxy has grown from the status of a Rs. 250 crore company to Rs. 1500 crore company in a matter of five years. In the next five years, the company's growth targets are expected to surpass Rs. 4000 crore). Similarly, the Agricultural Education programmes in India need to monitor the global developments and develop appropriate educational curricula that would cater to the futuristic needs of various sectors of Indian agriculture by providing requisite HRD. The sectors would include teaching, research, profession business and extension related to agriculture.
University Infrastructure for teaching

Whereas a lot of planning has been done and necessary infrastructure has been developed to impart agricultural education with expected levels of standards for agricultural education, there are wide gaps where strengthening is required for ensuring that at least minimum standards of education are met. Many of the agricultural colleges / universities lack necessary laboratory facilities and infrastructure for practical demonstration to impart adequate self-confidence and expertise in applying technical knowledge for solving field level problems. Therefore, there is need to establish accreditation norms to ensure that those colleges/SAUs which are not up to the mark are either asked to close down or provided the necessary assistance to ensure that minimum standards of agricultural education are maintained.

There should be continuous and comprehensive evaluation with emphasis on understanding rather than memorizing for the final examination.

With all these positive factors, the state agricultural universities have been able to make major contributions to India’s development in the past 40 years. India during this period has become the second largest producer of wheat, the second largest producer of rice, the second largest producer of sorghum, the fourth largest producer of cotton, the third largest producer of sugarcane and it shares the first position with China in the production of fruits. India has expectedly become the world’s largest producer of milk. The engine of this agricultural growth has been the new production technology to which the state agricultural universities working in close coordination with the ICAR institutes have made major contributions.

With all these advances there is a widespread perception in the country that the State agricultural university system is on the decline and unless we take corrective action at this state, its sustainability may become questionable.
are five main reasons for the decline. First, with an increasing degree of divorce between basic sciences and agricultural sciences, an impression is being created that agricultural sciences can stand on their own. They cannot and the result is that the country has been left behind in modern biotechnology, the foundation of future agriculture. Second, archaic and unscientific management practices with little or no priority setting, and personnel policies that do not recognize merit. Third, indiscriminate growth of colleges and campuses resulting in serious budget over-runs. Fourth, an increasing degree of inbreeding both at the staff level and in the admission of students.

New Direction

Science based education:. All possible efforts will have to be made to have an open door policy so that students and teachers from basic sciences are encouraged to join the state agricultural universities. So important is this input of basic sciences for the continued growth of the state agricultural universities that the SAUs should perhaps be renamed as the University of Science and Agriculture. The colleges of agriculture and basic science should be integrated into a single college.

Leadership

The Vice Chancellors of the State Agricultural Universities should be appointed on the basis of their proven record of leadership in the field of management. They should have expertise in the areas of organization and structure, priority setting; personnel policies, management of human, financial, and physical resource and they should have the ability to interact and communicate with policy makers in the Government. It is not necessary for them to be agricultural scientists. They should be outstanding educationists, administrators and managers.
National Agricultural Education Board. A National Agricultural Education Board made up of the Minister of Agriculture at the Centre and the Ministers of Agriculture in the states with Secretary DARE as its Secretary should be set up to provide a sense of direction for the continued good health of the state agricultural universities. Each of the universities should have a technical and management advisory committee made up mostly of the clients of agricultural research.

Rebuilding the Infrastructure. Teaching of agricultural sciences will change in the coming decades with the advent of modern biotechnology and microchip based agronomy, with the speedy growth of business agribusiness, there will be a call for a total overhaul of the laboratory infrastructure, in line with the biotechnological prerequisites. This situation also pretends not the present faculties that become obsolete:

Women in Agricultural Education. All possible efforts should be made to see that 25% of the staff members in the state agricultural universities are women. Their background in basic science and good management would prove to be of very great value. In conclusion, we need to reorganize our agricultural education system for the next 25 years in the same way as we did in the early 1960s when far-reaching policy decisions were taken to create the state agricultural universities. We need policy decisions and political commitments now to revive and rejuvenate the system for the challenges of the new century There is little doubt that India in the next 25 years is destined to emerge as a world leader in the field of agriculture when it will be competing for exports with countries like the USA. We will need a new kind of agriculture and new kind of human resource to reach this stage.
Distance Education in Agriculture

As we stand on the second year of the new millennium we are witnessing the remarkable transition from knowledge as a factor in development to knowledge as the key to development (Khan, 1999).

