Ovation to Inaugural Prayer

IAUA 26TH CONVENTION SOUVENIR

IAUA 26th CONVENTION

TNAU-2001

Lighting for a good start

Delegates at Inauguration

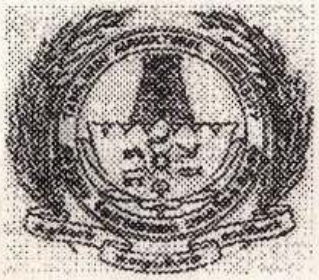
Release of IJAE

Memento for gracing

PROCEEDINGS OF THE

26th CONVENTION OF

INDIAN AGRICULTURAL UNIVERSITIES ASSOCIATION



23-24, OCTOBER 2001

Edited and Compiled by

Prof. Dr.S.Kannaiyan
Dr.R.Annamalai
Dr.R.Jagannathan
Dr.R.Ganesan
Dr.B.Parthipan

TAMIL NADU AGRICULTURAL UNIVERSITY
COIMBATORE, TAMIL NADU

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PRELUDE TO THE 26TH IAUA CONVENTION SOUVENIR

The Indian Agricultural Universities Association was registered in the year 1967 with nine Agricultural Universities. All Agricultural Universities in the country are now members of the Association and the membership at present stands at thirty two including four Central Institutes – Indian Agricultural Research Institute, New Delhi, Indian Veterinary Research Institute, Izatnagar, National Dairy Research Institute, Karnal and Central Institute of Fisheries Education, Varsova, Bombay which are deemed Universities.

The objective of the Association include promotion of Agricultural Research, Education and Extension Education and thereby rural development in the country in accordance with established policy of the Government of India, State Governments, member Universities and the Indian Council of Agricultural Research as laid down from time to time.

The Association organizes convention every year and hosted by one of the member Universities. The TAMIL NADU AGRICULTURAL UNIVERSITY hosted the 26th Convention of Indian Agricultural Universities Association and convened on 23rd and 24th October 2001. The Executive Committee/General Body selects the theme of the convention, which is relevant to the problems common to all Agricultural and Rural development policies. The theme for the 26th Convention of Indian Agricultural Universities Association was "Agricultural Research and Education Improvement Through Institutional Linkages". Based on the theme the host member Tamil Nadu Agricultural University had communicated sub themes to other members for sending related papers. The papers received were grouped in to XI concurrent sessions and were presented after the 26th Convention was inaugurated formally on 23.10.2001 and continued on 24.10.2001. The papers presented in the concurrent sessions and the recommendation of the 26th convention is presented in the souvenir.

The Tamil Nadu Agricultural University sincerely thank the IAUA for selecting it as the host for the 26th Convention of IAUA and the Indian Council of Agricultural Research for the grant released for the convention. The Vice Chancellor and Dean (Agriculture) & Nodal Officer of the IAUA convention specially thank all those who had participated in the convention and for those who had helped it to conduct smoothly and in grand manner.

EDITORS

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INAUGURAL FUNCTION AT A GLANCE

The 26th convention of Indian Agricultural Universities Association was held on 23 and 24 of October 2001 at Tamil Nadu Agricultural University, Coimbatore. The inaugural function was scheduled on 23rd and Prof.Dr.S.Kannaiyan, Vice-Chancellor, Tamil Nadu Agricultural University welcomed the gathering and narrated the activities carried out in Tamil Nadu Agricultural University, which contributed for the welfare of the farmers of the state. He complimented the Government of Tamil Nadu for the encouraging support to operate the projects in Tamil Nadu Agricultural University. He illustrated the "Participatory mode" being introduced in the University to make more functional the activities on teaching, research and extension.

Mr.R.Jeevanantham, the Honourable Minister for Agriculture, Government of Tamil Nadu inaugurated the convention. While appreciating the recent thrusts given in the TNAU to areas such as wasteland development, dry land horticulture, hybrid technology, biofertilizer, post harvest technology, marketing etc, the Minister informed that the Tamil Nadu Government would establish Agricultural Export Zones (AEZ) and the crops to be covered are grapes, cashew, onion, banana, orange, cut flowers, medicinal plants and turmeric. He pointed out that in an era of globalization no one can remain insulated. Unless the country becomes competitive, it would lose its prospects in the world market besides not producing enough to meet the growing domestic requirements, he emphasized. He underlined the need for a decision – support system that can provide market intelligence at various levels on food, price, taste and preference to help the farming community in planning its cropping pattern and marketing strategy. He expressed a concern at the regional imbalances in the development of natural resources (land and water) and urged the technocrats to bridge the gap by concerted efforts in agricultural education, research and extension.

He said food grain production had increased from 50.8 million tonnes in 1950-51 to over 208 million tonnes in 2000. Much of the gain was however, neutralized by the growth in population – from 361 million in 1951 to 1032 millions now and hence stressed the need to scale up the productivity levels of crops and profitability of agricultural enterprises through strategic planning of production of agricultural commodities.

Dr. Yusuf Kamal, Vice–Chancellor, Sher–e–Kashmir University of Agricultural Sciences and Technology in his presidential address expressed that higher food production had been achieved mostly through a vertical increase in the productivity otherwise the country would have needed an additional 100 million hectares of land to produce 200 million tonnes of food based on the 1961-65 productivity level. Future world's demand would be determined by two factors- population growth and per capita food consumption. In 2025, the world population is expected to be about 8 billion and food production

of 7.4 billion tonnes. The projected demand would be 8.2 billion tonnes. To meet the projected food requirements of South Asia (anticipated to have the world's most poor people), the average yield level of the cereal crops should be increased by more than 60 per cent . He called for a revamp and re-orientation of the agricultural education to make it more profession oriented. He urged the agricultural students to acquire new skills that would meet out demands of the millennium. Besides reorienting the curriculum, support for infrastructure development should also be provided, he emphasized.

Dr.Kirti Singh, Secretary, National Academy of Agricultural Sciences (NAAS), New Delhi in his key note address expressed concern at the poor attention paid to agricultural educational institutions, sought adequate autonomy and enough faculty strength for adequate performance by the departments of SAUs. He informed that State Agricultural Universities (SAUs) are facing great crisis now and steps should be taken to positively reverse the situation. He said that it would be difficult for the SAUs to generate all the revenue on their own and hence appealed for the required financial support from the State Government concerned.

Dr.M.Mahadevappa, Chairman, Agricultural Scientists Recruitment Board (ASRB), New Delhi in his special address expressed his concern about the decline in the takers of Agricultural courses. He further stressed the need for the recruitment and placement of high calibered scientists through ASRB to fulfill the research endeavours in the field of Agricultural sciences.

Dr.Kirti Singh, Secretary, NAAS, New Delhi released the first issue of Indian Journal of Agricultural Education.

Dr.R.Annamalai, Dean(Agriculture), Tamil Nadu Agricultural University, Coimbatore proposed a vote of thanks.

After the inaugural function, eleven sessions spread over two days were conducted. Various speakers presented the papers as furnished in the succeeding pages.

Session I

The session I was chaired by Dr.Kirtisingh, Secretary National Academy of Agricultural Sciences, New Delhi. Dr.A.S.Prabahar, Director of Instructions (PGS), UAS, Dharwad and Dr.P.Rangasamy, Dean, AC & RI, Madurai, TNAU were the Rapporteurs. The following papers were presented in the Session.

1. Agricultural Research and Education - Improvement through Institutional linkages	Dr.A.S. Faroda, Vice-Chancellor, Maharana Pratap University of Agriculture & Technology Udaipur.
2. Professional Ethics – A must for success	Dr.John Thomas, Dean (Agrl. Engineering), Kerala Agricultural University.

Paper 1. Agricultural Research and Education – Improvement through Institutional Linkages

Dr.A.S. Faroda
Vice-Chancellor,
Maharana Pratap University of Agriculture & Technology,
Udaipur (Rajasthan)

Academically strong manpower with proper awareness of the ground realities of agricultural sector and higher degree of motivation would ensure qualitative change in our research and education programmes.

Formal Agricultural Education in India has its beginning in the first decade of 20th Century when six agricultural colleges were established. This number rose to 17 by the time of independence of the country. Later, need was felt to integrate teaching, research and extension education on the American pattern of "Land Grant System of Agricultural Education" and the first Agricultural University on this pattern was set up at Pantnagar in 1960. Today, there are (32 SAUs; 1 CAU;) 4 Deemed Universities (ICAR – National Institutes); 49 private colleges and also there are strong agricultural faculties in BHU, AMU and VBU. About 17,000 students are admitted annually in these institutions. The SAUS & CAU etc. also carry out research in their constituent departments, research stations and substations. The ICAR has its own research set up which includes 45 Central Institutes, 4 National Bureaux, 10 Project Directorates, 30 NRCs, 82 AICRP. Thus, quantitatively there is well-established network of Agricultural Research and Education throughout the country.

Though good quality work in both the spheres of Education and Research is underway, however, with the passage of time there has been qualitative deterioration in both the fields. Besides newer skills would be required to compete internationally in various fields of agricultural sciences. Promotion of excellence in frontier areas of newer sciences like biotechnology, space technology, information technology, environmental sciences, geographic information systems, etc. needs to be encouraged to meet the future challenges effectively. Thus, there is a scope of improvement in Agricultural Research & Education, ICAR being pioneer organization of Agricultural

Research and Education, has taken steps to bring about qualitative improvement in its own institutions as well as SAUs. One of the methods to improve quality of agricultural education and research is to set up norms and homogenous conditions in both types of organizations and to develop effective institutional linkages. Indian Agricultural Universities Association may also take a lead in this direction to suggest methods to develop partnership between SAUs.

Future challenges can be met only by building linkages/partnerships between different organizations. When we think of institutional linkages then a number of types of linkages emerge in one's mind. For instance-

1) Linkages between various institutions within SAUs.
2) Linkages between SAUs.
3) Linkages between SAUs and General Universities and various types of research institutions of ICAR, CSIR, DST, DBT, etc.
4) Linkages between SAUs and International Organizations particularly those belonging to CGIAR systems.
5) Linkages between SAUs and Private or Public Sector industries
6) Linkages between SAUs and State line departments and farmers.

Such linkages will require suitable memoranda of Understanding(MOUs). In research, this will involve reorientation so as to promote field research jointly with farm families.

The greatest asset of a nation is its Human Resource. Higher education in agriculture, an important pathway to have competent manpower, needs constant review and revamping to respond effectively to changing needs of the society. The educational system must be dynamic, flexible, innovative and proactive to faster growth. Its quality, relevance and cost effectiveness should be of a high standard. It would be prudent to have constant dialogue on this subject to generate appropriate concepts and introduce timely changes. Thus a strong linkage between SAUs and other institutes is necessary.

Linkages are also required to improve the standard of education, bringing uniformity in grading, mode of admission, duration of courses, curricula development/revision, etc.

To change over to an effective market driven academic environment, it would be essential to involve the clients in planning, implementation and evaluation of the academic programmes. In this farmers, Govt. departments, research organizations and industries of the agriculture sector be actively associated as equal partners in this exercise. Formal institutional arrangements must be established to bring about this partnership.

Building linkages/partnership with other academic institutions within and outside the country in offering joint academic programmes would be highly valuable in achieving better standards in higher learning particularly at postgraduate level. This would also help in reducing public investments and avoid inbreeding, and assist in broadening the outlook of the students.

There is tremendous need to establish linkages/partnership within the country among SAUs and with General Universities of the country/ICAR institutes due to following reasons:

a. For special subjects like Fisheries, Sericulture, Horticulture, etc. certain SAUs/ICAR institutes have location advantage and could well serve as national centers in such disciplines.
b. Some of the colleges of the General Universities have excellent facilities and staff in offering courses on environmental sciences, biotechnology, etc. It would be mutually beneficial to permit students to attend a few courses in select outside institutions.

Paper 2. Personal ethics – A must for success

Dr.K.John Thomas,
Dean (Agrl. Engineering),
Kerala Agricultural University,
Trichur

India is a rich country where poor people live. Our richness is due to our intellectual powers, our biodiversity, our culture and heritage, our traditional knowledge base and above all our entrepreneurial spirit. But we have not created wealth out of it and thus we remained poor

"Tomorrow is not what happens to us ; tomorrow is what we make of it"

To know our tomorrow we have to define our today. There are two ways of looking at today; one – today is a mundane extension of yesterday and then tomorrow will also be a mundane extension of today-things then will move without any change. There is another way of looking at tomorrow. Plan your tomorrow and then use today as the launching pad to realize that vision. That is a better way.

Transforming your vision into quality is not going to be easy. It would need single minded determination, unshakable self confidence and tremendous amount of unstinting hard work. Hard work is the panacea for all evils. Example of Japan is one where hard work has paid very rich dividends.

My talk is mainly based on what was written by Sri.V.Ramachandran former Chief Secretary of Kerala about value systems and its implications. Living values are those values we need to adhere to while living who values which do not change and continue to guards the life of mankind day after day.

Talking about value based management, Swami Chinmayananda talked about state of happiness of four businessmen

- The first was unhappy because there was raid in his house
- The second was unhappy because there was no raid in his house but there was one in his friends house
- The third was unhappy because even though there was raid in house, there was no publicity for it.
- The fourth was unhappy because the amount reported to have been acquired by him is much less compared with that of his friend.

Unhappiness is of different types indeed. Today the value systems have changed. If we ask some one about his concept about living values, he is likely to tell us about cost of living. A.C houses, cars, or well furnished bar in house. Technological growth during the last few decades have been phenomenal matched only by increased violence, immorality, quest for wealth, drug addiction and political and social confusion.

1) Humility – becoming rare day after day. If every thing works on well, I did it we claim - otherwise we all blame others for not implementing the ideas and plans properly. Relations Expert suggest the following to develop - one word – we; two word - thank you; three words – you are right ; Four words - what is your opinion ; five words – shall we do like this.

2) Service orientation

Serve with a smile is a motto well said but least followed.

"Gadha ghara Chandana bharavahe
Bharasya Udhanathu Chandanasya"

Govt. Services have become serving neither the government's interest or of the people but taking care of one's own interest. This has to change. Similarly by most of us engaged in activities which can provide great opportunity to serve and help people are more concerned with work load and compensation rather than value of the job to the community.

3) Give and Take approach

It has slowly given way to take and not to give. President Kennedy said "Ask not what your country can do for you ; think what you can do for your country". Hardly anyone bothers about one's role to the society but only what one can make out of the society.

4) Consistency in behaviour

Behaviour of people fluctuates like a pendulum from one of humility while not in power to one of arrogance when in power. Even well behaved persons become rough and behave badly on acquisition of wealth or power for no obvious reasons. Today a "smile is not a smile" and "assurance that we will look into it" an assurance that the matter has been thrown into the waste paper basket.

A good leader should have consistency in thought, words and action and also in behaviour. What is in one's mind should come out as one's words and what we talk should be converted into action. Perfection comes to the leaders only through the clean thoughts, words and action.

5. Karmayoga

According to Swami Vivekananda, an action is good if it uplifts the poor and produces maximum happiness to the greatest number of people. As Lord Krishna told Arjuna '*Yoga Karmasu Kansalam*' , True yoga is efficiency in action.

6) Good public relations.

Doing good is exemplary but it is necessary that our good deeds are known to others to set an example to those who have the urge to do good. As Buddha said to Angulimala "Bad reputation is easily acquired and once established is very difficult to wipe out. Good reputation is not easily established and even if established can be wiped out in a few moments". Understand this as the ripening of Karma. Then is a saying "*Some people bring happiness wherever they go, others bring happiness whenever they go*".

7) Love and concern for people

"*Love thy neighbour*" says one of the ten commandments. The case of industrial organization in Japan when 292 employees including the management and the chief executive learned the mute language to make eight deaf and dumb employees feel at home is an excellent example for the "principle of concern". Today we see people hurt in accidents left in the road to die by passing automobiles for fear of getting involved. About inaction for fear of making mistakes and being punished Buddha's advice that "*Like a lotus that remain unsmeared by the water in the lake*", an enlightened disciple (man) is able to live in the society with out harming himself and still to be of great service to humanity.

There are many others to include in the list of living values, but the few mentioned above are very relevant to managers of the university /colleges and others in research and extension activities.

ISSUES EMANATED FROM DISCUSSIONS AFTER PRESENTATION OF PAPERS IN SESSION I

- Agricultural universities should establish close linkages with industries and other related organizations.
- There is a dire need for interaction with stake holders for improving agricultural education in the country.

- A Scheme for exchange of teachers/scientists among various institutions/organizations should be prepared and co-ordinated by ICAR.

- ICAR should complete the information technology network between agricultural universities and ICAR institutions in the country at the earliest.

- IAUA should develop a database on human resources and infrastructure available in the agricultural universities of the country.

- There is need to inculcate ethics among the managers, staff and students in the universities and create awareness on value based education. The senior officers and scientists should set examples in this regard.

- ICAR should implement the recommendations made by expert committee for improving quality of education in private colleges linking with Agricultural Universities and various ICAR institutes located in the region concerned.

Session II

The session II was chaired by Dr.A.M.Krishnappa, Vice-Chancellor, UAS, Bangalore. Dr.G.S.Nanda, Director of Research, Punjab Agricultural University, and Dr.M.Subramaniam, Director of Research, Tamil Nadu Agricultural University were the Rapporteurs. In this session following papers were presented.

1.	Problems of Teaching and Research in SAUs	Dr.G.L.Kaul, Vice-Chancellor, Assam Agricultural University, Jorhat
2.	Returns to Research investments in Indian Agriculture	Dr.C.Ramasamy, Director, CARDS, TNAU, Coimbatore

Paper 1. Problems of Teaching and Research in Agricultural Universities

Dr.G.L. Kaul
Vice-Chancellor,
Assam Agricultural University,
Jorhat

Imparting education and conducting research in agriculture and allied fields are two main mandates of the Agricultural Universities in India. The formalized education in agriculture and allied fields has traversed quite a long path since the first agricultural college was established in 1905. Following the recommendations of several committees constituted by the Government of India, the first of today's 30 agricultural universities and 4 deemed to be universities was established in 1960 on the Land Grant Pattern of the USA The long history of agricultural education and research has witnessed serious efforts made in shaping the agricultural education to meet the ever-changing needs. The system of education and research, thus, underwent reform from time to time. Even then, there are various problems faced by the universities in education and research requiring further exercise for evolution of even better system. Some of the problems are highlighted below for finding appropriate corrective measures.

Problems of Teaching

Inadequate facilities for quality training:

Recently, in 1998, there has been a thorough course revision as per the Third Deans ' Committee Report and Dr. M. S. Swaminathan Committee's recommendations. Emphasis has been laid in this exercise to adopt uniform course curriculum for all the universities in the country incorporating the courses and their contents in conformity with the advancement in the relevant science and national needs. This has been generally applauded as a significant positive move. However, uniformity in the teaching and learning environments has not been equally emphasized while effecting the reform. There has been severe disparity among the universities in the facilities required for imparting quality training to the students. There is enough reason to doubt about the effectiveness of the uniform course curriculum, teaching and evaluation system unless facilities, particularly, for practical courses are not uniformly built up.

The ICAR, as an apex body at the national level responsible for promotion and coordination of agricultural research and higher education in various branches of agriculture and allied sciences in the country must provide adequate support to the universities which are still far behind in required infrastructure. Moreover, different regions vary widely in agricultural potentials and weaknesses and as such course curriculum in agricultural education should accordingly be oriented with enough room for incorporation of course contents to reflect the regional needs.

Lack of adequate employment opportunity:

The university graduates are facing serious problems of unemployment and underemployment since last one decade. A large section of the graduates in agriculture and allied fields is remaining either unemployed for years together or are taking the jobs that hardly require the graduation in the respective fields of studies. This has acted as a force to discourage the meritorious students to enter the Agricultural Universities for education resulting in enrolment of relatively less meritorious students as compared to those enrolled about a decade before. Moreover, the thought of an uncertain future ahead dampens the spirit of the average students to take the learning very sincerely which ultimately affects the general standard of education and the educational environment in the campuses. Considering this reality, the intake capacity in the major faculties of the Assam Agricultural University has been reduced during the last decade, which has been partially able to decrease the intake of poor quality students but has not solved the problems.

Unfortunately, while the possibility of the graduates from the agricultural universities being recruited by most of the state governments is diminishing day by day due to financial difficulties, the response of the non-governmental agencies in regards to recruitment of graduates from the Agricultural Universities also has not been very satisfactory. For instance, the tea industry that can imbibe a considerable number of agricultural graduates in Assam has the habit of employing general graduates with hardly any regards for the professional graduates leading to the frustration of the graduates from the Assam Agricultural University. It would be desirable on the part of the universities and also the ICAR to make serious efforts to find the reasons behind such attitude and to thrash out appropriate solutions. Such reality also warrants for periodical assessment of the need of the education and reorientation of the education programs to meet the dynamically changing situations. Even it may prove to be very useful to involve the private sector in designing and planning the course curriculum.

However, the undergraduate courses in agriculture and allied fields appear to be still primarily oriented to cater the needs of the respective departments of the state governments. For instance, continuation of the program like Rural Agricultural Work Experience (RAWE) in many states, even for the sake of uniformity in education, appears to be of little justification considering no recruitment of the graduates by the state governments. This also points towards the need to allow room for diversification of educational programs according to regional situations. Of course, it is appreciated that, due thrust has been laid in the new curriculum on imparting education to develop entrepreneurship among the graduates through introduction of several optional courses with such objectives. While offering the optional courses the universities must carefully identify the most potential areas.

Lack of motivation among the faculties:

Designing good curriculum will not be enough if the teachers are not motivated and trained to take the curriculum with utmost sincerity. This is particularly true in case of education system like that followed in agriculture. Under such system of education where evaluation of students is still in the hand of the instructor himself/herself, the course instructor remains the arbitrator to decide about what or what not to be taught. Naturally, in such a circumstance, the capability of the teacher is the main deciding factor about the course content covered and quality of training. In view of this, the ICAR insisted on introduction of external evaluation. But, the experience shows that this has not been of any significant utility. Most of the universities, as a ritual started inviting the teachers retiring from the same university as external examiners for the practical examination, which has served only to satisfy the requirement of the ICAR than serving any real purpose; rather this has become an unnecessary burden to the universities.

The requirement for external evaluation should be taken seriously. To develop motivation among the teachers for quality teaching there should be provision for frequent refreshers ' courses for the teachers both inside and outside the country. This is a fact that large section of the faculty members lack exposure to horizons of scientific advancement in the related field of specialization with a very

adverse effect on the teaching programs. On the other hand, a system must also be framed for continuous monitoring and evaluation of the teaching programs and/or the role of teachers.

Financial crisis:

Most of the agricultural universities in the country have been passing through a very stringent financial condition. The universities can ill afford to improve the infrastructure to meet the need for quality education. The laboratory facilities can't be treated as adequate for imparting quality training to the students. Moreover, the students can't be provided with the required facilities for extracurricular activities, which also has an indirect bearing on the education. It is necessary to provide an intellectually stimulating campus environment for the teaching and learning to be enjoyable activities for both faculties and students. For effective and quality education to be possible the respective State government and the ICAR must take necessary steps for improvement of the financial conditions. In this context it may also be argued that the university leadership also should take necessary steps to do away with the avoidable expenditure.

The universities must be able to resist the temptation for expansionism like starting any teaching or research programs or establishment of new colleges etc without serious consideration about long-term sustainability. Even wherever possible, unproductive or non-strategic programs of teaching, research and extension programs should be done away with. For instance, in Assam Agricultural University, three new colleges, viz. Biswanath College of Agriculture, College of Veterinary Science, Azad, and College of Fisheries Science, Roha are very poor in infrastructure like building, laboratory, equipment, hostels etc. Due to the lack of basic facility in the College of Veterinery Science, Azad the university has arranged to keep the students only for the first year in that campus and then transfer to the College of Veterinary Science, Khanapara in the interest of quality training for the Students. However, such an arrangement can't be a solution for a long time. The spending on such campuses is rather very much unnecessary.

Inadequate exposure to recent advancement:

Even though, efforts have been initiated in most of the universities for building the infrastructure for utilizing the information technology in the learning process the progress made in this direction has been rather very slow or negligible. Still the students and teachers have very less access to global development through advanced information technology. The network must be expanded greatly for more utility. It is also note worthy that the awareness on information technology is still to reach all sections of scientific community. The library facilities also, in most of the universities are not up to the mark for the students and teachers to be ever equipped with the recent developments in different fields of specialization.

Problems of Research

Financial crisis:

Lack of adequate fund for research has been the major problem for conducting research in the Agricultural Universities. The fund received from the state governments is not enough even for meeting the salary needs of many Agricultural Universities leaving hardly any money for use in the research programs. Thus, the universities are dependent primarily on agencies other than the state governments for sponsoring the research programs. Even though, the state universities are receiving quite a good amount of financial support from the ICAR for research, this is far from being adequate for conducting research to meet the diverse needs of the farming community of the region and also to keep all the scientists equally engaged in research. To add to the problem, part of the fund received from ICAR for research is also diverted for other purposes inevitable for maintaining healthy environment in the campuses resulting in failure of the universities to spend the money received for the specified causes. Moreover, for many of the projects funded by the ICAR or other agencies it is

stipulated that a part of the total expenditure must come from the state government. Very often, if not always, this stipulation becomes the most serious impediment for accepting and utilizing fund from different agencies as it becomes rather difficult to obtain the share from the respective state governments. These all leads to identification of the universities in such states as non-performers which in turn renders these universities to be the less preferred ones at the time of consideration for funding. These all form a vicious circle and the financial conditions for such universities slip from bad to worse. This needs to be considered by the ICAR and remedial measures should be evolved.

Further, the ICAR appears to have not considered the geographical positions of the university while deciding about funding. Naturally, the universities located in the remote states far away from the heartland and with difficult communication system should have received more money for TA, DA etc. In absence of such a provision, the scientists from the remote universities are really handicapped to attend important meetings held in the mainland. In fact, remoteness of certain universities has been at least one of the major reasons for the scientists not to get enough opportunity to interact with the scientists from different parts of the nation as well as the world. Interaction with scientists from different developed laboratories and institutions is important to keep the scientists well aware of the recent development in the ever-changing biological fields of studies. The remoteness and poor communication infrastructure are also reasons for a relatively slow pace of development of facilities and maintenance of the facilities in working conditions in such universities thus requiring special attention.

Inadequate infrastructure:

Many of the universities are yet to build up the infrastructure adequately for the quality research to be possible. In fact, all the Agricultural Universities are multi-campuses with many research stations and constituent colleges distributed all over the concerned state. No doubt, many of the research stations were built in different locations for correct reasons, for example, stations built under the National Agricultural Research Project (NARP) while many other campuses were established for petty political reasons. Whatever might be the considerations behind establishment of different campuses, it has become very much evident that the schemes of expansion were devoid of far sightedness, as the sustainability of expanded university for long future was probably never considered seriously. In most of the cases, subsequent to establishment of such campuses, for namesake in many cases, the funding has not been adequate for the universities to manage different campuses.

The poor management, particularly of the outstations results in frustration and loss of enthusiasm among the scientists with serious adverse impact on the research works. Moreover, the locations of many stations also add to the frustration. In most of the universities, the scientists working in the relatively less developed and problematic locations consider the very placement as a punishment meted out to them and hardly take the assigned research works seriously. Thus, a large group of scientists is just wasted. Policy guidelines are expected from the ICAR to settle this problem for meaningful engagement of the manpower and judicious use of the ever-shrinking fund.

Very short-term ad-hoc projects:

The funding for research from agencies other than ICAR normally comes in the form of sponsorship of short-term projects. Much of the funding from ICAR is also of the same nature. Such short-term projects help to generate valuable information but due to absence of funding to carry on the project for some more time after the completion of the project such short-term projects have miserably failed to generate any tangible results worth transferring to the farmers' fields. This has resulted in generation of information that is sporadic in nature with little practical value. The funding agencies mainly the ICAR must take note of this reality. As solutions of such problems the funding agency should evaluate the technical program carefully to see that some tangible results could be possible from the project and it should also consider for funding of the project for relatively longer duration based on the nature of the projects. As research in many universities is largely dependent on the funding from the

ICM the agency must consider the regional problems on priority basis while considering for funding any project from such universities. Moreover, the ICAR must take monitoring of the ICAR funded projects, both of permanent and ad-hoc nature, very seriously for deriving desired results.

Incentives for performers:

The promotional schemes and various awards are the tools to . offer incentives to the performers over the non-performers. However, the way promotional schemes implemented in many universities have made such schemes rather ineffective for the purpose. It has become imperative in part of the ICAR to ensure that the schemes designed to encourage the performers are not made ineffective while implementing such schemes. The ICAR must effectively eliminate the scope of manipulation. The root of such manipulation lies in the wide room left in the scheme for modification by the universities in the name of autonomy. The wide scope for modification leads to arm twisting of the university leadership by the unions for diluting the scheme to the extent that there remains hardly any chance for offering incentive to the performer over the non-performer. The same scope is also used by the populist leadership of the university to give benefit to the non-performers to serve his/her own interest.

Paper 2. Returns to Research Investments in Indian Agriculture

Dr.C. Ramasamy
Director,
Centre for Agricultural and Rural Development Studies,
Tamil Nadu Agricultural University,
Coimbatore - 3

Agricultural research has proved to be one of the determinants of agricultural development, and therefore economic development. This relationship has convinced both international donors and national governments to invest more in agricultural research. Resources for agricultural research are becoming scare, and research managers are more prudent in allocating resource among competing research activities. The state agricultural research system in India must forge close interactions with national and international agricultural research systems to ensure higher efficiency in their research evaluation studies made in India and closely examine the methods and results of these studies. The outcome of this exercise is to help participants of this workshop get guidelines for future research investments in India and also fine tune methodologies for research evaluation.

Research evaluation studies

Economists in Western countries pioneered research on the economics of agricultural research in the early 1050s, and such studies were initiated almost two decades later in India. Since the early 1960s, expenditures on agricultural research have increase impressively in India. As investment continued to expand, policymakers in India waster to assess the pay off.

Methods

The methods used in research evaluation in India can be broadly classified as ex-post or ex-ante.

Ex- post evaluations

Most of the earlier studies in India, with few exceptions, used ex-post analysis. For criticism of this approach, see Araji *et al.*, (1978). The first major attempt at ex-post evaluation of agricultural research in India was made by Evenson and Jha (1973). They developed the total factor productivity concept to properly measure increases in output due to research.

They described total factor productivity growth as residual, which is simply the difference between the growth rates of outputs and inputs. One major criticism of this approach is that the residue represents not only the research contribution but also the effect of omitted variables and the effects of production function (Bal and Kahlon 1977).

Bisaliah (1977) ventured to decompose the total change in output to assess the impact of agricultural research investments. He estimated the Cobb-Douglas production function using one-year cross-section data for Punjab Karam Singh (1977) adopted an aggregate production function approach in which agricultural research was included as an input. This comes close to the approach adopted by Griliches (1963) to account for the 'measured productivity of growth of U.S. agriculture'. The research expenditures variable was given a lag of eight years in the production function.

Deviating from the production function approach, Kumar *et al.* (1977) used time series data to evaluate the returns to research and extension expenditures for a cattle improvement program in Kerala. They considered the value of inputs saved due to new technology as the benefits. Using the streams of benefits and costs, they estimated external rate of return, cost – benefit ratio, and internal rate of return.

Kahlon *et al.* (1977) estimated to agricultural research for the pre – green – revolution period (1960/61 – 1964/65) and post – green – revolution period 91967/68 – 1972/73) for India and a few selected states. They incorporated research expenditures (with suitable lags) as an independent variable in the production function. In another simplified approach, the obtained the estimates of output for the two periods at the fixed levels of inputs, excluding research expenditures from the production function. They attributed the difference between these two estimates to the additional investments in agricultural research.

Sita Devi (1991) and Ramasamy and Chinnadurai (1993) estimated simple econometric models to asses the contribution of investment in agricultural research to agricultural GDP for the state of Tamil Nadu.

Ex-ante evaluations

It is evident from a review of literature on research priority setting that a number of different approaches have used ex-ante evaluation of agricultural research. For the details of ex-ante evaluation methods see Evenson (1991), Norton (1991), and Dey and Lin (1994). Only a little work has been done in India on ex-ante analysis, and this approach must receive more attention both at the individual program level as well as at the regional and national levels, with close interaction among biological and technical scientists and economists.

Following the methodology developed by Herdt and Riely (1987), Widawsky and O'Toole (1990) attempted ex-ante research priority setting for rice in the eastern region of India. The methodology involved:

- Assessing the rice yield gap;
- Identifying technical constraints;
- Estimating yield losses for each technical constraint; and
- Ranking the constraints by the magnitude of the yield loss and developing a research agenda for a given geo-political unit (a production environment).

Ramasamy *et al.* (1993) further improved this method of setting research priorities for rice for the whole of southern India. After estimating yield losses, the defied a marginal productivity gain that will be achieved if the problem is solved through research. These marginal productivity gains (increments in output), adjusted for the probability of research success in solving the constraints will be the stream of benefits. In addition, the stream of costs to be incurred for research to solve a problem, adjusted for environmental externalities, was also generated. Using the stream of benefits and costs,

net present values (NP*Vs*) were calculated for each constraint. The research problem areas (constraints) were then ranked based on NP*Vs*.

Ramasamy et al (1994) developed a `decentralized agricultural research priority setting framework'. This approach is primarily meant for setting a prioritized research agenda for a zonal agricultural research station in India. Distinct stages of this framework are :

- Identifying research problems ;
- Short listing problems ;
- Prioritizing problem areas (using economic surplus and scoring models);
- Prioritizing by matching goals and research recourses ; and
- Institutionalizing the priority setting process.

Results

Among the two major groups of ex-post evaluations, the economics surplus approach provides an average rate of return to the agricultural research investment. The studies that include research as a variable in production function provide marginal rates of return. The returns to agricultural research investments show considerable variation but the returns seem reasonably high compared to the investments (Table 1).

Three recent ex-ante studies provide interesting results and clear – cut research agendas for consideration by agricultural research managers. The results of the study made by Widawsky and O'Toole (1990) are shown in Table 2. The results of the study by Ramasamy et al. (1993) which provide a research agenda for rice, are displayed in Table 3 for Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu. The NP*Vs* showed in these tables helped rank the research problem areas for rice in the respective states.

The results of decentralized agricultural research priority setting for the Eastern Ghat Highland Zone (EGHZ) in Orissa are shown in Table 4. The rankings of research activities for the zonal agricultural research station are based on NP*Vs*.

Table 1. Estimates of returns to investment in agricultural research in India based on ex-post evaluation.

Study	Period	Region	Aggregate or commodity	Returns to resh. expend. (Rs.)	Time lag (Years)	Value of inputs (Rs. ha^{-1})
Evenson and Jha	1953/54-1970/71	All India	Aggregate	11	8	
Kahion et al.	1969/61– 1972/73	All India	Aggregate	12	5	
	1956/57 –197273	Andhra Pradesh	Aggregate	32	3	
	1956/57 –1972/73	Maharashtra	Aggregate	14	1	
	1956/57 –1972/73	Bihar	Aggregate	64	4	
	1956/57-1972/73	Punjab	Aggregate	16	2	
Bal and Kahlon	1960/61 –1964/65	All India	Aggregate	2	5	
	1967/68-1972/73					
Bisaliah	1967/68	Ferozepur, Punjab	Wheat			67
Karam Singh	1960/65 –1969/72	Punjab	Aggregate	29		
Patel and Waghmare	1961/62 –1975/76	Maharashtra	Sugarcane	700		
Ramasamy	1962/63 –1978/79	The Nilgiris District	Aggregate of potato, carrot, cabbage, and paddy			
Sita Devi	1972/73-1988/89	Tamil Nadu	Aggregate	175		
Ramasamy	1972/73 –1992/93	Tamil Nadu	Aggregate	38	4	

and Chinnadurai	1975/76-1988/89	Tamil Nadu	Paddy			151
	1975/76-1988/89	Tamil Nadu	Sugarcane			488
	1975/76-1988/89	Tamil Nadu	Cotton			925
	1975/76-1988/89	Tamil Nadu	Groundnut			274

Table 2. Estimated rice annual yield losses from technical constraints in four eastern states of India.

Constraint	Loss (`000 t)
Weeds	1947
Anthesis drought	1548
Yellow stem borer	755
Seedling drought	671
Acid soils	661
Bacterial leaf blight	642
Lodging	629
Blast	573
Submergence	564
Zinc deficiency	490
Army worm	371
Green leafhopper	366
Rodents	365
Alkaline soils	338
Brown sport	298
Cold at anthesis	293
Iron deficiency	286
Birds	275
Gall midge	263
Sheath rot	253
Gundhi bug	249
Short duration	237
Saline soils	167
Sheath blight	161
White – backed plant hopper	159
Brown plant hopper	159
Iron toxicity	147
Case worm	144
Leaf folder	142
Grain discoloration	95
White ant	86
Cold at seedling	67
Bacterial leaf streak	64
Grass hopper	48
False smut	45
Whorl maggot	44
Striped stem borer	41
Hispa	32
Sulfur deficiency	30
Crabs	16
Mealy bugs	6
Tungro virus	5
Peat soils	5
Total	13970

Future agenda

1. Encourage close interaction among ICRISAT and other IARCs, national agricultural research institutions (ICAR and other agencies), and stage agricultural research systems to improve the efficient use of research resources and avoid overlapping activities.
2. Encourage interactions between public and private researchers.
3. Improve the organization of data on agricultural research expenditures. ICAR may assume the responsibility of organizing and publishing these data.
4. There must be continuous efforts to improve research evaluation methodologies (e.g., spillovers ; decomposing efforts of research, extension, and education ; and maintenance research *vs* research to enhance outputs).
5. Each research organization may assemble its own priority setting team to develop its research agenda.
6. There is a need to train agricultural economists on recent developments in the methodology of evaluating agricultural research.

Table 3. Net present value (Rs. million) and ranking of constraints in four Indian states.

Constraint	Biotechnology	Conventional breeding	Wide hybridization	Chemical and cultural
Andhra Pradesh				
Yellow stem borer	420.0 (4)	299.6	361.6	
Brown plant hopper	334.4 (7)	267.6	291.0	
Green leafhopper	222.5	147.8		
Gall midge		252.3		
Leaf folder	313.6 (8)		236.2	
Ear head bug	190.9	126.2		
Rice blast	420.9 (3)	262.1		
Sheath blight	254.0	168.0		
Bacterial leaf blight	289.2 (10)	174.5	210.6	
Salinity		176.3	312.4 (9)	
Fertilizer				369.9
Weeds				467.7 (
Water management				437.1 (
Lodging	372.9 (5)	320.1	321.0	
Drought	169.9		136.6	
Karnataka				
Yellow stem borer	136.8 (6)	97.0	116.7	
Brown plant hopper	111.7 (7)	38.3	96.5	
Thrips	87.3 (10)	61.9		
Gall midge			53.8	
Leaf folder	72.9			
Ear head bug	49.0	32.0		
Rice blast	162.3 (4)	100.4		
Brown sport	105.4 (8)	65.2		
Grain discolor				
Salinity			79.3	
Zn deficiency		58.0	82.9	155.1 (
Fertilizer				177.5 (
Weeds				168.3 (

Water management				163.4 (1
Varietal problems	86.8	51.1		
Kerala				
Yellow stem borer	60.7 (3)	43.0	51.8	
Brown plant hopper	50.7 (10)	40.4	43.7	
Gall midge		48.9		
Leaf folder			28.3	
Ear head bug	38.5	15.2		
Rice blast	23.5	40.6		
Sheath blight	65.8 (2)	39.9		
Brown sport	60.5 (4)	34.3		
Sheath rot	55.5 (5)	36.6		
RTV	51.7 (9)	32.8	38.4	
Acid soils	49.6	29.0	51.8 (8)	
Salinity		29.3	52.3 (7)	
Water management				67.6 (1
Lodging	54.0 (6)	46.3	46.1	
Varietal problem	38.2	22.4		
Tamil Nadu				
Yellow stem borer	427.8 (1)	147.0	180.4	
Thrips	155.0	110.0		
Gall midge		180.8 (9		
Leaf folder	218.9 (8)		164.2	
Ear head bug	141.6	82.3		
Rice blast	259.1 (5)	153.1		
Brown sport	161.8	100.1		
Low fertility				257.1 (6
Salinity		76.8	137.8	
Zn deficiency				227.4 (1
Fertilizer				370.8 (2
Weeds				272.3 (4
Water management				312.6 (3
Lodging	172.0 (10)	147.5	147.9	
Drought	100.0		80.2	

Table 4 Prioritized research portfolio for Eastern Ghat Highland Zone, Orissa'.