Knowledge creation and dissemination will sustain the dramatic advances in agricultural sector. The green revolution is getting further momentum with both the information and communication revolution and the eco-technology revolution in the offing (Swaminathan, 1999).

We need to explore an evolving methodology of distance education, determine the specific benefits it offers in agricultural education. In this connection the following points need to be addressed:

. Issues and principles in reshaping agricultural education in the new millennium

. Relevance of open and distance learning for agricultural education

. Possible applications of open and distance learning for in-service education and extension, and

. Promotion of a paradigm shift from individual to community access to distance learning.

KEY FEATURES OF OPEN AND DISTANCE LEARNING

In order to prepare a blueprint for agricultural education at a distance, it is worthwhile to explore the key features of open and distance leaning and their relevance in addressing critical challenges in agricultural education.
Open distance learning can be considered as one of most significant educational innovations of this century. This can be attributed to the ability of the open and distance learning systems to address critical challenges such as access, equity, cost, quality and relevance. Therefore open and distance learning has tremendous potential to transform education provision in developing countries.

A number of factors have contributed to the growing global acceptance of distance learning (Khan, 1997). These include:

. Population growth, particularly in the developing countries; increase in demand for education and training; dwindling resources for education

. Growing demand for equality of access to educational opportunities; flexibility and user friendliness of the methodology learning

. Cost effectiveness for users and providers and

. Advances in communications and information technologies.

RESHAPING AGRICULTURAL EDUCATION

According to the FAO (1997), the basic principles in reshaping agricultural education for the new century include the following to:

. Promote agricultural education programmes that are job-oriented and meet the actual needs of communities, regions and countries

. Distinguish agricultural education from training for public service, thereby fostering training aimed at meeting the needs of the private sector and preparing students for entrepreneurship
Support and promote agreements and cooperation and coordination at inter-institutional and international levels.

Promote integration of population, environment and sustainable development themes into agricultural education and extension programmes.

Increased awareness of environmental issues and

Need to make education of extension workers more relevant to current development needs.

India has the advantage of an integrated and comprehensive infrastructure for agricultural education. The agricultural education system in the country offers degree programmes in 11 specific disciplines with a total intake of about 11,000 students. Postgraduate programmes are on offer in more than 55 fields of specialization with a total intake capacity of about 5000 students (ICAR, 1999). A total of 29 agricultural universities have been established in different parts of the country employing about 26,000 scientists for teaching, research and extension education. We have also made notable achievements in diffusing innovations in science and technology through the Krishi Vigyan Kendras.

What do we expect from quality education

Quality education has to address the two essential components of the teacher and the taught. The teacher must be qualified, competent, and skillful and a continuous learner himself so as to ensure that his stock of knowledge is incisive and contemporary. The later is now critically important because of the rapid developments in science and the speed with which new knowledge is emerging. Equally important is the motivation of the student who should not only be able to absorb what is taught in the class, both in theory and practical, but also
supplement it with his own reading and study. If the students so groomed have developed the capacity of critical thinking, the ability to identify the most relevant approach to solving problems and executing research to finding right answers and solutions, the concern for quality is adequately addressed. It should also be remembered that expectations of quality agricultural education are distinctly different from those of general education because agricultural graduates have to meet the requirements of the employers and practicing farmers as also of academic institutions that are the users of this trained human resource.

**Linkages Among Educational Institutions (National And International)**

Education is the bedrock of agricultural research and development. The competence of human resource generated through the educational system critically influences the pace of progress. It is a tribute to the leadership of post independence India, both technical and political, that the value of science and technical input into the developmental process was recognized and a strong agricultural research and education system was developed. It is on the strength of this national grid that India has been able to achieve the capacity to feed its people in spite of the fact that our population has grown several fold since independence. It is now generally accepted that the ability to attain this miraculous growth in food grain production, as also in the production of other agricultural commodities such as livestock, milk, fruits, vegetables and fish, has been made possible on account of this national strength. Had we not developed the national agricultural research system with its strong human resources, we would have also languished like many other nations that secured independence at about the same time but are still precariously placed in terms of the ability to feed their population. However, while India has grown from six agricultural colleges in the beginning of the century to the present 28 State Agricultural Universities, 4 ICAR Institutes with deemed University status and one Central Agricultural University, there is a serious concern about declining standard of
quality in the products of agricultural education system. Diagnosis of the melody has identified several causes are also being addressed by all concerned. Special focus is being given on the importance of linkages among educational institutions as a means of quality improvement in agricultural education and research.