Rank	Research project	NPV (Rs. million)
1	Agroforestry models	51.7
2	Medium land paddy – drought	49.3
3	Weeds – upland crops	36.2
4	Wilt – tomato/ brinjal	30.2
5	HV – layer strains	29.2
6	Vegetable productivity	24.4
7	Niger project	24.0
8	Pest control – vegetables	13.1
9	Upland paddy – drought	10.7
10	Ragi – drought / duration	10.3
11	Sterility in maize	9.0
12	Sabar grass introduction	7.1
13	Package for coffee	7.1
14	Root knot nematode	4.8

15	Horticulture	3.5
16	Fruit rot – brinjal / tomato	3.3
17	Medicinal plants	0.9
18	Honey bee pasturage	0.3
19	Anthelmintics	0.1

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ISSUES EMANATED FROM DISCUSSIONS AFTER PRESENTATION OF PAPERS IN SESSION II

- Similar to Veterinary Council of India, there must be some check for quality maintenance on Agricultural Education at national level
- Atleast one per cent of the total budget of State funds must be provided for Agricultural Research.
- Constituting a "force group " to avail state funds for Agricultural Research so as to apprise the Chief Ministers and Agricultural Ministers of all the states
- ICAR should provide needed funds especially for educational activities of SAUs.
- Each Research Organization may assemble its own priority setting team to develop its research agenda
- There must be continuous efforts to improve research evaluation methodologies

Session III

The session III was chaired by Dr.V.M.Pawar, Vice-Chancellor, MAU, Parbhani and the Rapporteurs were Dr.C.Ramasamy, Director (CARDS), Tamil Nadu Agricultural University and Dr.John Thomas, Dean (Agrl. Engineering), Kerala Agricultural University

The following presentations were made during this session.

1. Agricultural Dimensions of WTO perspectives	Dr.M.L.Madan, Vice-Chancellor Panjabrao Deshmukh Krishi Vidyapeeth, Akola. (Full paper not received)
2. Few thoughts for effective transfer of technology	Dr.B.S.Nadagouder, Director of Extension, UAS, Dharwad

Paper 1. Agricultural dimensions of WTO perspectives (Power point presentation)

Dr.M.L.Madan
Vice-Chancellor,
Panjabrao Deshmukh, Krishi Vidyapeeth,
Krishi Nagar, Akola.

Main Objectives of New Economic Policy

- Eradicating mass poverty
- Freeing the economy from the grip of control and licensing wherever necessary
- Opening up the manufacturing and service sector to competition
- Reducing role of public sector
- Relaxing restrictions on investment by both foreign and private parties
- Liberalizing foreign trade which involved reducing quantitative restrictions on imports, lowering tariffs and removing exchange controls
- Introducing greater discipline in Government financial management

Goals of New Economic Policy

- Liberalization opening up for foreign investment
- Upgrading Economy
- Giving Competitive Strength to India's industrial and service sectors
- Choice in goods and services in terms of quality and price
- Encourage indigenous producers to upgrade quality and standard for both domestic and foreign markets
- Build up world scale domestic market

Liberalizing the Economy is not an end itself;

Only an Instrument to achieve the larger objective of putting the Economy on a fast growth tract for mitigating the problems of **Mass Poverty**

"Poverty"

Income the basic factor and has Many Important Dimensions. "Poverty is the deprivation of basic capabilities" Opportunity for education, health care, sanitation, nutrition, clean drinking water, housing, for component bio - element – the man and animals, in its eco-system.

GROWTH MODEL

Annual Economic growth @ 7 to 8% over 15 years period

"Trickle down effect"

Land Holdings

(In lakhs)

	Vidarbha	**Maharashtra**
Marginal (below 1 ha)	5.23	32.75
	(24.87)	(34.58)
Small (1 – 1.9 ha)	6.81	27.27
	(32.39)	(28.80)
Semi-medium (2 – 3.99 ha)	5.32	21.26
	(25.27)	(22.45)
Medium (4 – 9.99 ha)	3.21	11.71
	(15.24)	(12.37)
Large (10 & above)	0.47	1.71
	(2.24)	(1.80)
Total	**21.04**	**94.70**
	(100)	**(100)**

Creation of job
1993 – 1999

Growth in Agriculture job : 0.0%
Growth in New Agriculture job : 2.4%
(same as growth in equalities)
Thus overall growth has decelerated in nineties 93-94 Agriculture : 65% of total employment
1999-2000 : 62% of total employment

Rural India Agriculture created 2.3 M jobs
Non – agriculture created 9.2 M jobs

Agriculture Sector growth 93-99 – 3.0%
9th Plan elasticity much lower instead of 0.38 and 0.18

What is the WTO?

The World Trade Organization (TWO) is the only global international organization dealing with the rules of trade between nations. At its heart are the WTO agreements, negotiated and signed by the bulk of the world's trading nations and ratified in their parliaments. The goal is to help producers of goods and services, exporters and importers conduct their business.

Functions	**Fact file**
Administering WTO trade Agreement	Location: Geneva, Switzerland Established: 1 January 1995
Forum for trade negotiations Handling trade disputes	Created by : Uruguay Round Negotiations (1986-94)
Monitoring national trade policies	Membership : 140 countries (as of 30 Nov. 2000)

Technical assistance and training for developing countries	Budget : 127 million Swiss francs for 2000
Cooperation with other international organizations	Secretariat staff : 500 Head : Mike Moore(Director General)

The WTO top level decision-making body is the **Ministerial Conference** which meets at least once every two years

- General Council
- Goods Council
- Service Council
- Intellectual property (Trips) Council
- Specialized Committees
- Working Groups
- Working Parties

The WTO agreements

The WTO's rules – the agreements – are the results of negotiations between the members. The current set were the outcome of the 1986-94 Uruguay Round negotiations which included a major revision of the original General Agreement on Tariffs and Trade (GATT).

GATT is now the WTO's Principal rule–book for trade in goods.

- Goods
- Services
- Intellectual Property
- Dispute settlement
- Policy review

WTO

WTO put together mostly by US and EU in a deal.

They restrict the extent to which member States of WTO (140 countries) can control their own food imports and production and the environment and social impact of their farming sectors. Agriculture is unlike other industrial sector as its Multiple benefit extent beyond production of food.

Difficult value appropriation
Maintenance of viable rural communication.
Agricultural Environment (Food for work in India; F & M disease in Europe)

WTO And Agriculture

Uruguay Round – Conversion of quantitative measures on import of Agriculture products into tariffs called Tariffication. Tariffication required Tariff be lowered over 6 year span (from Jan 1, 1995) by 36 percent for developed nation and 24 percent by Third World (Waiver for least developed nations). Dilution of subsides on experts of Agricultural products. AOA binds Countries to minimum market access i.e. importing atleast 3% of agricultural products consumed without quantitative restrictions to be raised to 5.0% in 6 years (India covered under article XVIII B of GATT Countries with Balance of Payment problem can use quantitative restrictions)

AOA – Two disciplines

1) Border measures
2) Domestic distraction in Agriculture Economics Required to be calculated as per recommended formula Known as Aggregate Measurement of Support **(AMS)** and is 5% for developed nations – lower it by 20% in 6 years 10% for developing nations – lower to 13.3% in 10 years (None Asian Country has AMS level beyond 10%)

ASSESSMENT OF WTO AGRICULTURE AGREEMENT

Observations

1. Domestic Support and Export Subsidiary in developed Countries.

- Developed Countries (DC's) Commitment to reduce (1995-2000)
  Domestic Support : 20%
  Budgeting outlay for Export Subsidy : 36%
  Quantity of Export covered by Export Subsidy : 21%
- Farmers in DC's enjoyed protection and support for long.
- Endowed with resources and enjoy a favorable environment of production and export.

Result:

- Bulk of domestic support and export subsidy will continue every year beyond 2000
- Domestic support and export subsidiary enhancing the unfair advantage which the farmers have over developing countries

Observation

2. Farmers in Developing Countries (DLC's)

- Take into account the need for food security
- Protection to small farmers

Result : Domestic subsidiary concepts non-violable
Implication : Change in economic polity

3. Tariffs in DC's

- Through Tariffs in Schedules
- Farmers benefited
  - Direct import control
  - Prohibitive tariff

Result : Protection to agriculture patently unfair commitment to reduce scope to 36%

Implication : Should reduces Tariffs significantly in 5 years

4. Domestic Support and Export Subsidy in Developing Countries

- Not applying domestic support and export subsidy earlier
- Not recorded in their schedules

Result : Debarred from applying these measures in future. Beyond minimize levels. Farmers disadvantage

Implication : Lift restrictions (Article 3 DLC's will not be subjected to restrictions)

5. Lifting of restrictions for encouraging food production.

- Food products in DLC's excluded from import Control and Domestic Support

Result: DLC's encouraged to produce more and reduce dependence on imported food.

6. Removal of inequity in Article 13. Restraint provision unbalanced and iniquitous
   - Annexure-2. Subsidiary in developed country
   - Immune from counter measures and counter vailing

   e.g. Investment Subsidiary
   Input Subsidiary

Action : Article 13 to be amended.

7. Support to small farming (SF)

- DLC's farming not commercial venture but as family activity for generations
- Subsistence cultivation at household levels
- Small farms cannot stand to international competition.
- Need support otherwise large scale unemployment and Increase in poverty

Action : DLC's flexibility regarding import restraint and domestic subsidiary classification in article 3 and 4 of AOA.

8. Removal of unpredictability about domestic subsidiary.

- Country can modulate choice of product and rate of subsidy to match
- Causes uncertainly in the mind of exporters in other countries, who do not know which products will be covered by reduction to what extent.
- Hence exports difficult to plan

Action : Such action to be planned and announced

9. Social and Environmental Costs
   - Costs of Agriculture Policy are greater than ever challenges;

Suggestions for reform

Key Issues:

Non-trade Concerns:

- Efficient agriculture
- Use of inputs
- Input/output rations
- Livelihood of Communities
- External costs not born by farmers

- Intensive agriculture frequently exhausts those resources which are least renewable – Soil, Soil nutrients and Water
- Huge social expenses.
- Rural urban divide.
- Moving Communities from rural to urban sites

Key Issues:

Rural Poverty to Food Security:

Rural communities face hardship and decline

- Farm Incomes fall
- Utilization/Consumption capacities reduced among rural poor
- Pushing farmers to grow new and unfamiliar crops for export (e.g. hybrid cotton – Andhra and Maharashtra)
- Common Agriculture Policy Subsidies benefited those who produce more - resulting in intensification (50% of CAP subsidies go to top 17% of producer in Europe, 80% of them go to 17% of producers in India)
- Collapse of rural communities linked to domestic food insecurity
- Failure to compete with cheap imports has undermined production
- Food security premised upon imported food stuffs.
- Reliability of such imports contingent upon supply of hard currency
- Transportation and storage incapability increasing vulnerability

Key Issues:
The Environment:

(A) Shift in agriculture practice leading to marginalization of small farm.

- Expansion of large farms
- Increase use of monoculture, pesticides and fertilizers resulting in high cost of production.

(B) Direct impact on environment

- Loss of crop diversity
- Increasing susceptibility to climatic fluctuations
- Vulnerability to pest outbreaks
- Increase reliance on pesticides
- Loss of soil minerals
- Water courses become polluted
- Soil degraded

Thus long time food security dependent upon move towards more sustainable means of production.

WTO Impact :

Growth rate of World Merchandise Trade in 1999	: 5%
Economic growth in Europe and Latin America-2000	: 10%
Average growth 1990-99 mainly Commercial Service Trade	: 6.5%
Developing Countries merchandise Exports increased	: 9%
Shared valued of World Exports	: 27.5%
Least Developed Countries (LDC's) growth	: 2.5%
Growth World 1999-2000 average	: 6%

WTO – A Candid View :

More concern for domestic issues

- World Agriculture Prices dripped below Indian prices
- Volatility of World prices of agriculture goods has increased
- Cyclical pattern in prices not impacted by WTO regime
- Procurement prices continue on an upward trend
- Indian prices at risk of exceeding world prices so exports unlikely (example wheat 2001)
- * Prices politically correct – economically disastrous
- Closed internal free trade in agricultural commodities (Variation in price surpluses States low, deficit States high)
- Price equalization through trading within States or regions
- Government forced to mop up surpluses at procurement price; since not time and quality efficient – poorer farmers sell at low prices to traders who sell elsewhere on procurement price.
- * Nexus between traders and policy makers.
- **Inefficiency of transport infrastructure** (cost from Punjab to Mumbai by road twice cost of shipping grain from Australia and 4 times from Bangkok. Rail transport much cheaper but not used*)
- Agriculture Exports subjected to export restrictions, e.g. wheat, rice, dairy products but where is production capacity?
- Accumulating stock need a re-look in terms of food security, health and energy requirement
- Bound rates and non-tariff barriers so imports to flood.

Paper 2. Few Thoughts for Effective Transfer of Technology

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The world is changing fast. Technology is now the established instrument of transforming the society and removing the remnants of economic backwardness. A scientific and disciplined attitude must be developed by all in order to face the challenges of the ever increasing human population and decreasing natural resources.

Indian agriculture has undergone profound change since independence as a result of the devoted and dedicated endeavour of researchers and extension workers and receptive farmers. The land mark is the increase in food production from a meagre 50million tonnes at the time of independence to over 200 million tonnes in present years and likely to increase to 240 million tonnes. It is estimated that the foodgrain requirement by 2050 AD would be 400million tonnes very shortly. Therefore, it would be wise not to rest on today's laurels without planning for future which will call for considerable introspection on our part.

The demands made upon transfer of technology for accelerating agricultural production are enormous and most formidable. This is a complex task, inter-disciplinary and multi-institutional in approach and content. Therefore, the integrated functioning of research, education and extension has been the cardinal principle of agricultural development system. The extension system involves: i) research institutions, ii) educational institutions, iii) training institutions/centres, iv) marketing system v) extension organizations / sub-systems, vi) input agencies, vii) village institutions and vii) the farming communities. As a short-term as well as a long-term strategy of development, a systems view of the extension organization has to be taken for fostering the functional linkages and creating synergistic effect.

In the Indian context, there are four major organizational streams devoted to extension work for agricultural and allied production: 1) the ICAR extension system; 2) extension system of the

Ministry of Agriculture/State Departments of Agriculture; 3) extension system of the Ministry of Rural Development/State Development Departments; and 4) development work by the non-governmental organizations (NGOs), business houses, etc.

The ICAR extension system comprises mainly research institutes and agricultural universities. The agricultural scientists and extension personnel of these institutions are required to play the role of first-line extensionists through organizing demonstrations, training, etc. on a limited scale, but forceful enough to have catalytic influence on other extension systems/sub systems. The main agency for agricultural development work is the Ministry of Agriculture and State Departments of Agriculture. The introduction of Training and Visit (TV) System of extension by the ministry is intended to strengthen the extension system considerably for rapid transfer of technology.

At present, the Indian extension system deals with 81.5 million land-holdings and about 500 million farmers, including farm women, young farmers and agricultural labourers. An extension system or sub-system, howsoever vast, cannot reach them quickly. Therefore in the Indian context, multiplicity of extension agencies, training institutions, input organizations, etc., and **duplication of work by them is misnomer.** What is required is to develop and maintain a strong functional relationship and play **complimentary and supplementary roles** influencing the total agricultural production in the country.

What is Transfer of Technology ?

Technology Transfer is a systematic process of making farmers aware of a new technological component or system, then creating farmers interest in the new technology so that they can evaluate it within their own farming system and agro-economic conditions.

In transferring new and science-based technology to farmers, extension systems use mass media in the early stages to create farmers awareness and interest. When farmers become interested in a new technology, they need more specific indepth information about the technology so that they can learn how to use it and to evaluate its expected costs and anticipated benefits. At this stage, group methods, including meeting, demonstrations and field days are typically used. These methods are supplemented with indepth brochures that farmers can take home so that they will know how to incorporate the new technology in to their farming system. In general, most information about new technology (indigenous/science-based) travels from farmer to farmer through **word-of-web-of-mouth** informally.

Factors Influencing Transfer of Technology:

Many variables influence the effectiveness of technology transfer programmes in developing societies and practically all can be classified in to five general categories as characteristics of technologies, socio-economic characteristics of potential adopters, cultural definitions, institutional constraints and past experiences with adoption of agricultural technologies and techniques (Napier, 1991).

Early proponents of diffusion theory believed that farmers acceptance of new technology was largely explained by socio-psychological factors. Farmers, in turn, were categorised across a continuum ranging from innovators to laggards (Rogers, 1983). This conception assumed that farmers were essentially a homogenous group and that technology would eventually 'trickle down' from the innovators, to the early and late adopoters, and eventually to the laggards. Hence, it was the farmers' problem; neither the technology nor the transfer system was called in to serious question. But it is obvious that farmers are not a homogenous group and many other factors may directly or indirectly affect their capacity to adopt.

In the present day context, there are five main factors that affect the process of technology transfer.

1. Limited availability of location specific technology (appropriate technology)
2. Low degree of ability to understand risk and uncertainty in evironmental factors including climate and soil.
3. Lack of support systems including shortage of draft power.
4. Weak economic base of the households and farm resources, and
5. Weak market structure/forces

Hence, the Transfer of Technology system has to deal with each one of these factors while designing technology delivery system.

Consequently the burden of responsibility for non-adoption is now being, shifted from 'the farmer' to 'the technology' system itself. This realisation necessitates the need for change in the Transfer of Technology models.

Transfer of Technology is governed by various factors as mentioned under the Norms of Society/Proneness to Change. Any society will consist of heterogenous members, including traditional and modern members. The scale of adoption and rate of adoption of an innovation by these members of a society can be represented by Minimum to Maximum and Low to High continuum, respectively. Hence the scale and rate of adoption of an innovation varies among the traditional and modern members of a society and they are influenced by the degree of prevalence/existence of the mentioried factors.

Model of the innovation-decision process and its significance to transfer of technology:

Diffusion researchers have long recognized that an individual's decision about an innovation is not an instantaneous act. Rather, it is a process that occurs over time and consists of a series of actions involving both covert and overt behaviours.

Rogers (1983) presented a model of innovation-decision process which consisted of five stages-knowledge, persuasion, decision, implementation and confirmation. It is
the process through which an individual passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of the decision.

Dey (1976) found that in all stages of the innovation-decision process, personal cosmopolite channels like extension workers were most important for high urbanized villages and personal localite channels like other farmers were most important for the low urbanized villages.

In high urbanized villages after getting initial information about the innovation from the extension workers, for going ahead with adoption, the farmers seek support and reinforcement from other farmers who belong to his own social system.

In low urbanized villages, after getting initial information about the innovation from other farmers (localite) for going ahead with the adoption of new technologies, the farmers seek technical guidance from the extension workers.

It is also reported that while taking more information about the innovation (persuasion stage) and putting it in to trial (decision stage), the chief concern of the farmers is the method i.e. 'how to' information. The next is about 'yield potentiality' or 'increase in yield', in the persuasion stage and 'availability of inputs' in the decision stage.

For successful technology transfer programme the extension workers have to plan their communication strategy based on the actual information needs of the farmers with whom they work.

Personal channels are more important than impersonal channels such as radio and other mass media in all types of villages and in all stages of the innovation decision process, except knowledge stage in the high urbanized villages.

Transfer of Technology Models:

In the traditional Transfer of Technology model, research results were transferred directly to the State Department for onward transfer to the farmers. This model was changed with the establishment of State Agricultural Universities. There were several studies in India and abroad to develop Transfer of Technology models and for establishing direct, effective and functional linkages between researchers and their clients. Rhoades *et al.,* (1985) categorised these models in to the following three categories: 1) The top down model 2) The feedback model and 3) The farmer-back to farmer model.

The top down model considers TOT as one way process. The scientists pass on the technologies developed by them on the research stations to the extension agency, who in turn transfer them to the farmers for adoption. But this model failed to reach the farmers for adoption due to assumption that the scientists know well about the requirement of farmers. It was evidenced more in rainfed area, having more complex farming systems.

Feed back model involved the response of the clientele in the technology promotion. In this approach, the researchers test and verify their technologies in actual farm situations and get the farmers reaction to it. The Operational Research Project concept of the ICAR is on these lines.

Farmer back to farmer model starts with the assumption that research must begin and end with the farmer. This model stimulates active farmers participation in the entire research process and the contribution of farmers in fine tuning of technologies.

Prasad (1995) advocated Area Audience-Orientation-to-Research And Development (AAORAD) approach which takes in to account two dimensions; area-irrigated, rainfed, hilly coastal, remote; and audience-male farmers, farm women, farm youth, agricultural labourers, nomads, subsistence farmers etc. This model recognized the four distinct activities, i.e., diagnosis to define problems, Indigenous Technology research to develop potential solutions, off-farm and on station testing and adoption of proposed solutions to farmers conditions, and farmers evaluation/adoption of technology and monitoring its adoption.

At present five transfer of technology'Extension systems are in vogue in the country for the purpose of accelerating agricultural production and rural development. These are: 1) first-line extension Education system of the ICAR, 2) National Agricultural Extension Project (NAEP/ T & V system). 3) Special Extension Thrusts programme on specific crops, 4) Rural Development programme and 5) the NGOs (Prasad, 1990).

In India with varied agro-climatic and socio-economic situations, varieties of extension systems and approaches can be justified, but they must not function in isolation.

Participatory Technology Development (PTD) model is an evolving methodology where by 'outsiders' facilitate the technology development and transfer (Anonymous, 1991). This has been used to develop and adopt technologies taking in to consideration the farming environment as well as the household. Testing of the improved technologies through on-farm experiments ensuring farmers participation in the development and transfer of new technologies are emphasized.

Constraints in Transfer of Technology:

In the Indian agriculture, there is still a wide difference between the production potential and the actual production which is called as **"Yield gap"**. Several factors influence the transfer of technology system/sub systems to the development of agriculture sector in the country. Study of these factors in their proper perspective is essential. Broadly, these factors are classified in to five categories, i) common basic constraints, ii) technological constraints, iii) organizational and administrative constraints, iv) extension constraints, and v) social constraints. The following discussion would point out some major bottlenecks in the acceleration of pace of agricultural production in the country.

Common basic constraints:

a. The land is a basic natural resource in the agricultural production system of this country. The growing population is further aggravating the situation. The per-capita land in this country is not only limited, but also scattered in small pieces. Besides, the trend is towards further fragmentation making it too difficult to cultivate the land holdings economically and efficiently. The consolidation is the only solution if the farms are to be made more productive.

b. Another constraint is the lack of proper study and survey of our soils, water resources and manpower potential. Even today our farmers select crops and copping sequence, and apply costly fertilizers without proper knowledge and understanding of soil properties and requirements. It is important, therefore, to undertake a comprehensive survey of agricultural resources and mapping them with detailed basic data for proper planning and launching of appropriate programmes and projects.

c. Proper marketing and pricing policy to cover all crops and animal products is another constraint which needs careful consideration. All the coarse grains, millets, oilseeds and pulses should be brought under the framework of the pricing policy of the Government. Crop and animal insurance are equally important for boosting production.

d. Co-operatives though failed to play their proper role in the rural economy must succeed in supporting the agricultural development efforts. They are vital for the large number of small and marginal farmers in the country. Unless agricultural inputs are locally available in time through the co-operatives the agricultural production will continue to be severely affected.

e. Conservation of soil and water resources is another basic need. Deforestation, erosion of soils and sedimentation of rivers, lakes, dams and ponds are continuing features. The land fertility and water-retention capacity of soils are equally important and need immediate attention.

f. No country can economically prosper unless its people are committed to the concept of development. But it is our misfortune that this spirit of hard working and dedication to the duty of the common people is gradually eroding. There is need for an educational drive to make the youth aware of the importance of growth equality.

Technical Constraints:

a. The need for evolving high-yielding crop varieties resistant to pests and diseases is not exaggeration.

b. Farm management has become a very important subject for realizing the full potentials of high yielding varieties and costly inputs including labour.

c. Short duration crop varieties essential for successful multiple cropping and relay-cropping are not adequate at present.

d. Appropriate, low cost and locally suited agricultural implements are still a far cry. They are not sufficiently manufactured and readily available.

e. The Indian farmers are yet to learn to adopt a judicious and balanced use of costly chemical fertilizers and micronutrients. They are to be guided about the balanced use of organic manures, vermicompost, major fertilizers and micro-nutrients.

f. Supply of sufficient inputs, specially that of improved seeds, planting materials and animals, is another extreme problem.

Administrative constraints:

a. Staffing the transfer of technology projects has been another bottleneck in the agricultural development system. The constraints are: i) non-availability of trained staff, ii) delay in the recruitment of staff due to relatively rigid recruitment rules of the government, universities or institutes, iii) frequent transfers, iv) diversion of ill-equipped staff to the extension projects; and v) lack of appropriate incentives to the extension workers specially at the field level.

b. The second constraint in our agricultural research system is that all the emphasis in on research, agricultural education and administrative set-up to regulate it, while the extension work is relegated to back benches.

Extension Constraints :

a. Despite the introduction of new systems of rural development like the extension approaches, methodology and communication devices have remained more or less static in our country: Community Development, Integrated Rural Development, First-line Extension Work. Etc. Similarly the 'Farm Youth club Work' device to train young farmers systematically through scientific project works has failed. The Farm Youth Club/Farm Science Club concepts are to be modified as a long term training strategy for the farmers so that the results of new development systems could be achieved.

b. The infrastructures for training farmers are inadequate. The training courses for farmers are recognized on ad-hoc basis. The Farmer's Training Centres (FTCs) have become outmoded and in many cases non-functional. The number of 'Krishi Vigyan Kendras', the innovative vocational training institutions are woefully limited. One KVK in a district will take over 125 years to cover nearly 0.4 million farmers by short or long training courses only once even if it is a continuous process. There is a need for large number of KVKs and also remodelling the FTCs as KVKs.

Social Constraints :

a. The adoption behaviour of farmers very much conforms to normal curve-limited percentage of farmers and progressive/innovators, a similar percentage are laggards and the rest are in between early adoptors and late adoptors. Therefore, the blanket statement that the farmers are a very receptive lot and all the lacunae that exist are because of the extension agencies is not correct. Only 20-25% of the farmers are receptive to new ideas. The extension workers have to keep this in view while devicing specific strategy best suited to the target groups.

b. The decision-making process in the families in rural areas is yet another constraint because they are dominated by the elders (preferably men than women) who are generally less progressive in outlook than the younger generation.

Strategies for Effective Transfer of Technology :

Diffusion of innovations refers to the spread of those innovations through a population, and is simply the result of a host of individual adoption decisions. Diffusion pattern follows 'S' shaped curve. It starts with few innovators, early adopters who try a new technology. The speed of the process increases as others are able to observe results and as interaction between innovators and others takes place. It is important to note that the 'break' in the diffusion curve, that is, the point at which diffusion tends to progress at a more rapid rate after a slow start, results from a social process of interaction among farmers. Existing communication networks and ties are central to this.

- Extension Workers can influence the steepness of the upward slope by providing the knowledge for decisions to be based on. Extension communication is powerfully reinforced by the informal communication which takes place among farmers on a day-to-day basis. Therefore, the informal communication about performance would have to be consistent with the persuasive messages from extension if the diffusion rate is to increase.

- Extension workers must workout a strategy for an information campaign with respect to such questions as; **who should be approached first? What type of client may require longer term effort? Or, which channels of communication should be most useful; early in the campaign or later in the campaign?** In total, he must work out a basis for differentiating among members of a society and plan an information package to serve the various categories of clients.

- Sometimes messages to persuade the farmer may be of little effect because the support mechanisms which facilitate implementation may not be available to his reach. Strategy in that circumstances ought to include efforts to develop service institutions.

- Extension workers can capitalize on those early adoption experiences in different areas and speed up the diffusion process.

- Innovators and farm leaders can be sought out early in an information campaign and persuaded to try new innovations. Hence, the diffusion process can be enhanced by the early action of innovators; others can observe the results and obtain information from the innovators and from extension personnel or other formal information sources, besides model farmers.

- An innovator may be able to accept innovation quickly, but unable to act because of situational constraints (Lack of access to credit and market). Therefore, extension worker should remove the main constraints, in conjugation with educational programmes beamed to the farmer.

- Finally, the feedback information from farmers to extension worker and from both to the designer of technology, not only enhances technology transfer in the short run but also lays the ground work for redesigning of appropriate technologies.

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ISSUES EMANATED FROM DISCUSSIONS AFTER PRESENTATION OF PAPERS IN SESSION III

- High level use of inputs, decline in out put – input ratio, externalities causing environmental hazards, widening inequality and labour migration are the non trade concerns, which are to be taken into account in addressing agricultural issues under WTO.

- There is a need to redefine policies and research programmes to cater to the needs of small and marginal farmers.

- Any step towards removal of subsidies may increase cost of production which could raise input cost and affect small and marginal farmers.

- It is to be ensured that the subsidies reach only to the intended group of farmers.

- Priority areas for research should be identified by Agricultural universities to help farmers to benefit under the present global conditions.

- More investment is required for venturing both research and development in the area of post harvest technology

- Private sector extension must be encouraged by the public sector extension system to lubricate the diffusion process.

- State Agricultural Universities must conduct more number of demonstrations for accelerating technology diffusion.

- The universities may follow the UAS, Dharwad model of hiring private TV channel for specific hours to focus on university technologies.

- The TANWA model of Tamil Nadu may be replicated for other areas and states
- Sensitization of farmers on IPR issues by the extension workers will help the farmers to properly claim their rights over traditional knowledge and land races.

Session IV

The session IV was chaired by Dr.M.Mahadevappa, Chairman, Agricultural Scientists Recruitment Board, Indian Council of Agricultural Research, New Delhi.

Dr.N.Sreerama Reddi, Dean (Agriculture), ANGRAU, Hyderabad and Dr.Sabitha Doraiswamy, Director (CPPS), T.N.A.U., Coimbatore acted as Rapporteurs. The following paper was presented.

1.Prospects of Agricultural Research in Mountains/ Hill Areas	Dr.Tej Partap, Vice-Chancellor, CSK HPKV, Palampur (HP)

Paper 1. Prospects of agricultural research in mountain/ hill areas

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Millions of mountain people, both men and women, have been responding in a myriad ways to the daily challenges of survival in a difficult environment. In the past, the principal part of this response has been to improve mountain agriculture. Indigenous knowledge and wisdom played a singular role in bringing about the needed changes. As the pace of change in mountain agriculture is significantly outpaced by more drastic changes from other forces, such as population growth, deforestation, expanding commercialization, and so on, mountain agriculture is in dire need of becoming more sustainable in the future. Though these new demands on agricultural research and education systems of mountain areas attract attention in various national international for a as part of the over debate on sustainable agriculture development, but there are only few examples of focused efforts. This paper presents analysis of findings of studies of agricultural research and educational institutions and gist of deliberations of a regional consultation on agricultural research and education for sustainable mountain agriculture, organized by the International Centre for Integrated Mountain Development (Banskota and Partap, 1996).

Challenges to Mountain Agriculture

What has gone wrong with mountain agriculture today? In the past it was seen as a relatively successful system. What has changed now? The population density in mountain areas has moved from low to high. Agricultural systems are no longer able to provide adequately for the needs of the households, and this has increased the pressure on marginal mountain resources.

Seasonal migration is now becoming more and more permanent migration, because the capacity of the mountain agricultural economy is declining. Many a are as under shifting cultivation and pastoral nomadic systems, with rotational cultivation are now becoming permanent cultivation systems with increasing soil erosion and declining soil fertility. There has also been a reduction in the diversity of crops. Previously hill farmers used to grow many different crops in just one season but now more and more areas are changing to mono cropping. Regarding forests, apart from deforestation, the patterns of ownership and control are also changing with resource tenures moving from community to individual and private groups. Settlement patterns were dispersed and small, and people were close to their homesteads, but now there is increasing agglomeration. The economies have moved from being those based on barter systems to those based on cash as mountain areas become more monetised.

In spite of the large population, there is still a scarcity of labour during different seasons. The burden on women is increasing and a higher proportion of children make up the labour force. Mountain

farmers are increasingly being seen as sacrificing long-term strategies for short-term needs. Mountain farmers can no longer afford to think too far into the future. Most of the resource management mechanisms dependent upon institutional mobilization, cooperation, and partnership are breaking down. Mountain people do not have too much faith in governments also because most of the governments have been more interested in extracting resources out of mountain areas and have not put back enough for the benefit of mountain people, their agriculture, and their economies.

Need of the Hour:

Sustainable mountain agriculture development emphasizes the need for some fundamental changes in agricultural research and education. Present policies, investments; research, and technology development have only a limited focus on mountain problems. Even if there have been efforts towards crisis management, most interventions have been undertaken with a predominantly plains' bias. These are significant lacunae in our understanding of the interventions that should be undertaken in future to render mountain agriculture sustainable. The alleviation of poverty and the extent to which we can improve mountain environmental conditions will greatly depend upon a comprehensive understanding of the constraints and opportunities prevailing in this extremely challenging environment.

Overcoming the centuries old neglect and isolation of mountain agriculture and the farmers, the focus of education and research should not have been simply on maximizing productivity, but more on the sustainable use of fragile resources. Also, without improvement in many social, legal, and resource access conditions, mere availability of improved technology cannot achieve the desired end result of a healthy, vibrant mountain agriculture at the grass roots. One also the finds strong need for steps that help integrate farmers' preferences and knowledge with scientific knowledge and technology, for which our SAUs' are inadequately equipped.

Under these circumstances. the daunting task of sustainable mountain development emphasizes the need for fundamental changes in agricultural research and education. First. there are relatively few universities in the mountain region. Second, most of the existing universities suffer from the same type of neglect and isolation that mountain populations and areas have experienced in the past. Thirdly, mountain institutions have also overlooked their immediate environment in their research and teaching activities and focused more on non-mountain and lowland ; . concerns. Fourthly, because of the problems of access and communications prevailing in mountain areas, professionals there have always found it easier to liaise with their counterparts in the plains than with those in mountain areas, I reinforcing the plains' bias in teaching and research activities.

Why Focus Attention on Mountain Agricultural Research and Education?

Reason stems from the fact that, in mountain regions, we encounter three areas of concern, all of them interlinked and constituting a central theme in national policy. These are:

- **Poverty:** Where do we often find pockets of poverty? Obviously in the mountains with their problems of difficult accessibility, scarcity of agricultural resources, and social and political marginalization that commonly form barriers for economic and social prosperity.
- **Environmental conservation**: Serious forms of environmental degradation I Again, in the mountains, where the fragility of the environment, inappropriate planning of physical infrastructure, and intensive utilization of available resources together result in serious environmental degradation.
- **Gender concerns:** Women in mountain communities. given their overall lower status and literacy levels, often are doubly marginalized in the vicious circle of poverty and resource degradation. Their opinions, needs and perceptions are rarely reflected in state and national policies and fora. Nowhere is the intricate link between poverty and environmental degradation

more obvious than in mountain regions. And nowhere is the need for addressing these problems in an integrated and gender balanced manner more obvious than in mountains.

Most mountain areas need to expand their economies at a fairly rapid rate to satisfy the legitimate aspirations of their people. This process of expansion will entail a significant increase in the use of natural resources. The challenge for us all I . is to attain this without harming fragile-marginal mountain environments. Lifestyles and development patterns we promote in mountains must therefore be compatible with these environments; otherwise pollution, degradation, and damage will set in fairly quickly. Thus, while a progressive rise in the standard of living is a legitimate aspiration of the people of mountain areas, this does not mean that we should mimic wasteful and polluting lifestyles of elsewhere. On a priority basis, our agricultural development strategies should aim at satisfying basic human needs in terms of food and income and a healthy and secure environment. Full use need to be made of modern science and technology, as well as indigenous knowledge, to realize these goals.

Highlights of A Review of Mountain Agricultural Research and Education systems:

The International Centre for Integrated Mountain Development undertook a comprehensive review of the agricultural research and education institutional systems existing in eight countries of the Hindu Kush-Himalayan region. It provided a clear picture of the state of institutional capacities for facilitating sustainable development of mountain agriculture.

Questions are being raised about appropriateness of generated technologies and human resources for promoting and /or for providing answers to complex economic and environmental issues. Many institutions are being increasingly criticized for research activities that appear to have little relevance to the problems of their surrounding environment. While much of the present development approaches emphasized the need for greater familiarity and understanding of the local environment, local resources, local knowledge base, local cultures, and local adaptation mechanisms but research and education institutions in mountain areas were not focusing on the problems of their local environment. Efforts were also wanting that could facilitate integration of modern science and technology with the conditions of the local environment in the academic and research activities.

As mountain areas are opening up and coming in contact with the wider . market economy, and governments are seeking support from these institutions for launching agricultural diversification and enterprises development programmes, but poor institutional capacities to meet new challenges posed by global marketing was a common problem.

Major highlights of this regional review of Hindu Kush Himalayan region- covering eight countries, included;

Agricultural Education

Many of the educational institutions located in the HKH region suffered from the following problems:

i. Their organizational structures and curricula emphasize crop production under irrigation, and this is unsuitable for mountain ecological and socioeconomic conditions.
ii. Agriculture in mountainous areas is largely based on integrated crop-livestock-agro forestry farming systems. whereas the educational system is implicitly based on the monoculture of individual commodities. mostly food and cash crops. Horticulture and pasture management. which are very important in mountain areas, are not sufficiently covered in the curricula.
iii. Adequate emphasis has not been given in the curricula to the fragile aspects of the mountain environment.
iv. Linkages of these institutions with research institutes. extension organizations. and the public sector development system are often quite weak. Educational institutions often confine themselves to on-campus teaching.
v. There is little interaction between teaching institutions and farmers.

Research Institutions :

The comprehensive review of mountain area agricultural research institutions. including universities, revealed following common scenario:

i. Most institutions have been greatly influenced by plains' based , research. Only some institutions have been able to incorporate the mountain perspective into their mandates and functioning.

ii. R&D institutions for mountain agricultural development are still oriented sector wise and they continue to focus primarily on maximizing yields rather than on the sustainable use of marginal mountain resources and its unique bio-resources / agro-biodiversity.

iii. iii. Incorporation of indigenous knowledge in formal agricultural research systems has received very low priority. This has in turn led to limited adoption of modern technologies by mountain farmers.

iv. Wherever agricultural research institutions have been able to make a significant impact, the key factor behind this was their ability to understand and harness the comparative advantages of mountain areas.

v. Most of the research institutions devote their efforts to field crops, especially cereals- wheat, maize, and rice, and, in some cases, potatoes. The research is limited mainly to evolving higher yielding varieties and pest management, fodder production, pasture management, horticultural crops, and agro-forestry , especially as components of integrated farming systems based on several commodities, are often not included in the research agenda of these institutions. Most research efforts are limited to biological and agronomic aspects, while research on farm machinery . sustainable use of the resource base, soil conservation. and socioeconomic aspects is almost entirely neglected.

vi. A principal problem in mountain areas is the primitive methods of post-harvest processing and marketing of produce, :3s a result of which the net income of farmers is quite low. Even if yields are high . as a result of using improved production technology 'j farmers face problems of value addition and marketing. Women play an important role in the household economies of mountainous areas, especially in livestock management, small farmer poultry production, harvest and post-harvest management of most field crops, production and processing of horticultural crops, and several other aspects of agricultural production and marketing. In spite of this, very little attention is given to training women in different aspects of agriculture and research on gender-specific problems.

vii. Women play an important role in the household economies of mountainous areas, especially in livestock management, small farmer poultry production, harvest and post-harvest management of most field crops, production and processing of horticultural crops, and several other aspects of agricultural production and marketing. In spite of this, very little attention is given to training .women in different aspects of agriculture and research on gender-specific problems.

viii. Most of the institutions have never been subjected to external peer review and continue to do research on the same topics. sometimes for decades. This result is considerable misuse and wastage of precious human and financial resources.

The Solutions - Needed Approach

It is up to the institutions to find the appropriate technologies. the practices. the human skills, and the solutions needed to make mountain agriculture sustainable. We need to devise systems that serve the needs of mountain farmers. This does not necessarily mean restricting our efforts to food crops, as experiences with high-value crops in many accessible pockets throughout the mountain areas are demonstrating. What are the comparative advantages of specific mountain areas? How can these be developed so that the benefits of these developments can be felt on small mountain farms? What are the problems in terms of environmental management and what can be done in affordable terms?