**Linkages among institutions**

There is need to foster partnerships among the faculty from different disciplines to build up knowledge for the sustainability of the farming systems. Discoveries in different key disciplines like Genetics, Physiology, Pathology, Nutrition, Breeding, Biotechnology etc. realize their full potential only when related to one another and applied to real world needs through integrative research and development. It is, therefore, necessary that major support is provided mainly to programmes that are multidisciplinary in nature. With the linkages of the SAUs with the Land Grant Universities in US, it was possible to develop skill among the faculties to take advantage of the progressive developments in agricultural science and technology. It is now imperative that partnerships be developed between not only the SAUs and the ICAR Institutes, but also with various international organizations like the CGIAR Institutes and overseas universities. The programmes could improve substantially the ICAR scientists are inducted into the faculty of the SAUs to complement the efforts of the NARS. There is need also to foster connectivity with a wide spectrum of related institutions nationally and internationally through internet technologies including teleconferencing to ensure greater exposure of our students, faculty and farmers to exchange and disseminate their ideas, perspectives, values and cultures.
Debeurocratization

All our SAUs and DUs follow an administrative system adopted from Govt. departments. Unfortunately such a setup is not suited to promote excellence in teaching and research. Debeurocratised institutions such as the Indian Institute of Science have progressed by leaps and bounds and achieved international competitiveness. While we adopted the American system of teaching (semester, continuous assessment and GPA) we have stayed put with the colonial administrative system that can't support the American system of education. Therefore, there is an urgent need to develop an altogether new administrative setup for all agricultural Institutions, rather than tinker with the existing outdated system. A national debate involving teachers/scientists/farmers at various levels must be initiated to develop our administrative machinery that supports and promotes excellence in teaching and research. By developing such a system SAUs/DUs could be role models for excellence in education.

Faculty competence

The most important component of education is teaching. For excellence in teaching, one needs competent teachers. One of the major reasons for the decline in the quality of teaching in the recent years is the decline in the quality of teachers. This has happened for many reasons. First, there has been an undesirable inbreeding in the Universities and second, promotions have not been based entirely on merit, and third, education has not been given due weightage in appointments and assessment.
The relevance of linkages

It is the context of the requirements of high quality linkages assumes importance. Quite clearly the needs of the present are very different from the requirements of the past, and the future will call for yet qualitatively very different expertise in kinds and levels. Disciplinary excellence will continue to be important but interdisciplinary functioning will gather overriding value. Also the areas in which expertise is relevant will have highly dispersed, wide spectrum, and the level of expected expertise will have to be very high. Consequently no single institution will have expertise in all the areas at levels of advancement that will become an essential requirement. In such a situation, linkages, collaborations and joint ventures will necessarily become matters of imperative rather than choice. Sooner this fact is realized and incorporated in our system of operation, the better it would be for achieving the goals of quality.

Linkages in the past

When the land grant system of agricultural education was started in India, technical assistance was available to the SAUs through linked programmes with Universities in the USA through the USAID, the Rockefeller Foundation, the Ford Foundation, etc. About 500 teachers and researchers from the SAUs and Central Institutes received both degrees and advanced training abroad under these programmes. When the level of indigenous competence and facilities improved, joint training programmes between Indian and US Universities replaced the foreign technical assistance. Subsequently, the inter-institutional programmes became confined to those between the SAUs and the ICAR Institutes. The Centres of Excellence and other approaches under the UNDP and FAO which organised in-service training through summer institutes, etc. also helped in upgrading and updating the knowledge-base of teachers and researchers in agricultural disciplines and related sciences.
Emerging Needs

As explained earlier a highly competitive world coupled with the need for coping with rapid changes in the technological and science arenas necessitate that we plan and implement strategies on lines different from those adopted in the past. It is clear that business as usual will not do and tinkering on the periphery will have to yield place to a major shift in paradigm. Our need now is qualitative, at times revolutionary, changes both in strategic planning and the pathways of operation. The programme implementation in addition to requiring new methodologies of operation will also be very expensive. The constrained resources will have to be deployed on high priority areas which are competitive winners and which maximize returns on investments. Taking advantage of developing linkages to capitalize on synergies is an obvious means of gaining in efficiency, cost effectiveness and competitiveness. An FAO Consultation recommended that the organization, i.e., FAO, other multilateral international organizations and donor agencies support joint efforts of Governments of countries and institutions for bringing about improved efficiency and impact of higher agricultural education through the establishment and/or strengthening the:

* Centres of Advanced Studies and Research in key subject areas of national and/or regional level importance for training high quality specialist staff.