Many believed that growth and increasing investments in new technology would provide all the answers to the problems of poverty and inequality and also help to restore the environment. It was believed that. by providing high-yielding varieties, better irrigation, more investments in new inputs, and promotion of trade and exchange, the problems of food and stagnant agriculture could be resolved. Many of these assumptions are now being questioned and this is best captured by the debate on sustainable mountain agriculture development.

Whether or not the biophysical environment can support certain types of intervention in mountain agricultural development is a very important question before agricultural education and research systems.

Conventionally, there are two views about mountain areas. The first view is related to the perceptions of people outside mountain areas. Their views are that mountain areas are good places generally for relaxation, that people in mountain areas have very colorful lifestyles, that the resources in mountain areas must be used for the development of the plains and urban areas. The second view is an insider's view - a view that is more mountain friendly. This view sees the mountains as a home for a large number of people. Mountains are living environments as much as any other and, indeed, one of the most complex ecosystems found on earth. Mountain areas need to be protected, rehabilitated, and developed as much as any other ecosystem of economy. It is in this context that the question of mountain agricultural research and education needs to be examined.

Recommendations relating to Hill Agricultural Universities:

In 1996, ICIMOD organized a regional conference of Vice Chancellors and Heads of agricultural research institutions falling inside the Hindu Kush Himalayan region (Banskota and Partap, 1996). After days of deliberations, delegates to the conference made several -pertinent suggestions. These appear fully relevant in , national context also. Therefore, a gist of these suggestions is reproduced here:

- Academic Courses reorientation at graduate level and specialization on mountain agriculture at higher level. .
- Vocational training oriented to mountain farmers needs.
- Human resources development - faculty improvement in terms of mountain agriculture specific skills and knowledge.
- Summer Schools and Fellowships for exchange of staff.
- Increasing information exchange among institutions in mountain areas
- Mountain Universities Forum needs to be created under the auspices of any national regional for a like this forum" ASAU".
- Universities be assigned a definite role in Agricultural Extension and their capacities be further strengthened.
- Comprehensive Natural resource management training is largely a missing dimension in the curricula and it needs to be inducted.
- Adequate funding be made available to reorienting and institutional capacity building to the universities.

Thus the contribution that agricultural research and education can make in transforming mountain agriculture and rendering it more sustainable is unquestioned. To facilitate this, much greater commitment is needed on the part of governments in terms of investment in developing appropriate research and educational systems for sustainable mountain agriculture. There is also a need for a careful review, of policies so that the prevailing biases against the development of mountain agriculture are removed. While you discuss the different issues during the next few days, think about the mountain farmers and their families also and their homesteads situated on steep mountain slopes. How will your message be relevant to them? How can they benefits from your wisdom and insight?

Reference

Banskota, M. and Partap, T. 1996. Investing in the Future : Agricultural Research and Education for Sustainable Mountain Agriculture – Report of a Regional consultation, ICIMOD, Kathmandu, Nepal.

ISSUES EMANATED FROM DISCUSSIONS AFTER PRESENTATION OF PAPERS IN SESSION IV

- Appropriate strategies have to be developed for the improvement of mountain agriculture
- Special efforts may be given for cold water fish cultivation.
- Encouraging the farmers for the cultivation of medicinal plants
- Sufficient funds should be flown to the mountain Institutions for Research, education and infrastructure development.

Session V

The session V was chaired by Dr.G.L.Kaul, Vice-Chancellor, Assam Agricultural University. Dr.M.N.Sheelavantar, Registrar, UAS, Dharwad and Dr.S.Uthamasamy, Director of Extension Education, Tamil Nadu Agricultural University were the Rapporteurs. The following papers were presented.

1. Monitoring and Accountability in Agricultural Education and Research.	Prof.Dr.S.Kannaiyan, Vice-Chancellor, Tamil Nadu Agricultural University, Coimbatore
2. Strengthening Agricultural Education in India through Inter – Institutional linkages.	Dr.Panjab Singh, Director General, ICAR, New Delhi

Paper 1. Monitoring and accountability in agricultural education and research

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I. Background

India continues to face the fast growing population and has to confront the major challenges of feeding the huge population. There was an impressive growth in agricultural production due to a breakthrough in agricultural research, which brought about substantial improvement in productivity of crops. Almost all crops exhibited significant growth in terms of productivity at national level. Total public sector investment on agricultural research and education in India was Rs.10923.71 million during 1994-95. For agricultural extension an amount of Rs.3347.67 million was spent during the same period. Empirical studies reveal that investment on agricultural research and education plays a crucial role for the growth of agriculture in India. Teachers in Agricultural Universities have important roles to play. They have to impart knowledge, help learners how to learn, update syllabi, produce innovative, need-based courses, try out materials and evaluate learners' achievement as reflected in their performance. They must come out with special courses and programmes designed to cater to the needs of students coming from the weaker sections of the community and from rural and tribal areas. They must play their roles in the area of agricultural human resource development and thereby promote academic excellence (AIU 1995). Teachers and researchers in agriculture have a larger responsibility and accountability to the society as huge sum of public money is invested on agricultural education and research. They must be totally committed to development of agriculture. In this paper, an attempt is made to look at the notion of accountability first in general terms and then in the context of Agricultural education and research.

II. Agricultural Education and Research in India

Agricultural development is a multi-disciplinary and complex process interwoven complementarily to utilize the available resources for higher output. Organized instructions in agriculture and allied sciences started in India in the beginning of the 20th century when six agricultural colleges were established between 1905 and 1908. Initially, these colleges offered diploma courses. Subsequently they started undergraduate and post-graduate programmes in 1920s and 1930s respectively. All these colleges were engaged in teaching alone leaving the research and technology transfer to State Departments of Agriculture and Animal Husbandry. The establishment of Indian Agricultural Research Institute (IARI) in 1958 with the integrating functions of Education , Research

and Extension for transfer of technology was a landmark in the history of agricultural education in India (Kannaiyan 1994).

The Education Commission (1966) recommended the establishment of atleast one agricultural university in each state with the following functions.

- Concern for all aspects of generating, disseminating and applying knowledge related to agriculture, undertaking both basic and applied research;
- Primary emphasis on teaching, research and extension activities which are directly and immediately related to address the solution for social and economic problems of the country side;
- Readiness to develop and teach wide range of applied sciences and technologies needed to build up the rural economy;
- Readiness not only to teach undergraduates, post graduates and research students, but also to give specialized technical training to young people who are not candidates for degrees; and
- Emphasis on adult and continuing education side by side while teaching regularly for enrolled students.

The National Agricultural Research System (NARS) is a two tiered system comprising of ICAR and its institutions at national level and the State Agricultural Universities (SAUs) and their associated zonal research stations at State level. ICAR employs about 6000 scientists working in 45 research institutes, four national bureaus, nine project directorates, 79 coordinated research projects and 30 national research centres. There are 30 Sate Agricultural Universities (SAUs) with four ICAR institutions with deemed university status and one Central Agricultural University in India. Currently the SAUs have 22500 sanctioned scientific staff position in 161 colleges with under graduate and post graduate admission capacity of 11000 and 6000 students respectively and a total enrollment of about 44500 students (Kannaiyan 1994).

Agricultural Universities withstood the test of time and focused complex issues associated with green revolution and environment. The role of SAUs in rural development in general and agricultural development in particular is increasing over the period. The research, teaching and extension activities are accountable to the nation. SAUs are not only generating important agricultural technologies but as well developing scientific man power for research, teaching and extension. Besides, other dimensions to be covered by agricultural universities are ecology and environment, biotechnology, aquaculture, sericulture, dairy and veterinary, export oriented horticulture, agro-forestry and agri business management (Singh, 1998).

Agricultural education is a sub-system of the total system of education, which is a sub-system of our socio-economic system. Agricultural education in its broadest sense covers all human endeavours in acquisition, transmission and absorption of knowledge of the better means and understanding of the process which lead to scientific farming. Agricultural education covers all basic needs of human beings like food, cloth and shelter. Agricultural education must be more practical oriented, skill development oriented and issue based and problem solving in nature. It must create self-employment and solve social, economic and environmental problems.

Professional Agricultural education in India is cheapest in the world. Because of lower cost of agricultural education, students from rural areas and of relatively low socio-economic status could afford to take higher education in most of the agricultural universities in this country. However, it must not be misunderstood that we are not investing adequately in education and research. Every year government invests thousands of crores of rupees on subsidized education, scholarships, grants to institutions for recurring and non-recurring expenditure and so on (Abdul Kareem and Ramaswami 1997). Total public investment in agricultural research and education, at 1981-82 prices, has shown consistently high growth rate of 5.40 per cent since 1960s. The major impetus came in the 1970s

when the investment grew at the rate of 9.50 per cent, mainly because of manifold increase in the central funds. The investment, in terms of percentage of Agricultural GDP increased from 0.21 per cent in the early 1960s to 0.39 per cent in the 1980s, which further rose to 0.49 per cent in the early 1990s. The rate of returns to investment in agricultural education is mostly low. Mehta(1994) has concluded that:

- Social rate of return is low due to large unutilized capacity in faculty and infrastructure as well as efficiency in the system.
- Private rate of return is more than social rate of return but in self-employed graduates it is negative.

The question is about the accountability of huge investments made on agricultural education and research and dividends received by concerned agencies thereof.

III. Accountability

Accountability means rendering an account of or taking an account of the responsibility or tasks assigned to an individual or a department or an institution or both. Accountability is a broad concept and subsumes the concept of 'responsibility' which means that a person is required to carry out or to see to it that certain tasks assigned to an individual or a department or an institution are carried out (AIU, 1995).

Accountability in agricultural education and research must be examined on the following inter-related parameters: teaching, research and extension. The key players involved are teachers, learners, researchers, administrators and policy-makers. Accountability is a critical need for the University system at all levels. As the report of the UGC Committee, towards New Educational Management, says:

> *"Accountability of the teachers through the Heads of Departments/Deans/Directors should be to the Vice-Chancellor and the various University bodies (such as the Board of Management and Academic Council). The University through the Vice-Chancellor should be accountable to the society. Everyone in the University community should realize that autonomy and academic freedom do not free them from being accountable".*

Every person involved in planning, designing, administering and undertaking agricultural education and research must be aware that he is primarily accountable for various responsibilities. In recent times different concepts of accountability in agricultural education and research have been discerned out (AIU, 1995).

Social accountability

Social accountability refers to the responsibilities of the University system to the society. It is normally measured with respect to its objectives. This is what exactly the system of agricultural education and research is expected to do and what is exactly achieved and why there occurs a gap in the expectation. Social accountability, therefore, presupposes the formulation of clear cut goals and objectives which should be made known to the society well in advance. Social accountability is difficult to measure and achieve as it involves normative judgement and connotation. The present objective of the agricultural education and research system is framed in normative context and is not expressed in quantitative terms. For instance, the Indian Education Commission has formulated the objectives of the Indian higher education system in the following words;

> *"Education should be developed so as to increase productivity, achieve social and national integration, accelerate the process of modernization and cultivate social, moral and spiritual values'.*

The objectives should be expressed in some concrete form, usually in terms of quantitative performance indicators, so that the achievement of the University during a period of time can be easily compared with the objectives and the gap between expectation and performance can be analyzed and responsibilities can be fixed for any shortfall or lapse. The objectives of the University may be formulated on the basis of the following considerations:

- The objectives of the University can be spelt out in terms of manpower that would be turned out by the University every year. The target of manpower to be created by the University should be based on the assessment of manpower requirements of the different sectors of the economy based on a manpower survey to be conducted by the University periodically.
- The courses to be offered by the University and their relevance to meet the needs of the society and nation may also influence the objectives of the University
- The number of students to be admitted in each year, course-wise and sex-wise should be another component. This would help the University to achieve the equity aspect of agricultural educational objective.
- The special facilities and opportunities to be offered by the University to the weaker sections of the society both in the matter of admission and appointment should also influence the objectives of the University.
- The objectives of the University should also take into account the type and number of industry and institution linkages expected to be forged during the particular year.
- The objectives of the University should also take into account the manpower needs indicated in the regional and national plans.

The university must have clear-cut and well defined objectives, which will provide solid foundation for the teachers and researchers to pursue their activities, which are beneficial to the clientele and the society.

Micro Accountability

The micro accountability is concerned with the responsibilities and performance of each one of the functionaries within the system- academic, administration and financial accountability. Administrative accountability relates to the managerial functions that are necessary for smooth functioning of university and its various subsystem. Academic accountability is concerned with the implementation of academic programmes and the achieving of minimum standards of education. Financial accountability deals with the procurement of funds and efficient utilisation of resources. The degree of accountability can be perceived only when the functions and duties assigned to the agencies in the system are properly evaluated.

Legal accountability

The educators are accountable to their universities, government and management. Legal accountability is mainly characterized by following the rules and regulations and managing teaching-learning in the framework of rules. Unlike most traditional universities, agricultural education is generally free from irregularities in academic discipline. Such academic indiscipline consequently results in lethargy on the part of students and teachers; superficial coverage of subject matter; inadequate time for practical and skill achievement. In fact, legal accountability should be the major concern to administrators and teachers in agricultural universities.

Moral Accountability

Moral accountability is towards students and the society. Students put in private investment for education, and society provides social environment in addition to the public investments for education. Are we not accountable to the investments of society and are the teachers not responsible to

give rich dividends to students in terms of advanced and need-based agricultural education and proficiencies? Yes, the agricultural universities have definite moral responsibility in this regard.

Agricultural education has also social and ethical accountability (Doering, 1992). It is complementary to moral responsibility. Students come to us not only without a sense of agricultural context but also with only a very limited collection of any strong social and ethical norms of the society to which they belong. The students must be able to identify and deal with agricultural issues of their own society. In Indian conditions, it is more pertinent where social system is more complex and traditional. Agricultural education system must consider :

- Do our agricultural graduates understand the difference between what is and what ought to be and their role in agriculture?
- Are our students able to relate agricultural science with social and ethical values, beliefs and experiences?

To answer these questions positively, it is necessary to expose our students to teachers who share their experience in dealing the social and ethical issues in non-prescriptive way.

Accountability in economic context

Agricultural education is expected to promote self-employment in rural areas by helping youths develop skills for managing in rural agro-based small-scale enterprises. It was the heartfelt expectations of the father of nation, Mahatma Gandhi. The picture is, however, gloomy, forcing agricultural graduates to migrate to urban areas for service of whatever cadre it may be. It has reflected in low private and social rates of return to investment in agricultural education.

Dynamic, competitive, global multilateral agro business environment necessitate change in agricultural education. However, change is never popular, it is often resisted. Thus the educators, administrators and policy makers in agricultural education sector must accept the role and responsibility to be in forefront of efforts to build understanding and acceptance of rapid changes in agricultural sector that is fueled by economies of scale and global competition (Rainey 1992).

Agricultural universities are therefore, required to provide higher education in Food process engineering, Biotechnology, Agri-business management, post harvest technology and farming systems management and Environmental Sciences to make agricultural graduates complete in knowledge and technology, nationally and internationally. Only competent agricultural graduates would be able to pay back rich dividends to society and earn for themselves substantially more than the investments made. Others would wander disgusted for petty and non-remunerative jobs. But then they will curse their university who conferred degree to them.

IV. Accountability in Agricultural Education

Having established the need for accountability, let us see how it has to be implemented. Accountability is an extremely useful concept but if steps are not taken to make different faculties of the University system accountable to the society through performance appraisal, all talk about accountability leads us nowhere. Teachers' performance as teachers, evaluators, leaders and socially conscious citizens has to be evaluated through quantifiable norms by the Governing and Management Bodies of the University consisting of representatives of the University management, the Deans /Directors and the Heads of the Department. The norms of evaluation should be evolved by the agricultural university by considering the views of teachers also. Norms of evaluation may include :

- How many students of a particular teacher in a particular subject pass?
- How many of those who passed have earned high marks?
- How many times in an academic year the teacher absents himself in normal circumstances?

- How many times the teacher comes to work late?
- What extra-curricular activities the teacher participates?
- How many educational conferences he has attended?
- What are his contributions to the expansion of knowledge area?

A good teacher must be a constant hunter of new knowledge. He should also be a good communicator so that the newly acquired knowledge can be shared with the students. Good teachers are innovators. For students to derive the benefit of their innovativeness, Academic Committees should be formed within each college under the overall guidelines of the Board of Studies of the university. New academic programme relevant to the students and job opportunities and special skills needed in the area where the college is situated can be devised and implemented. The College Academic Committee must have the freedom to devise these courses. The University Board of Studies can examine the proposals and offer expert advice. The University can send an Affiliation Commission to verify the infrastructure facilities available at the colleges. This affiliated to the university will help in making teachers more innovative and socially relevant. The second set of norms may include :

- ❑ Have the teachers undergone refresher courses within last three years in specific subject area?
- ❑ Has had added recent books to the university library based on his recommendation?
- ❑ Has he helped to purchase recent journals for the university?
- ❑ How many books and practical manuals the teacher has written during the past five years?
- ❑ What are new methods of teaching introduced by the teachers ? (Lecture *vs* participatory *vs* audio visuals *vs* field visits).
- ❑ What are the assignments given by the teachers? (Theoretical *vs* Practical Problems).
- ❑ Do the teachers corrected the deficiencies pointed out by the Review Reports / Impact Evaluation Studies?

Several educational commissions and experts have made it very clear that the purpose of education, including agricultural education, is to give the younger generation the right socio-political, economic and cultural orientation in such a manner that the national needs of socio-economic development are met. The teachers are expected not to coach the students for certain examinations and through them for degrees alone. Universities and Colleges must not be looked upon as mere machines to conduct examinations that churn out graduates in large numbers. Society and Government look upon universities and teachers to provide motivation to the students and shape them as good citizens.
According to the UGC report on Programme of Action (1986)

"teachers are accountable to the pupils, their parents, their community, and to their profession".

Programme of Action has enunciated that a system of teacher evaluation should be open, participatory, and database would be created. Norms of accountability would be laid down with incentives for good performance and disincentives for non-performance.

What needs to be emphasized here is that teacher-centered accountability is not and should not be a unidirectional process. It is reciprocal and interactive. The individuals and institutions involved in this process are: the Head of the Department concerned, the Deans / Directors of the Faculty concerned, the Boards of Studies, Academic Council, Board of Management, Society - the community in which teachers and learners interact, the University, the ICAR and Ministry of agriculture. They are all responsible for the effective and smooth functioning of the academic systems.

The following points must be kept in view in the process of exploring the features and properties of "accountability".

- In the shaping of the personality of learners, it is not only the teachers who play their role; parents too have to play their role; the community has to play its role; the educational system has to play its role.
- Learning cannot and should not be viewed as an input/output activity; teachers' input is not and should not be a unidirectional process: it is an interactive process.
- Effective teaching-learning is possible if and only if the system offers teachers some of the basic facilities such as secretarial, library, and laboratory facilities.

The notion of accountability cannot be examined in isolation. What is really important is to state clearly the objectives of education at different levels and work out a framework of norms in terms of which the roles and responsibilities of different constituents can be examined – keeping in view the primary objective of education which is to help learners externalize their built-in potential. Looking from this point of view investment in agricultural education is an investment in human resource development, in man-making and nation-building activities.

In order to motivate teachers to put in their best, it may be useful to link 'promotion' to 'performance'. Teachers should be asked to submit self-appraisal reports every year and discipline-based committees should examine the reports of teachers in their respective disciplines.

V. Measures for Improving Accountability in Agricultural Education

Management Efficiency of Teachers

Management is a process of achieving the objectives set forth by efficient use of human and natural resources. It includes planning, organizing, direction and control functions. A teacher in order to efficiently discharge his role should plan his curricular and extra curricular activities, organize men and materials, guide his students and control their action through appropriate measures to achieve desirable results. To effectively plan his activities, the teacher must be conscious of time management. Time management must be thought of at a micro-level class room lecture planning to that of annual job plan. This is yet another task that is easier said than done. Training must be given to the teachers to make them aware of the principles of time management and adopt the same. While organizing his resources to impart knowledge and skill to the students, the teacher should not confine to his own potential. He should also be a facilitator who creates an environment for learning. To enrich the information flow he must invite experts in the related subjects from nearby places or within the university to share their experience with the students. Apart from conventional sources of information (books and journals), teachers must also collate information from internet which enables faster access to latest information. Efforts to guide students must focus on creating a good personality and not confined to mere transfer of subject matter. In this regard, communication skills of the individual will significantly influence in creating a binding with the students and guiding their action.