* Twinning arrangements with mutual benefits from staff and student exchange and research cooperation between well developed and developing educational institutions.

* Technical cooperation among developing countries (TCDC) arrangements. Here, institutions of higher agricultural education of different developing countries can support and learn from each other.
* Sub regional or regional international institutional bodies which sphere head policy formulations, programme planning and/or implementation for higher agricultural education such as Consortia of Institutions for post-graduate education or the regional associations of higher agricultural education.

Developing academic excellence is a long-term process which requires continuity of institutional effort, commitment of political will and support of technical assistance agencies and donors over an extended period of time. All these are important considerations that should be integrated in the national planning process for effective implementation.

Some suggestions for improving quality

* Faculty development is an issue larger than execution of individual programmes. For teachers in agricultural universities, unlike in general education, pre-service training has not been given a serious thought in the past. Institutions like NAARM do offer courses in specific areas of educational technology and research management. Some of these specialised courses also deal with project management, human resource management and management information system for research, curriculum design and development, programme instructions and computer and video-based instructions in the area of educational technology. Agriculture educational institutions should encourage their faculty to undergo training in these areas. It will be worthwhile to consider NAARM establishing regional centres and assuming the role of coordinating educational technology.

* There is need for interchange of senior staff for short periods between well developed SAUs and developing SAUs, SAUs and apex institutions like IARI, for giving special lectures and training in specified areas. The senior staff can act as Course Associates for courses agreed upon between collaborating institutions.
Such a movement of senior staff is at some cost to specialists in terms of sacrifice of time and personal convenience. Liberal incentives would be necessary to convert desirable objective into practicing reality.

* For improving faculty competence several Centres of Advanced Studies in specialised disciplines have been established with the assistance from UNDP, Agricultural Universities and ICAR Institutes. Of the 28 Centres established so far, 17 are located in the ICAR Institutes. These Centres encourage and promote the pursuit of excellence through collaboration between scientists of identified ICAR Institutes and counterparts from other institutions. The implementation of the Centres of Advanced Studies concept is a very effective operational mechanism of accelerating attainment of high standards in specific fields of agricultural education and research. It will be wise to enlarge this activity and to ensure that the attained peaks of excellence are maintained and sustained.

* Implementation of programmes on multi-disciplinary modes is an accepted way of finding solutions to difficult problems that have defied solution so far. Research programmes need to be formulated by involving appropriate faculty members from related departments of SAUs and research institutions right from the beginning. The programmes should be jointly implemented and reviewed periodically by peers including retired scientists.

* Selectivity of making investments is crucial to efficient functioning and deriving the highest cost-benefit advantage. Prioritization of programmes on the basis of well argued criteria and transparency of decision-making is necessary. It is recommended that the ICAR undertake a detailed prioritization exercise and review the priorities periodically taking into consideration the problems of, farms and farming community and the advances made at national and international levels. The result of the prioritization should be circulated to the ICAR Institutes,
SAUs and other institutions and universities involved in research. The postgraduate research programmes of the students should be related to these national priorities. The ICAR should also take initiatives in formulating inter-institutional research programmes and coordinate research where many partner institutions are involved in executing the programmes.

Research in disciplines related to agriculture is not confined to SAUs and ICAR institutions only. General universities and institutions of the CSIR, Department of Atomic Energy, DRDO etc. also have relevant research programmes. Linkage between and among these institutions is important. Avenues should be explored to formalize linkages and partnerships, and opportunities should be provided for the research work of university students in the laboratories of the institutions of science departments. Recognition given to scientists of institutions for teaching in the university system and of the teachers of the universities to do research in the institute laboratories will be equally important.

Feed back from farmers, agricultural departments, KVKs and consumer organisations can be very helpful in formulating relevant research programmes. Some of the SAUs have developed excellent mechanisms of interaction with farmers and extension agencies. Based on the experience gained, it will be of advantage to develop courses designed specifically for promoting interaction and linkages.

Relevance of International Linkages

As mentioned earlier, in the initial phase of development, the SAUs benefited immensely from linkages with Universities in the US. The agricultural universities at Pantnagar, Ludhiana, Hyderabad and Jabalpur had arrangements with specific universities in the US and a large number of faculty members had the opportunity of receiving Ph.D. degrees as also of knowing the system first hand, by participation, about the working of the land grand system. When this programme
was phased out, the opportunities for faculties of the SAUs to have a mechanism of sustained interaction with institutions abroad came to an end. For the past few decades the exposure of the faculty in India with developments abroad is highly constricted and is confined to occasional attendance at International seminars or occasional visits under other programmes. This facility is not normally available to the large number of younger members of the faculty. There is an urgent need to establish formalised technical linkages and collaborations between research and teaching institutions in India with counterparts abroad for achieving the objectives of upgrading and updating the knowledge base and skills of Indian teachers and researchers, to improve their competence. A detailed exercise will be needed by each SAU/research institute to identify areas in which linkages would be necessary and most beneficial, and the institution abroad with which they wish to collaborate. For research, collaboration should be easy to establish because many foreign institutions also see benefit of establishing working partnerships with institutions in India. For example, in the sphere of new biology, many laboratories abroad would seek collaboration with Indian laboratories for testing and evaluation of material generated via genetic engineering because of the cost effectiveness with which such labour-intensive activities can be undertaken in India. For the Indian researchers, the advantage would be to gain time by completing the technical facilities-intensive, laboratory phase of the working in laboratories abroad and bring back the material to India for further advancement. This kind of organic partnership will require that rationale modalities are worked out. It will also require modifications in our administrative and operational procedures. We believe that in the World Bank-aided Agricultural Human Resource Development Programme, provisions are available under which schemes of the type outlined above can be operated meaningfully.

The International Centres of the CGIAR system provide another opportunity of developing viable and beneficial linkages for international collaboration. In fact at one time, there was a successful collaboration between IARI and IRRI in which
IRRI sponsored the research programmes of students who had completed their course work at the IARI. It is a pity that this arrangement was not continued. There is a strong case for not only the revival of this kind of a linkage but of extending it to many other CG Centres where collaborative effort would be of benefit to both the partners.

Yet another area in which Indian collaboration with CG Centres would be useful is 1-2 years of Post-Doctoral research by Indian scholars in these centres through inter-institutional agreements. The facilities of sabbatical leave that are now available in the ICAR systems can be utilised for giving concrete shape to this proposal.

The rapid developments in science also demand that we make efforts of our own initiations and set apart funds for the purpose of sending students to selected universities abroad for pursuing Ph.D. programmes in areas relevant to our needs. This kind of arrangement can also be operated on ICAR scientists who would like to pursue degree programmes in the identified areas by availing study leave provisions available to ICAR employees.

Promoting South-South Collaboration

In the SAARC regions, India has a pre-eminent position in terms of research, teaching and training infrastructure. It would be appropriate to formulate programmes for training students from these countries in India. There is also both need and scope for a more liberal exchange of teachers and researchers between SAARC countries through a designed channel of smooth functioning.

Linkages for Information Net-working

An oft-repeated concern is the widening gap between the developing and the developed world, in research infrastructure, knowledge content and research
capabilities. An important contributor to this gap is the fast pace at which knowledge and information accumulates. In recent years, this disparity in knowledge and infrastructure base is also seen between institutions within our country. There is no reason why this gap should exist for information. Modern information and communication techniques provide viable and cost effective methods of linking institutions for fast dissemination of knowledge and information sharing. The ICAR has initiated networking plans involving NIC to provide various forms of connectivity including for Internet, between ICAR institutes, SAUs and others. This useful initiative needs to be strengthened for ensuring smooth, continuous and trouble free operation.

This connectivity is particularly useful for augmenting library facilities that currently are woefully short of requirements because of the high cost of quality books, journals and other forms of literature.

Keeping the above all in view and to meet the following objectives, the present researcher has devoted the entire work, and arranged his study in the following chapters.