An appropriate questionnaire must be designed to get the information relating to the aspects indicated above, and the information gathered in that way must be analyzed and the teachers performance must be evaluated.

While focusing on measures to improve the managerial efficiency of teachers it is essential to control their actions through a set of rewards and disincentives, as stated by the National Policy on Education which was evolved in 1986 and revised in 1992, has suggested measures to improve efficiency of teachers as :

> *"Non-observance of norms must result in disincentives while good performance must receive recognition, incentives, and due publicity".*

Accountability through assessment of performance can also be enhanced through simplification of procedures and processes, which hamper action. Modernization of offices will also increase the efficiency of the system and streamline evaluation of performance. To make the college as

a whole accountable to the immediate society it serves and the student community, a College Evaluation Committee (CEC) should be formed. The CEC will consist of two educational experts in the State, the Vice-Chancellor of the University to which the college is affiliated, and a representative of the Board. It can also have a representation from Deans and Directors.

Economic strengthening of SAUs

Because of the constraints on resources, every rupee spent on education whether it be government-generated or privately raised should be monitored. Cost effectiveness is of the utmost importance in the field of education. This can be implemented through a periodic assessment of the effectiveness of financial and administrative norms. New courses / programmes can be evaluated by examining the following criteria.

- Relevance for prospective users
- Number of users
- Cost per user (unit cost)
- Teaching, evaluation and administrative expenses
- Fees to be collected
- Equipment cost
- Other operational expenses
- No course be offered incurring loss
- No course be offered for making large profit
- Actual cost plus 10 per cent margin for development and future expansion
- The 10 per cent be corpus fund open to Inspection

This corpus fund should also take care of special incentives for outstanding teachers and students/research scholars. It is ironical that agricultural education is given secondary importance in SAUs as compared to research. Education needs more investment as it is essential for modernizing laboratories, classrooms and production of instructional material. It is estimated that major portion of the budget allotted to SAUs is spent on administration and thus meager amount is left for educational and allied activities.

Resource Sharing

In order to ensure accountability among teachers and researchers, adequate facilities must be created at the university level. Information flow across institutions and adequate infrastructure will enhance the performance efficiency of teachers and researchers. Every SAU must interact with other SAUs within and outside the state and there must be an annual sharing of policies and programmes among all such institutions. Such meetings can discuss common problems and remove the cause of those problems in a concerted manner. Procedures and processes that hinder the smooth functioning of agricultural educational institutions can be totally eliminated or greatly simplified as a result of such meetings. Common principles can be evolved for admission procedures, teaching and evaluation methods, reporting of results and elimination of duplication of research projects. Moreover, library and computer facilities can be shared with one another. Networking of agricultural institutions in the state and across the state will remove wasteful expenditure. It will improve efficiency and help to render better services to the people of the state and the nation.

Management Information System

For streamlining the flow of information within an educational institution and between the institutions, a Management Information System (MIS) can be developed. This can be linked to the state and national level information networks. One item of information vital to students is the Academic Calendar. The University should draw up a calendar for the entire academic year detailing the various activities with dates – admission, commencement of classes, beginning and end of terms

/semester, summer vacations, holidays, elections, youth festival and other major extra-curricular activities, internal tests, university exams, starting of evaluation, completion of evaluation, announcement of results etc. Each college affiliated to the university must draw up its own calendar of activities in unison with the university calendar. Setting a date for each activity – whether major or minor – is not merely a sign of discipline; it is at the base of accountability.

A university activity does not drop from heaven. It is a deliberately planned action for the benefit of the students, teachers, administrative staff or the public. It entails deliberations by persons initiating the action. It needs cooperative action by a group of persons. It requires materials and equipments. It may demand space. It definitely needs time, but the time has to be set and connected work has to be broken down into smaller items with their own finishing time and all items have to be coordinated against the time set for finishing the whole activity. Thus one can see how important it is to analyze every activity and enlist the cooperation of all to reach the target within the time set before the activity begins.

If there is a proper understanding between the institution and its teachers/researchers about what to do in a term, when to give mid-term and end-term tests, institution's policy about absenteeism of both the teachers and the taught, how the term papers or test papers have to be valued, grading system and how performance appraisal should be done both for teachers and students, how many class assignments students must take, then much of the dissatisfaction of teachers with the students and vice-versa, will be removed. Both groups will have ample respect for one another if they transact business with this advance information.

Student unions and their leaders must know before hand when they should plan their art and drama festivals so that their plans and the plans of those who are in charge of university /college examinations and class test do not clash. A simple calendar can work wonders. Working against deadlines set before hand may appear a bit too hard in the beginning but in course of time it becomes a pleasurable routine.

Quality Improvement

The system of quality improvement in agricultural education has been implemented by ensuring uniform syllabus of the courses taught in the agricultural universities all over the countries. The stamp of accreditation, as a necessary condition for the quality and survival of an institution has been thought of at present. And herein comes the accountability of our agricultural institutions and teachers. In fact it is high time now to have a separate Agricultural Education Policy of the country; so far only policy statements have been made. It will definitely strengthen the agricultural education. However, in context of accountability in agricultural education following recommendations would be useful (AIU, 1995).

Of late, there has been a widespread consensus that quality of graduates in various disciplines of agricultural sciences does not match with the changing needs. Hence, there is an urgent need for the SAUs to give attention for upgrading the quality and standards of agricultural education. Academic inbreeding is considered a major problem in most of the SAUs. Curricula and teaching methods are to be modified, physical facilities, equipments and teaching aids have to be modernized and competency of teachers needs to be improved especially in the context of globalizing India's agriculture.

Globalization has inherently a business connotation. Indian education which is dominated by classical ethos, words like 'business', 'marketing', 'profit', etc., are still untouchable. There is no economic statement in objectives or even as part of the strategy plan. We should shift the mental paradigm of education as elitist transfer of knowledge from one generation to another to a more industrialized concept and paradigm. Economics and business have to be an agenda and part of ethos of educational institutions as a pre-education to globalization (Mukhopadhyay 1997).

This requires agricultural education to encompass business connotation with sound technology base, emphasis on 'natural resource management' to ensure sustainability with inbuilt environmental concerns. This requires the present system of agricultural education comprising the following components, namely, faculty, students, learning environment and the learning content to be reoriented and modified, to meet the imperatives of globalization. The teachers must make efforts to equip them to the changing context such as globalization. Unless they take personal interest, transformation of agricultural education will get delayed.

It is essential to update the knowledge of faculty with respect to advanced educational and instructional technologies. In view of this, establishment of Educational Technology Cell in each agricultural university, would be very useful. ICAR may provide substantial grants for the same. At present, it is being executed by ICAR in some of the agricultural universities in India.

Agricultural Curriculum

In context to the changing scenario of agricultural sector it is very essential to update and develop present curriculum and courses to suit the needs of farmers, agro-based private sector and public sector. It is observed that old and outdated courses are still continued with which agricultural graduates are never tuned to present requirements. Internationalization of curriculum without disturbing their localized and need-based character needs to be thought of, because our graduates will have to work in an environment that is influenced by competition in the international markets in near future. Career guidance cells would be of vital importance in this connection. Students need to be acquainted with present market needs and prepared for accordingly. Linkage between industry and education should be strengthened through guidance cells.

Agriculture is an applied science, hence rigorous practical training and continuous updating of knowledge and skill is necessary. At present due to various reasons, students are engulfed in activities other than learning. Academic calendars are not strictly adhered to, evaluations and assessments are not properly done in case of students as well as teachers, attendance is poor, mostly theory is taught. Lack of experiential and hand-on experience learning, more weightage to grades rather than overall development, lack of effective and cordial linkage between teacher and student, apathy towards each others efforts in teaching learning, inefficient faculty and so on, has resulted in the creation of inefficient, inadequately equipped graduates and post graduates in agriculture. Teachers must rise to the occasion and spur the thinking of management among students to make the whole system relevant to the societal need.

We always say that ours is an agricultural country and 70 per cent people are dependent on agriculture. Then in how many high schools in the country, agricultural education is imparted? In developed countries like USA, in Illinois State, more than 50 per cent schools impart instructions in agriculture (Russell 1993) and in Australia Agriculture Course in school level is very popular. But in India basics of agriculture start at higher education level in spite of the fact that rural boys and girls live in and around farms during their high school period. Therefore, agricultural education should invariably be imparted from school level, so those students are ready for advanced training at graduation level. There has to be national policy in this regard.

VI. Accountability in Agricultural Research

Accelerating food production was the main challenge for agricultural scientists for the first three decades after Independence. This evolution was driven by area expansion in the first phase and by productivity growth in the second. Research managers had a relatively simple task of research resource allocation in the context of this 'major' objective. Experience and judgement of scientists led to fairly efficient research resource allocation decisions and reasonable realization of the objective.

The last decade, particularly these last few years, has added complexities. Regional balance, sustainability, trade-technology links, demand shifts towards non-food grains, income growth for the

poor, are a few of the many new challenges confronting agricultural scientists today. With time, this complexity will grow further. On the other hand, availability of public funds for agricultural research is declining. Research managers find it difficult to address all the challenges and pursue all scientific options to table them. These factors necessitate more analysis and use of some sort of decision rules along with technical information. Research planning and prioritization has thus become a complex and specialized task.

The agricultural education has to have a strong linkage with research. The universities have a mandate for research. The contributions of the universities in research having a bearing on agricultural education and national development have now been well recognized. Brilliant research work has been done all along by the Indian scientists from Sir J.C.Bose and C.V.Raman to a number of scholars even today. Particularly, the research work done by the agricultural universities and institutes has led to the green revolution in India. The mass movement in agricultural education has produced a band of research workers in India. However, there is a criticism that some researchers are neither internationally recognized nor locally used, neither there is originality nor local relevance. There has also been an apprehension that some Indian scientists fair poorly when assessed for their output in terms of research publications and patents applied for. There also appears to be duplication of work to a greater extent. The quality and cost effectiveness are also far from satisfactory. This might be happening because of the bureaucratic approach in our research management.

The scientists working at the lower level do not have the freedom to work independently and also publish independently and the senior scientists do not have time for research, as they remain too engrossed in administration. Hence, in research too there has to be decentralization of powers and decision making. Once this is done, the researchers will have to be brought under the sphere of accountability. This is quite essential because in India, the research projects are funded mostly by the government. There are norms for teachers in terms of contact hours and assessment but such type of structures are lacking for the research workers. The norm for researchers may include :

- Number of research projects handled.
- Relevance of research projects.
- Methodology / concepts developed
- Technology / products / policy interface delivered
- Publications made
- Impact assessment of the technology / product delivered

The vast research infrastructure in the universities has to be made to make researchers accountable, and some measures are suggested for improving accountability.

VII. Measures for Improving Accountability in Agricultural Research

Research Prioritization

Prioritization is required at different levels for making researchers accountable to the client. The ICAR lays out broad national priorities taking into account national needs and objectives. It identifies commodities and regions which are likely to face stress or which offer opportunities in the context of national objectives. It also has to take a long-term view of natural resource conservation and sustainability issues. Such *exact* judgements require analysis of expected costs and benefits.

Once the broad areas are flagged, a similar exercise has to be done for each of them. For example, if maize is identified as a priority crop, decisions have to be taken regarding where and what major research strategies should be adopted. There invariably are several feasible strategies, each with varying technical opportunities and varying degree of needed resources (costs). An essential input in this decision process is a scientific analysis of various constraints, corresponding (specific) options to tackle them, and judgment regarding the possibilities of alleviating these constraints. Once again some sort of optimizing decision rules have to be applied to rank various options.

State Agricultural Universities and Zonal Research Stations which have research mandates for a state, region or zone, have to follow a similar approach to decide their research agenda. As one goes down the line, all parameters (constraints, options, costs, and benefits) become somewhat more objectively measurable and research programmes/projects become sharply defined. Ideally, one would sum up the disaggregated profiles of priorities to arrive at the aggregate (national) agenda in a 'bottom up' planning approach. This should be the long-term planning approach. This will help the research manager more accountable to the farming society (Suresh Pal and P.K.Joshi, 1999). Given the national policy goals, the criteria of efficiency, sustainability, poverty and gender impacts may be used for research prioritization (Box 1).

Box 1. Criteria for agricultural research prioritization

Criteria	Measurable indicators
1. Impact on efficiency	(i) Reduction in unit cost of output (ii) Internal rate of return or economic surplus
2. Impact on poverty	Percentage of total benefits accruing to farm families below one ha, landless labourers and poor people located in the target domain.
3. Impact on sustainability	(i) Favourable to ecosystem (ii) Favourable to life system (iii) Adds to system resilience Examples : Reducing soil erosion (area covered), enriching soil nutrients (kg of NPK), improving soil texture (area covered), reducing use of pesticides (g/ha), conservation of irrigation water (ha. meter), recovering problem lands (area covered), quality of life, nutritional security, etc.
4. Gender impact	(i) Improving nutrition, health and welfare of farm women and children, (ii) Increasing income of farm women, (iii) Employment for women, and (iv) Decreasing drudgery in farm operations.

Choice parameters for research

Choice of research strategies is also important for research scientists accountable to the nation and the state. It is important to note at the outset that there are many instruments and policies to address national goals. Research is one of them. In many cases, other instruments are more effective. Without this understanding, choices are likely to be distorted as research managers, in their bid to garner greater political support, promise too much and then allocate scarce research resources to solve problems which are best tackled by non-research instruments.

With this caveat in mind, the important criteria or objectives, which need to be considered, are briefly indicated below:

- **Growth:** To attain an overall economic growth of more than 7 per cent, the agricultural sector must grow at 4-5 per cent. This can come only through technology-based productivity growth. Agricultural research has a central role in achieving this.
- **Efficiency**: To be globally relevant, this growth must be cost-efficient. Research options need to be assessed for economic efficiency in terms of real prices of factors and products.
- **Sustainability:** Adverse environmental and ecological consequences of modern growth processes and trade-off between short and long-term benefits are now better understood. This is demanding increasing attention all around.

- **Trade issues**: In the wake of the New World trade climate, new trade opportunities and challenges are emerging. In addition, there are issues of technology gaps, technological dependence and intellectual property. The research system must remain vigilant and responsive to these considerations.
- **Equity:** Accent on poverty alleviation requires that research contributions to this cause be also assessed. Equity in all three dimensions – regional, personal and gender, is important and research (technology) may influence this in positive or negative way.

Research managers need to consider above information and analysis in order to make decisions about priorities and research allocation so that researchers are accountable to the all sections of the society (Suresh Pal and P.K.Joshi, 1999).

Public investment VS Private Property rights

The development of hybrid seed helps the Seed Company recuperate the research and development costs because, contrary to open pollinated seed, farmers need to buy new seed every season to maintain the improved traits of the original seed. The much discussed terminator gene, if ever commercialized, would be another way for the seed company to assure that the farmer buy new seed every season because his own production is sterile. While the notion that the seed produced by the farmer is sterile is ethically unacceptable, at least for small farmers in developing countries, because of the associated risks and dependency, a more ethical approach involving the ability to turn on specific new traits in a seed is currently being developed. Using such an approach, farmers would have the choice of buying the chemicals needed to activate the improved traits embodied in the seed, e.g. insect resistance, or plant the seed with the original traits. Farmers who choose not to buy the chemicals would presumably be no worse off than before trying the improved seed.

But even if the private research agency could enforce property rights, for example through hybrid seed or built-in gene switches such as those mentioned above, research investments by the private sector would be less than socially optimal. The reason is that groups other than farmers, e.g. consumers, would benefit through lower prices. Since the private research agency does not have the right to tax consumers, the benefits derived by the farmers will set limits for how much the agency can capture. Therefore, relying on the private sector for agricultural research is likely to result in under investment from the point of view of society. Hence, public sector research is needed and more accountable to the poorer section of farming society.

Strong National Agricultural Research Systems (NARS) focused on solving problems facing poor farmers and consumers are likely to make major contributions to both efficiency and equity goals. These contributions would be significantly enhanced if the NARS have access to results from international research aimed at the creation of knowledge and technology relevant to many countries. The impact of NARS may also be enhanced through innovative partnerships with private sector research agencies in which non-exclusive right to processes and traits are transferred from the patent holder to NARS for restricted use in research to develop technology for eco-regions and commodities of little or no commercial interest to the patent holder. The private research agency holding the patents would, in turn expect to improve public relations and develop new markets, as poor farmers who benefit from the technology become customers. The former would be of particular interest to the large life science companies suffering from bad publicity related to genetically modified seed. Hence, linkage between private and public sector is needed for making researchers more accountable to the nation.

Public-private sector linkage in research is another important factor to be considered in research accountability. Private sector institutions, which can participate in research, are of two types. First are the private companies (input, processing, etc.) who appropriate research benefits and generate profits for the owner. In the second category are the non-profit private organizations like research foundations, co-operatives, farmers' organizations and non-governmental organizations. Resources if

any raised by these organizations are reinvested in research. Participation of these two types of private organizations in research can be in the form of funding and / or execution of research. Depending upon the nature of research (basic, applied or adaptive), public and private sectors can participate in several ways in the funding and execution of research. The public sector should share the responsibility of basic research, applied crop and resource management research, training of manpower and enforcement of regulatory policies. A significant part of applied and adaptive research should be in the private sector. However, this compartmentalization may not be so simple in real world situation and research programmes in both the sectors can interact at different stages of research. These interactions can be operationalised in the following modes:

- Consultative : for research prioritization
- Collaborative : in the funding and execution of applied research
- Contractual : private funding of public research programmes, public research services to private sector on cost recovery basis
- Client : providing basic and strategic research support to the private sector
- Supervisory : ensuring competition and quality of services and enforcement of regulations. (Suresh Pal and P.K.Joshi,1999) .

These interactions will make researchers more accountable to the country. So far, the discussion has focused on applied research leading to knowledge and technology of direct utility for farmers. But applied research depends on the availability of results from basic research, the latter being more likely to be a public good. Private research agencies including the large life science corporations have benefited greatly from past university and other public sector research. Will the public continue to invest in such basic research? If not, will the private sector provide the funding and will that imply the results from basic research be more likely to be patented? Recent partnerships between life science corporations and universities indicate that the former recognize the importance of continued basic science, even if they have to cover at least some of the cost and even if they are not assured exclusive rights to the resulting knowledge. However, continued public funding of basic sciences underpinning the development of improved agricultural technology is essential for continued technology development and thus making agricultural research accountable to the public.

VIII. Accreditation System and Self Study

All over the world various national and state agencies conduct accreditation as a regulatory process. However voluntary accreditation of educational institutions, as carried out by the various accrediting bodies, is a uniquely American process. Quality assurance and institutional and program improvement are the two main purposes of accreditation. There are two types of voluntary accreditation of educational institutions. The institution as a whole is accredited or specific programs within an institution can seek accreditation from the concerned national professional associations. However, India, the concept of assuring quality in agricultural education is relatively new. The concern, which has in the past focused upon standards, has now shifted to quality. Several national organizations are already functioning in relation to assessment and accreditation of institutions of higher education. For example, the National Board of Accreditation of All India Council of Technical Education (AICTE) is a statutory body that deals with professional disciplines such as engineering, management and pharmacy studies. Another organization, the National Assessment and Accreditation Council (NAAC) is an autonomous institution established by the University Grants Commission (UGC) that has the mandate of judging and assuring quality in liberal arts, sciences and other disciplines. Similarly, the Medical Council of India looks after the accreditation of medical education, while the Indian Council of Agricultural Research (ICAR) discharges the same responsibility for agricultural education.

The ICAR aids, promotes and co-ordinates agricultural education in India. It has been guiding and regulating quality of agricultural education in the country through Education Panel (1952), Standing Committee (1965) and Norms and Accreditation Committee (1974). To further improve and

sustain the quality of agricultural education, an Accreditation Board was established in 1996 with well-defined objectives and function with Director General of ICAR as its chairman with Deputy Director General (Education) as Vice-Chairman and Dr.N.L.Maurya, Assistant Director General (Accreditation) as Member Secretary and eleven members of experts from Agriculture and allied sciences and representatives from Agriculture and Agro-Industry. The Accreditation Board has approved a set of criteria and general institutional requirements that must be met by an institution to be accredited. The process starting with a self-study, which is an educative exercise is designed to achieve institution-wide improvements in teaching and learning.