Objectives: the present taking certain objectives into consideration has completed study. These objectives are:

1. To study the trends in Agricultural Education and Research.

2. To study the investment pattern in Indian Agricultural Education and Research.

3. To find out the influence of various factors on the financial investment in Agricultural Education and Research.

4. To analyze the impact and financial investments on Agricultural Human Resource.

5. To suggest the tools/ methods to make the financial investments more viable and result oriented on the basis of analyses and results of the study.
The objectives were pursued by adopting the research methodology delineated below:

Research Methodology:

Area of Study: The present study covers the following agricultural universities as its area

1. State Agricultural Universities. In India, there are as many as 35 SAUs. These Universities are spread over state wise all over the country. The complete list of these universities is given below:

1. Acharya NG Ranga Agricultural University (ANGRAU)
2. Assam Agricultural University
4. Birsa Agricultural University, Ranchi
5. Central Agricultural University, Imphal.
7. ChandraSekhar Azad Agricultural University University, Kanpur.
8. CCS Haryana Agricultural University, Hisar.
11. Dr.P.D. Krishi Vishwa Vidyalaya, Akola.
12. Dr.Y S Parmar Univ. of Horti & Forestry, Solan.
13. GB Pant University of Agriculture & Technology, Pant Nagar.
15. Indira Gandhi Krishi Vishwa Vidyalaya, Raipur.
17. Kerala Agricultural University, Vellanikkara.
18. Maharan Pratap University Agriculture & Technology, Udaipur.
20. Mahatma Phule Krishi Vidyalaya, Rahuri.
21. Maratwada Agricultural University, Parbhani.
22. Narendra Dev University Agriculture & Technology, Faizabad.
23. Orissa University Agriculture & Technology, Bhubaneswar.
24. Punjab Agricultural University, Ludhiana.
25. Rajasthan Agricultural University, Bikaner.
26. Rajendra Agricultural University, Pusa.
27. Sardar Ballabh Bhai Patel Univ. of Agriculture and Technology, Meerut.
28. Sher-e-Kashmir University of Agricultural Sciences & Technology, Jammu.
29. Sher-e-Kashmir University of Agricultural Sciences & Technology, Srinagar.
30. TamilNadu Agricultural University, Coimbatore.
31. TamilNadu Veterinary Animal Sciences University, Chennai.
32. University of Agricultural Sciences, Bangalore.
33. University of Agricultural Sciences, Dharwad.
34. WBUAFS, Kolkata.
35. Uttar Banga Krishi Viswavidyalaya, West Bengal.
2. Central Agricultural University under the control and supervision of DARE is situated at Imphal in the state of Manipur.

Sample / Data Source: This study covers all the universities (given in study area) of State as well as Central jurisdiction. The sampling design is basically one where the data available in the various records of these universities were culled not to meet the basic requirements of this study.

All the data relating to the expenditure, allocation, number of students produced, and population of the state were considered for the analysis, leading to the achievement of objectives. The source of the data was of heterogeneous nature in the sense that various bulletins, data books, report, compendiums of seminars, symposia, workshops and conferences, etc.

3. Classification and Tabulation of data

4. Analysis of the data was made with the help of statistical tools like: percentage, average, trend-analysis, correlation and regression. After getting the required parameters, test statistics was used to test the differences, level of relationship and cause & effect relationships by using the tests like t-test, 2-test, F-test and other relevant tests as per requirements.

Chapter wise schemes:

1. Introduction: In this chapter the researcher has presented the scenario in Indian context with special reference to agriculture, agricultural education, SAUs, Deemed Universities, historical perspective of agricultural education and the present status and in order to have a most effective agricultural education system for the country.
2. **Review of present scenario and Investment in Agricultural Education and Research**: In this chapter the researcher has referred to the various research works done by eminent personalities and developments that have taken place in the agricultural education system after the universities came into existence.

3. **Agriculture and Education system**: The researcher has explained the agricultural education system prevailing in the country. The researcher has also discussed the National Agricultural Policy in all the state agricultural universities. The financial investments have been dealt in the context of manpower development for the country's agricultural industry.

4. **Trends in agriculture investments**: The researcher has taken the full data of the all SAUs and depicted them in a statement form. He has compared the central allocations with that form the states for agricultural education. State wise, University wise allocations, expenditures, number of students produce by each university and by each state have also been discussed. The researcher has also dealt with the various Determinants of trends in investments, combination between public and private investments, determinants of private investments, and carried out comparisons of these investments with the populations of the states, and worked out the cost per producing a student.

5. **Growth in investment**: In this chapter the researcher has brought in the inputs, i.e. allocations / expenditure of the Center as well as States, outputs i.e., human resources produced, regional divergence, i.e. state wise investments in agricultural education supplemented by central investments.
6. **Results:** In this chapter the researcher has analyzed the data state wise, university wise, student wise, population wise, cost per student wise and brought out the divergences by critically reviewing the various data collected.

7. **Recommendations /Findings**

8. **Abstract and summary presentation**