Accreditation is a process of assuring an acceptable institutional quality and it is a tool for improving educational standards. The process intends to strengthen and sustain the quality and integrity of education and it is for improving transferability and marketability of students nationally and internationally. Accreditation status of an agricultural institution will constitute a statement to the general public that: (i) it has clearly defined and appropriate educational objectives, (ii) it has established an environment that makes achievement of these objectives possible, (iii) it is accomplishing its objectives substantially and (iv) it is so organized, staffed and supported that it is expected to continue to do so.

The Accreditation Board has approved a set of Criteria and General Institutional Requirements that must be met by an institution to be accredited. The process starts with a self-study, which is an educative exercise, designed to achieve institution-wide improvements in teaching and learning. The accreditation as well as an institutional self-study is an on-going process and not an end in itself. One of the goals of the self-study is to foster planning and institutional research. As the society is becoming more and more technology dependent, it is of paramount importance that the State Agricultural Universities which are key institutions primarily involved in agricultural education should offer latest science and technology based agricultural education as well should follow modern teaching methods. Self study is an important component for educational transformation and continuous improvement of quality in agricultural education. For effectiveness of any accreditation process, the minimum norms and standards for different academic programmes must be prescribed by the universities involved in agricultural education. Indian Council of Agricultural Research has taken up lot of initiatives for improving the quality of agricultural education with a view to train highly qualitative human resources to meet the challenges and requirements of our country in agricultural sector. India is one of the countries in the world which have a highly organized Agricultural Institutions for Education, Research and Extension. Agricultural education and research system in India played phenomenal role in achieving self-sufficiency in food production. The system helped to improve talents and skill among agricultural graduates who have reflected the acquired capabilities in various ways in the process of agriculture development. Accreditation Board could play a major role in improving the quality of agricultural education. Self-study report mandates participatory role of all the faculty members, which inculcate in them accountability and responsibility.

The involvement and commitments of senior and junior level faculties provide a link between different generations of teachers and help to develop second line and third line of educational leaders and research managers. The exercise provides a vision for all those involved in the system. Self-study report is a key document, which will be helpful to assess the comparative performance of institutions during different time periods.

Dynamic assessment is an important factor, which is essential for the growth and development of agricultural institution. It must have both internal and external components. Evaluation of courses needs serious consideration. While evaluating the course the following aspect may be taken as the basis.

- Flexibility
- Relevance of the course
- Content
- Emphasis

A proper consideration of these aspect involves an in depth and thorough scrutiny of courses by academic experts. Norms and standards and also procedures for assessment and accreditation of programs and institutions dealing with agricultural education in India have also been developed.

There are four criteria, which need to be fulfilled before an institution is considered for accreditation.

- The institution has clear and publicly stated objectives consistent with its mission.
- The institution has organized effectively the human, financial and physical resources necessary to accomplish its objectives.
- The institution is accomplishing its educational objectives.
- The institution can continue to accomplish its objectives and improve its quality of educational programmes and its effectiveness.

All these criteria are to be supported by material and documentary evidences. The accreditation and self study processes will promote accountability among teachers and researchers consistently over time.

IX. Summary

Accountability in agricultural education and research is not a simple notion. It is a multi-layered concept, related to 'responsibility' and 'autonomy'. It is not uni-directional, but provides a holistic approach that focuses on both process and product. Academic accountability in agricultural education and research has to be ensured in different areas of operation of the academic system, and accountability in these areas should cover both the academic and non-academic staff as well as the authorities.

One area of operational is to keep the market demand and learners' needs to formulate need-based curricula and courses and there should be provision to revise each course every four to five years. To dispel the conventional notion of agricultural education becoming elitist, the university academia have to give special attention to design of courses for both students displaying excellence and students belonging to the weaker and disadvantaged sections of the society. To facilitate the achievement of these objectives, adequate infrastructure, which is functional in nature, has to be provided; and writing of low quality and conceptually wrong textbooks should be discouraged.

The second area of operation is the system of admission, recruitment and promotion. While every attempt should be made to admit students on the basis of merit, care should be taken to facilitate the provision of agricultural education for the students belonging to disadvantaged and weaker sections of society. To reduce dropout rate and wastage of educational and other resources, the students should be made to be accountable with regard to their own study and course completion. Once admitted, they should not be allowed to take the college and university campuses for granted. Related to this area of operation is the recruitment and promotion of teachers. To ensure accountability among teachers, recruitment should be based on merit, and promotion on the basis of performance (rather than seniority). And, to nurture and maintain academic accountability among both students and teachers, strong academic discipline needs to be adopted.

The third area of operation is the performance of teachers and researchers. The conventional notion of teachers as independent entities should go, and teachers should be made accountable in regard to what they are doing. Teacher – accountability encompasses all teaching-related activities, including evaluation/examination, and development of a congenial academic atmosphere in the campus/work stations/study centres. A teacher will be able to do justice to the profession of teaching only if he/she is well read, in touch with latest research findings, and well versed with the latest technologies of teaching and training. To facilitate a teacher to sincerely concentrate and carry out his/her task, opportunities for academic/professional development through orientation and training must be provided; he/she is given reasonable freedom to innovate and regulate his/her own work and evaluate his/her students.

The fourth area is with regard to decline in standard of teaching and research at national and state levels. While univocally sharing this concern, it was pointed out that autonomous colleges and centres of excellence need to be more accountable and provide guidance to colleges situated in their neighbourhood. To ensure accountability in research, higher preference should be given to conduct of serious and society-linked research; and a central agency may be established to look into the quality of doctoral studies undertaken in agricultural universities.

To initiate and sustain accountability measures, some structural changes would be essential. There should be a proactive and supportive academic leadership for providing a congenial environment. There should be change in the style of institutional management; and besides strong institutional planning, and institutional evaluation.

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Paper 2. Strengthening Agricultural Education in India Through Inter-Institutional Linkages and Networking

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Prologue

Agricultural education has a critical role to play in our efforts towards sustainable food, nutritional and environmental security. India has seen a great expansion in the institutional system concerning agricultural education; from a mere six agricultural colleges in the beginning of 20th century, we now have 31 agricultural universities, including one Central Agricultural University (CAU), four ICAR institutes with 'deemed university' status, and a few agricultural colleges affiliated to general Universities under University Grants Commission (UGC). The country has acquired an unique capability to provide agricultural education in as many as 11 undergraduate programmes and 95 postgraduate disciplines through 247 constituent and affiliated colleges/faculties. This strong institutional system has enabled us to address certain important national and agricultural research and educational needs. Some of the fine institutions of higher learning in agriculture and related disciplines in the country have enabled us to achieve a modicum of recognition and respect in the national and international scientific community. It is largely on the strength of this institutional capacity that India has been able to attain a phenomenal growth in food grain production, and also other agricultural commodities such as milk, livestock, fruits, vegetables, sugar, oil and cotton.

Despite accruing significant grains through a vast institutional framework for agricultural research and education in the country, we cannot certainly afford to be complacent as the challenges facing agriculture in the 21st century are much more complex than those faced before. Strategies for agricultural research and education have to be reoriented keeping in view the over-exploitation and dwindling of natural resource such as water, deteriorating soil health, depleting genetic diversity, and declining possibilities for public sector employment.

An era of challenges could also be an era of uncommon opportunities. Today, agriculture has the unique opportunity to use knowledge from the domains of computational sciences, earth sciences and biological sciences to usher in an 'evergreen revolution'. This essentially requires an ability to cope with change, and to capture the emerging opportunities. At the same time, globalization of agriculture, economic liberalization and advent of an intellectual property regime warrant generation of internationally competitive, skilled human resources in the agricultural sector. Although job markets are expected to radically change, the demand for skilled and well-trained human resources in agriculture is likely to escalate. Development of new and more efficient production technologies, global competition, concerns for the environment, and other factors are likely to generate new avenues of demand for professionals with an expertise in agriculture. The opening of our doors to the global market shall also produce considerable challenges as well as opportunities, both at home and abroad. But to take advantage of such opportunities, we must produce top-notch graduates committed to the pursuit of scientific careers and excellence. Our youngsters must be well-equipped with scientific knowledge, communication skills, guidance, opportunities for innovative experimentation, access to recent scientific and technological advances, and above all, critical reasoning and independent thinking.

Are our educational institutions in agriculture geared to meet these challenges? The situation does not seem to be highly encouraging. Several educationists and eminent scientists in the recent decades have been expressing their concern about the declining standards of quality in the products of agricultural education system. While the factors influencing such a malady could be many, an important factor is the inadequacy of effective and viable linkages among institutions concerned with agricultural research and education at various levels. In this paper, we shall focus on some of the salient issues related to inter-institutional linkages and networking in agricultural education.

Expectations from the 'teacher' and the 'taught' in agricultural education the 21st century Teachers:

The following attributes are of particular importance in the teachers of the present era:

- Qualified, competent and skillful, with a constant urge to learn
- Excellent communication skills
- Ability to motivate students and stimulate critical reasoning and independent thinking
- Capacity to provide excellent practical training (field/lab) in the area of specialization

Information in biological sciences and our capacity to communicate such information has grown from a trickle to a torrent, agricultural science being no exception. It is a fact that students do not necessarily has to depend on teachers for "information" in specific areas of interest. This also brings into sharp focus the role of a teacher in an era where 'Information Technology' is going to dominate our lives in several ways. Will the growth in IT undermine in any way the utility of a teacher? To answer this question, it might be instructive to remember the following statement by T.S. Eliot (from "Two Choruses from The Rock"):

"Where is the wisdom we have lost in knowledge?
Where is the knowledge we have lost in information?"

The need for a teacher who has the capacity to interact well with the students and transmit the ability to effectively sieve the 'grain' from the 'chaff' in terms of information is indeed stronger than before. While the 'information highways' are highly useful in keep both the teachers as well as students abreast with the most recent developments, one can easily get lost in the jungle of information unless one develops the required skills to analyze and utilize what is needed. In this context, teachers are not only expected to be as aware as the students about the strengths and constraints of the modern information technology, but also be on their toes all the time to keep pace with the developments, particularly in science and technology.

Agricultural Graduates: In our opinion, the following four major qualities would have considerable significance in the coming decades.

- Knowledge base, skills and appreciation of various approaches to problems-solving in agriculture.
- Ability to apply modern technologies for improving crop production, productivity, value-addition and export quality of agricultural produce
- Sense of social responsibility, and capacity to analyze important issues influencing national and international agriculture.
- Entrepreneurial skills and qualities

Significance of Linkages and Networking in Agricultural Education

No single organization can hope to grasp all of the activities and opportunities in biology in general, and agricultural science and technology in particular. At the same time, not only the fates of the research institutions and universities, but increasingly the fates of the nations will be decided by their abilities to use the facts and principles of agriculture with ingenuity and wisdom. The changing agricultural scenario within and outside the country and rapid technological developments warrant scientists and graduates to cover a much wider spectrum of agriculture-related activities and social obligations. Farming systems research, biofertilizers, integrated nutrient management, integrated pest management, biotechnology, natural resource management, resource optimization, crop modeling, post harvest technology, value added products, agricultural business management and computerized

decision support systems are among the areas that shall get an increasing emphasis in the agricultural sector.

Although our Agricultural Universities have the desire to stimulate curiosity and put the youth on the road to life-long learning, quality of agricultural education can be significantly strengthened only through cross-fertilization of ideas, and an exposure to multi-disciplinary and holistic way of thinking and practice in areas of specialization such as those listed above. This can be made possible only through effective and viable linkages and networking with various scientific and educational organizations within the country and abroad.

National and International Linkages in the Past

After the initiation of the Land Grant System of agricultural education in India, technical and financial assistance was made available to several SAUs through well-land out linkages with the US Universities, mainly through the USAID, Rockefeller Foundation, and Ford Foundation. Nearly 500 teachers/researchers from the SAUs and Deemed Universities under ICAR received training abroad through these programmes. The foreign technical assistance was gradually replaced by join training programmes between the Indian and US Universities when there was a perceptible improvement in the level of indigenous competence and facilities. The agricultural universities at Pantnagar, Ludhiana, Hyderabad and Jabalpur had particularly benefited from such linkages. When this programme was phased out, opportunities for the faculty members of most SAUs to have a sustained interaction through an institutional mechanism with leading institutions abroad dwindled considerably. Subsequently, inter-institutional linkages in agricultural research and education became confined mainly (a) between the SAUs and the ICAR institutes; and (b) between SAUs/Deemed Universities/ICAR institutes and the CGIAR (Consultative Group on International Agricultural Research) Institutions, mainly CIMMYT (Internal Maize AND Wheat Improvement Center), Mexico, and IRRI (International Rice Research Institute), Philippines.

Recent Initiative to Strengthen Agricultural Education in India

A key initiative in the recent years to improve agricultural educational base in Indian is the Agricultural Human Resource Development (AHRD) project funded by the World Bank, with the thrust areas of (a) improving the quality and relevance of agricultural education and in-service training programmes; and (b) strengthening the capacity of participating states to develop and manage human resources in the agricultural sector.

The ICAR-AHRD Program provided a fillip to training of faculty members in various disciplines at leading Universities/Institutes in countries such as USA,UK,Australia, Canada and Israel (Fig. 1A,B). At IARI, as many as 40 faculty members from 18 disciplines belonging to five Schools (Crop improvement, Crop production, Resource management, Basic sciences and Social sciences) received training in agricultural education and research in reputed institutions, such as University of California (campuses at Berkeley, Davis and Irvine), USA Cornell University, Ohio State University, Purdue University, Texas A & M University, Michigan State University, North Carolina State University, University of Illinois, Washington State University etc. in USA, besides International Agricultural Center, Wageningen, Netherlands, Rothamstead Experimental Station, UK, Hebrew University of Jerusalem, Israel, and Asian Institute of Technology, Bangkok, Thailand. The Institute has greatly benefited through this program, as these faculty members have not only revitalized many of the post-graduate courses, but also could bring in qualitative improvement in practical training of the students. Besides the perceived improvement in teaching through the organized exposure to leading educational/research institutions, linkages established by faculty members with scientists pioneering in various areas of specialization could make significant difference to the quality of the research programmes undertaken at the institute.

Inter-Disciplinary Faculty-Student Linkages:

The relevance of partnerships among faculty from different disciplines to build the knowledge required for the sustainability of the farming systems need not be overemphasized. The potential value of each of the disciplines can only be fully realized when related to one another and applied to the real world needs through integrative research. It is primarily through research and interaction with students that faculty members from diverse disciplines would be able to effectively blend with and contribute to the intellectual community on campus. One of the possible ways to channelize such interaction is formation of interdepartmental groups, comprising both faculty and students from inter-related disciplines. These groups can focus on stimulating discussions on broad disciplinary areas that are of considerable relevance. Many Universities in the USA, particularly various campuses of the University of California, have successfully adopted this mechanism of promoting faculty-student linkages that contribute to a dynamic learning process.

Partnerships with Private Sector to Strengthen Agricultural Research, Education and Employment in India:

In recent years, the private sector has come up in a big way in absorbing some of our agricultural graduates. Global opportunities for export of agricultural produce is also inducing some of our graduates to become entrepreneurs. However, agricultural universities have to come up with human resource development programmes that shall not only complement and supplement the existing educational and research programmes but also generate scientifically and technically enriched manpower that has the ability to create agribusiness. Food biotechnology, seed technology, vegetable sciences, floriculture, post-harvest technology, biofertilizers, biopesticides, and mushroom cultivation are some of the areas that have great potential to promote agribusiness in the country. The private sector can become a highly useful partner in strengthening research programmes that require considerable financial and technical assistance, besides entrepreneurship. Viable linkages between public and private sector institutions interested in agriculture are quite common in the developed world; however, success stories of such partnerships are extremely limited in our country.

The challenge now is how to forge strong university-industry linkages that could lead to a 'win-win' situation to the University as well as the agri-industrial sector. Such an interaction would not only provide an opportunity for self-financing of the programmes, but also fine-tuning the agri-production and/or processing technologies through effective feed-back from the students as well as the resource personnel from the University and private sector. ICAR has come up with detailed guidelines to promote university-industry interaction through contractual research that has enough built-in incentives. GBPUAT, Pantnagar is among the few SAUs in the country that has emphasized on generating manpower that is adequately trained in agribusiness.

University-NGO Linkages

Symbiotic partnership between the Universities and the NGOs could play a catalytic role in effective dissemination of technologies generated by the Universities, besides technology refinement through effective feedback from the farmers. Such linkages may also provide employment as well as better field – experience to the young graduates. Some committed NGOs involved in rural development, through linkages with ICAR institutes such as IARI, could bring in quantitative as well as qualitative improvement in technology adoption in many regions of the country. It is essential to extend these partnerships also in the area of educating the student community on one hand and farmers on the others. NGOs can also play a vital role in strengthening the institutional linkages with progressive farmers and farmer's societies.

Linkages of Agricultural Universities in India with Universities abroad and CGIAR Centers.

In recent years, ICAR has also signed MOUs with four leading Universities in USA for cooperation in agricultural research and education. These Universities are Texas A & M University (1997), Iowa State University (1998). Cornell University (1998) and Ohio State University (1999). Partnerships with these reputed Universities shall considerably enhance the quality of agricultural education.

The CGIAR Centres have been providing valuable support to human resource development in agricultural universities of the country over the decades. During the early 1980s, there was a successful collaboration between IARI and IRRI in which the latter sponsored the research programmes of selected students who had completed their course work at IARI. There is a strong case for revival and extension of such linkages wherein bright students from the SAUs/ Deemed Universities/ CAU have the opportunity to derive benefit from the collaborative research programmes with various CGIAR centers Another possible area of effective collaboration with the CG Centres could be post –doctoral research / sabbatical research in identified areas through inter- institutional agreements. This may also be possible through an institutional mechanism for faculty deputations or exchanges for specified durations between the institutions.

Knowledge Networks among Educational and Scientific Research Organizations

Expanding communication and technological opportunities are rapidly blurring geographical boundaries in education. The SAUs which were earlier established on a regional basis, need to therefore adapt to the changing situation. The present – day scenario demands for multi – disciplinary, multi – institutional and multi – state collaborations and networking. Firstly, networking among various institutions concerned with agricultural education in the country through modern technologies, such as videos and Internet, is the need of the hour. This would facilitate broader exposure of the faculty members and students to diverse perspectives, values and culture, besides cross – fertilization of ideas.

A potential area where modern technologies such as IT could be of great benefits is establishment of `Help Lines' and `Internet Networks' in the Institutes for the benefit of the farming community. These communication channels will play an increasingly important role in the years to come as more and more villages / farming communities get an improved access to communication networks. Such a networking could be of great help to the farmers in obtaining a quick feedback from the scientists to the problems in agronomic management of crops, besides improving plant health and soil health of the farms. The institutions would be benefited through constant interactions with the farmers, which is important for technology diffusion and refinement. Graduates in the institutions should be trained in operating such networks, as this would be an excellent opportunity for education about the farming systems, besides experience in practical problem – solving. It would also be of great benefit to if `Lecture Notes' (along with relevant references) are made available online (through internet) for major courses by reputed SAUs/ DUs ; this would be of great benefit to the graduate / post-graduate students of some universities where relevant expertise in teaching some courses might be lacking. Another possible area where networking can be of considerable benefit to the farming community is effective communication of knowledge gained through GIS (geographical information systems) and agricultural marketing intelligence based on dynamic updating of information from the state, national and international levels.

Interaction of Student and Teaching Communities with the National Academics

The National Academics can play a catalytic role in two of the possible areas in enhancing the quality of agricultural education in the country.

i) promoting scientific awareness and stimulating scientific discussions in SAUs and deemed universities through regular organization of `Academy – Institution Interface' ;

ii) Aiding in the formulation / strengthening of linkages between internationally reputed organizations and academics and national academic institutions in agriculture ;

iii) Promoting the exchange of scientific knowledge between cooperating countries in different disciplines in agriculture ; and

iv) Fostering federations of Societies devoted to improvement of education and research in specific disciplines.

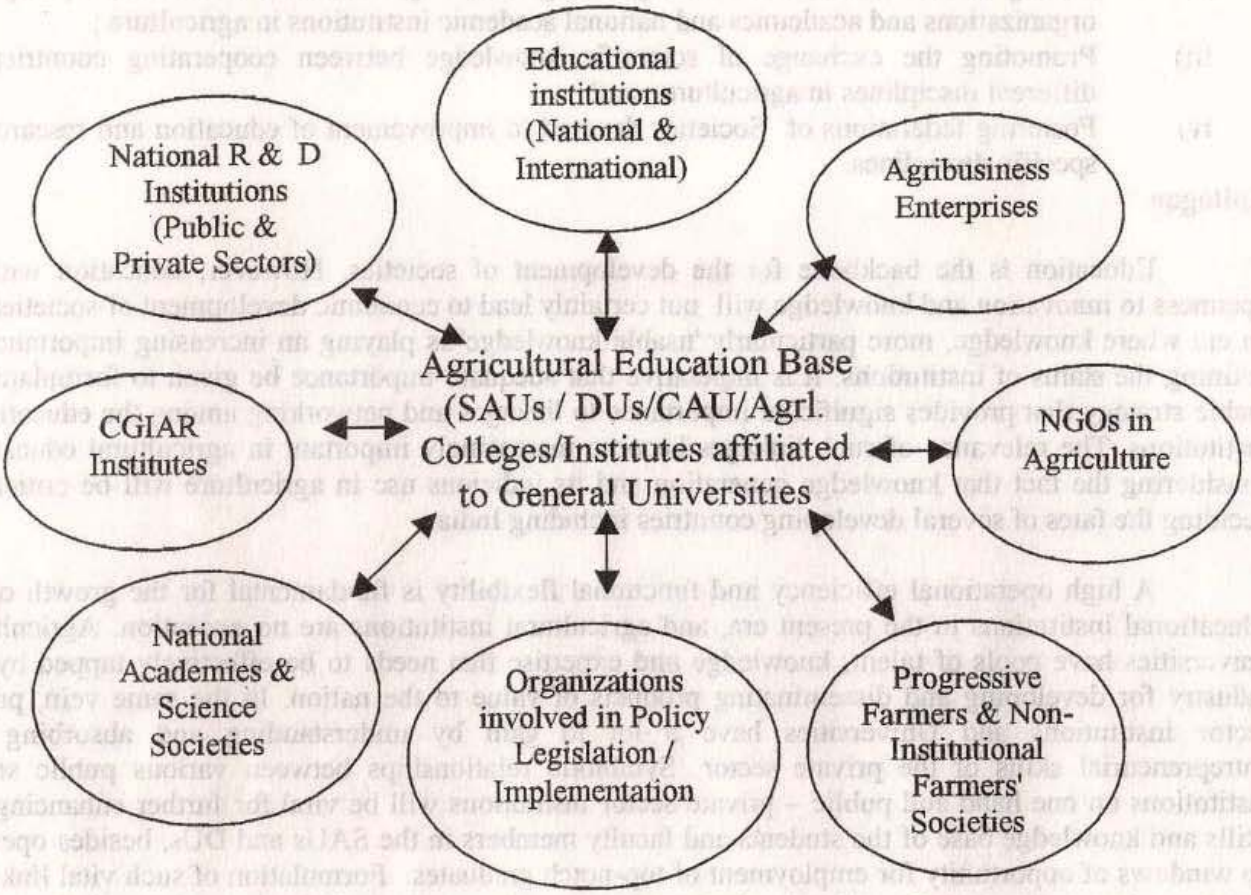
Epilogue

Education is the backbone for the development of societies. However, education without openness to innovation and knowledge will not certainly lead to economic development of societies. In an era where knowledge, more particularly 'usable knowledge' is playing an increasing importance in defining the status of institutions. It is imperative that adequate importance be given to formulating a viable strategy that provides significant importance to linkages and networking among the educational institutions. The relevance of such linkages become increasingly important in agricultural education, considering the fact that knowledge generation and its judicious use in agriculture will be critical in deciding the fates of several developing countries including India.

A high operational efficiency and functional flexibility is fundamental for the growth of all educational institutions in the present era, and agricultural institutions are no exception. Agricultural universities have pools of talent, knowledge and expertise that needs to be effectively tapped by the industry for developing and disseminating products of value to the nation. In the same vein, public sector institutions and Universities have a lot to gain by understanding and absorbing the entrepreneurial skills of the private sector. Symbiotic relationships between various public sector institutions on one hand and public – private sector institutions will be vital for further enhancing the skills and knowledge base of the students and faculty members in the SAUs and DUs, besides opening up windows of opportunity for employment of top-notch graduates. Formulation of such vital linkages requires adequate appreciation of each other's attributes and capacities. It is also perhaps time that our institutions dealing with agricultural education extend beyond formal schools of learning and develop outreach programmes that can be of considerable value to the ultimate stake holders of agricultural education, the farmers. Revolution in information technology is already galvanizing the process of knowledge communication. This also warrants capacity building, infrastructure development and upgrading the skills of communication of faculty members in SAUs/DUs.

Although the capacity for information communication has grown very fast in India in the recent decades, the need for a competent and qualified teacher is perhaps now more required than ever before, for it is critical to filter and analyze relevant scientific information for effective utilization in generation of 'usable knowledge'. To attract and retain the best of talent in educational institutions, particularly in SAUs/DUs which have a crucial role to play to nation's growth. We need to have effective and efficient institutional reforms, simultaneous with educational reforms. Viable linkages and networking within and across the agricultural institutions are possible only when institutions demonstrate functional flexibility and an ability to adapt quickly to the changing national aspirations and international scenario. Realization of this important fact, formulation of effective policies and programmes, and implementation of the programmes with sincerity and commitment are the need of the hour for enhancing the quality of agricultural education and its products in the country.

FOSTERING PARTNERSHIPS IN AGRICULTURAL EDUCATION



ISSUES EMANATED FROM DISCUSSIONS AFTER PRESENTATION OF PAPERS IN SESSION V

- Revamping the curriculum in Agricultural education programmes in relation to requirements of farmers, industries, public undertakings etc.,
- Measures for improving accountability in agricultural research
- Need for public and private investments in agricultural development
- Identification of indicators to prioritize agricultural research.
- Process of accreditation to strengthen agricultural education and research
- Exploiting the emerging areas such as Information Technology, Bio-technology, trade liberalization etc. in the field of agricultural education and research
- Developing professionals so that they will be job creators
- Developing linkages within the Institutes as well as within and outside the country in the context of WTO
- Establishing linkages by the private KVKs funded by ICAR with the respective SAUs to avoid duplication of work and to effect monitoring of their works.

Session VI

The session VI was chaired by Dr.Panjab Singh, Director General, ICAR, New Delhi. Dr.T.Marimuthu, Dean, (Post Graduate Studies), Tamil Nadu Agricultural University, Coimbatore and Dr.A.Susheela Thirumaran, Dean, Home Science College & Research Institute, Madurai were the Rapporteurs. The following papers were presented during the session.

1. Post Harvest Technology – challenges and opportunities	Dr.V.V.Sreenarayanan Dean, College of Agrl. Engineering. T.N.A.U., Coimbatore
2. Biotechnology Education in Agricultural Universities	Dr.S.Sadasivam Director Centre for Plant Molecular Biology, TNAU, Coimbatore

Paper 1. Post Harvest Technology: Challenges and Opportunities

Dr. V. V. Sreenarayanan
Dean,
College of Agricultural Engineering,
Tamil Nadu Agricultural University
Coimbatore.

Introduction

India has a strong competitive advantage in food processing, since we are blessed with unsurpassed natural advantages. India has 169 million hectares of arable land and enjoys a wide range of agro-climatic conditions ranging from hot tropical to temperate with rainfall varying from less than 13 cm in some parts to about 600 cm in others. This makes it possible to grow all possible varieties of agricultural products.

The agriculture production in the country has been increased considerably during the past three decades, due to the introduction of improved agriculture technology. However, this has produced a lot of problems, commonly referred to as 'second generation' problems. For example, the crops harvested during rainy season place a heavy demand on drying and storage facilities. The combination of more intensive cropping seasons and more production inputs increase the demand for labour at critical times. Increased productivity have also led to the failure in the existing infrastructure to cope with the large marketable surplus resulting in the inability of the farmers to retain them. Once the crop is harvested, the quality starts deteriorating due to the attack by the microorganisms, insects and rodents. A bulk of produce is also lost due to improper handling and storage. A reduction in food supply after harvest is considered a "post harvest loss". It has been estimated that about 10 to15 percent of durable and 30 to 40 percent of perishable crops are lost due to improper post harvest operations.

One of the efficient ways to increase food availability is to control the losses occurring between the field and the consumer, or in other words, it is much economical to save, what is already produced. To provide the capability in the postproduction delivery system and to minimise the losses, the food industry must be analysed as a total system, in the light of the actual social, economical and physical conditions prevailing in the region. We are the second largest producer of fruits (46 million tonnes) and vegetables (80 million tonnes) next to Brazil and China, respectively. The largest livestock population of about 500 - 520 million (53 % of world's buffalo population and 45% of sheep) is with us. We rank first in the milk production (74 million tonnes). Ours is the 'Home of Spices' and we produce all varieties of spices worth over Rs.3500 crores and it is approximately 25 - 30% of world

production. Nearly 22 million tonnes of oil seeds are cultivated. We also have 8040 km long coastal line, 28000 km of rivers and millions of hectares of reservoirs and brackish water which serve as potential for the production of larger marine products and varied fish resources.

Though we produce more raw materials for food and reach self-sufficiency, we cannot ignore the projected population growth of 1500 million by 2030 AD and challenges in the areas of productivity and production. The ever-increasing population not only demands food to live but also fibre to wear and shelter to reside. All these share the lands already under production and thereby reduce its availability for cultivation. Among the other alternates remains before us to increase the food material availability is the reduction of post harvest losses, which accounts for 10 - 15% in the case of durable and 30 to 40% in the case of perishables. By converting all our agricultural and allied production into food or value added products, it is possible for us to feed another 117 million population.

The post harvest processing solutions are not unique. They vary with the commodity and are also location specific. The various processing operations for application at farm level, village level, and organised industrial level have to be different. While there are number of technologies available to cater to the needs of industrial level operations, the processing technologies at rural threshold, namely, farm, and village level technologies are lacking. By improving handling, processing, storage and preservation, the loss can be reduced significantly. However the potential for preventing losses greatly depend on the cost and benefits involved.

Many improved technologies/processes have been developed for the various unit operations during the past, and their popularisation for processing and preservation of food material and adoption will go a long way in increasing the food availability.

Post Harvest Technology of Cereals and Pulses

The Indian rice milling industry is dominated by small capacity mills of 1 to 2 tonnes per day capacity. This mills yield poor recovery of quality products as a result, there is steady shift from traditional milling in hullers / shellers to modern rice mills for higher recovery. There is enough scope for R&D to increase milling efficiency for higher recovery. Also industry calls for development of technology towards better utilization of rice bran and recycling of rice mill effluent.

Wheat milling industry has been operating in both organized as well as unorganized sector. Organized sector comprises of 640 roller flourmills, with an annual processing capacity of 10 million tones. The output comprises of maida, rawa, atta and bran. Areas needing R&D intervention in wheat milling process are storage, conditioning flour milling, blending and product separation.

Pulse processing in India has been confined to unorganized sector with an estimated population of over 12,000 dhal mills. Most of these have been using milling process that is whether dependent and process time runs between 7 to 10 days. Thus the losses are very high. Working conditions in these mills are very poor due to high level of dust and noise pollution, inadequate lighting and safety arrangements. The R&D interventions needed in pulse processing are storage, conditioning, dehusking and polishing.

Post Harvest Technology of Fruits and Vegetables

Horticultural crops in India are currently grown in 12 million hectares, which represents 7 per cent of India's total cropped area. Annual horticultural production is estimated at 100 million metric tonnes, which is over 18 per cent of India's gross agricultural output.

India's share of world trade in this sector is only around one per cent. India's major exports are fruit pulps, pickles, chutneys, canned fruits and vegetables, concentrated pulps and juices, dehydrated vegetables, and frozen fruits and vegetables.

The fruits and vegetable processing industry has been facing problems of low capacity utilization and technological obsolescence. It has to work under the constraints of high fluctuations in raw material quality due to small operational holdings, fluctuating price, low concern for quality by the trade sector, inadequate R&D support with respect to product development, high cost of energy, uncertainty in availability of adequate volumes for processing, inadequate and expensive cold chain facilities and varying requirement of processing conditions from one material to another.

The number of fruit and vegetable processing units, the installed processing capacity and production of processed items are going up steadily (Table 1).

Table 1. Installed capacity and quantity processed during 1993-98.

Particulars	1993	1994	1995	1996	1997	1998
Fruit and Vegetable Processing Units	4132	4270	4368	4674	4932	5112
Installed Capacity (Lakh tonnes)	11.08	12.6	14.02	17.5	19.1	20.4
Production (Lakh tonnes)	4.69	5.59	8.50	9.60	9.60	9.10

Post harvest Technology of Spices and Plantation Crops

India is known as the "Home of the Spices", having favourable climatic and soil conditions for their production. Spices constitute an important group of agricultural commodities, which have been considered indispensable in the culinary art of flavouring of foods. Some are also used in pharmaceutical, perfumery, cosmetic and several other industries. There are five major spices (black pepper, cardamom, chillies, ginger and turmeric), which account for about more than 75% of the total Indian annual foreign exchange earned. Minor spices, which are more than 42 in numbers, are further divided into bulbous spices, seed spices, aromatic tree spices, acidulant tree spices, leafy spices and other minor spices.

According to the Bureau of Indian Standards, 63 spices are grown in the country, engaging a land area of 2.36 million hectares. About 92 percent of the spices produced in the country is consumed by the domestic market, and only about 8% is exported, which however helps in earning a substantial amount of foreign exchange. A steady increasing trend has been observed in the export of value-added products, in that the export of value added spices products increased from Rs.54 crores in 1990-91 to Rs.1650 crores in 1998-99. Though India is the largest producer of spices accounting for 61 percent of world production and 30 percent of world export, it secures only 9 percent in terms of value. The reasons are that the country does not produce high quality spices that fetch good price and the spices are exported raw without any value addition.

Plantation crops are high value commercial crops which play very important role in India's export trade. Coconut, cashew, arecanut, cocoa, oil palm, tea, coffee, etc., are the important plantation crops. Among the plantation cops, oil palm and cocoa are the recent inclusions. The plantation crops and spices serve a variety of human needs not only as food, oil and industrial raw materials but also pungency, aroma and flavour to food, beverages and confectionery items. Plantation crops generate considerable employment opportunities to millions of people during on-farm operations and off-farm processing activities.

Spices are valued for export and can earn huge foreign exchange to the country. In the International market for spices, 'quality' is the catchword because of the stiff competition among the spice producing countries. With the entry of more countries in the spice production and trade, the position of India in the world market is becoming more competitive. Therefore, it becomes imperative to raise the productivity level of spices to make available the commodities at competitive price and also to improve the quality of produce adopting the latest technology.

Spices, like all other agricultural commodities invariably contain high moisture (55 to 85%) at the time of harvest, which must be brought down to 9 to 12 %. Further more spices vary considerably in shape, texture, size, colour etc., as they may be fruits, berries, barks, seeds, leaves, rhizomes, roots, unopened flower buds (cloves) or other floral parts (saffron). Hence their pre-treatments, curing, cleaning and methods of processing also vary considerably. During their post harvest processing, they are subjected to different unit operations such as washing, peeling, curing, drying, cleaning, grading and packaging, until they are ready for the consumer or the market. Such post harvest processing technology should ensure proper conservation of the basic qualities of spices for which they are valued, viz aroma, flavour, pungency, colour etc. Further more, the quality specifications for spices are continually becoming more stringent. It is therefore necessary that procedures should be ready along with methodology for quality evaluation and decontamination.

Post harvest Technology of Flowers

The great variety of colour, perfumes, size and shape of the flowers make them more attractive. Some of them also are valuable as medicinal plants. The commercial cultivation is confined to groups of cut flower production. Rose, Jasmine, Chrysanthemum, Tuberose, Marigold, Crossandra, Gladiolus, Vanda, Arachins, Aranda etc. are exported as cut flowers.

An agro climatic condition of 10° to 32°C temperatures, humidity from 50 to 85% and light intensity of 2000 to 6000 foot candles is required. Variation of 10°C between day and night temperatures is preferred. The infrastructure requirements for the commercial production and post harvest technology of cut flowers are green house, grading and packinghouse and cold storage.

Floriculture is largely on export oriented agro industry. There are fourteen flowers in the world cut flower trade. The trade is growing at the rate of 15% per annum. Yet Indian exports are limited only to a few flowers namely Jasmine, Chrysanthemum, Gladiolus and Orchids.

SWOT Analysis

Rapid changes have taken place in agricultural production sector in the country. Increased agricultural production with overall growth and development in other sectors have resulted in changed socio-economic scenario of the country as a result of which greater thrust has now been placed on needs and wants of consumers together with stress on social equity and benefits to the farmers and rural work force. The society, therefore expects nutritional security, better quality, convenience and more employment from all agricultural activities. This demands faster growth in technological sector too. Therefore there is an urgent need to augment R&D efforts synchronize actions and achieve synergistic effect through better planning of R&D programmes, effective management of the scientific programmes together with faster and effective transfer of technologies.

Strengths

- Surplus production and productivity of food grains.
- Separate ministry for food processing
- Exclusive commodity boards.
- Popularity of processed foods.
- Availability of technologies from reputed institutions and progressive departments.
- Good number of Industry associations.
- Availability of multidisciplinary expertise.
- Availability of qualified professional manpower.
- Support from state &central government and other agencies including subsidies etc.
- Special schemes for 100% EOU.

Weaknesses

- Higher field and post harvest losses.
- Small farm holdings.
- Equipments have not been developed for specialized crops.
- Technological limitations to small-scale processors.
- Emergence of strong competitors and global policies.
- Social imbalance.
- The seasonal products are available as fresh and cheaper and are usually consumed as such, leaving low surpluses for the processing industries.
- Land ceiling laws.
- Failure of co-operative structure.
- Low productivity- high unit price.
- Lack of organized export promotion.
- More intermediaries in market network.
- Lack of farm-industry liason.
- Large unorganized sector- leads to poor quality.
- Lack of infrastructure – cold storage, drying yard, storage facility, power, water, ports, transportation etc.
- Lack of coordination in production, marketing and consumption.
- Inadequate or lacking grades and standards.

Opportunities

- Surplus production and crop variability.
- Liberalization of economy.
- Great scope for reduction of post harvest losses through improved modern handling, preservation and storage practices.
- Integration between farmers and processing companies.
- Export of value added products to other Asian and African countries.
- Saturation of traditional markets.
- Increasing demand for processed foods.
- Harnessing technological advancement in allied sectors.
- National and international collaboration.

Threats

- Reliance on foreign technology.
- Export of raw agro produce.
- Import of processed foods.
- High cost on basic infrastructural facilities.
- Reduction in the availability of human labour for agricultural operation

Strategies

The number of R&D organizations in the country has been working in the area of post harvest technology. However in agro climatic diversity and vastness of the country, there is large scope for research institutes that works close collaboration with farmers, processors, manufacturers and developmental agencies. In this backdrop, following strategies in the field of post harvest technology related to R&D and transfer of technology have been identified.

- Technology for reduction of qualitative as well as quantitative post harvest losses should be implemented.
- A system approach should be developed for selected horticultural crops for their storage, processing, packaging, transport and sale.
- Development, refinement and operationalisation of modern agro-processing technology of farm produce and by-products.
- R&D on modernization of pulse milling industry, including pre-milling treatments given to the pulses.
- Development of improved technologies/machineries for various post harvest operations, which reduces drudgery and gives higher efficiency, economy and employment generation.
- High capacity agro-processing machinery and technologies, which may be demanded by large farmers or association of farmers and processors or custom service agencies.
- Nutritional security, convenience, quality improvement and increased exports.
- Development of appropriate technologies for processing of spices including cold/cryogenic grinding and packaging.
- Development of health foods and convenience foods including improvements in traditional food products.
- Manufacturing promotion and entrepreneurship development.
- HRD, higher formal education, entrepreneurial development in post harvest processing and agri business.
- Creation of exclusive **Post harvest Technology Centres** in the country.

Emerging Trends in Post Harvest Technology

We are processing only less than 1% of our farm produce and convert only 7% of them as value added products. The food industry in India is caught in a vicious cycle which is typified by inefficiencies, wastage and value loss. This is mainly due to the adoption of obsolete technologies, inefficient methods and lack of skilled and technical manpower.

Because of the nutritional and quality changes that result from traditional processing, a significant amount of research has been carried out to develop new methods of treating foods. Some of them are already commercial, while others still require fine-tuning to make them competitive with technologies currently being used. Although the destruction or inhibition of unwanted spoilage and disease organisms is the common goal of these technologies the resultant end products can be divided into two types. The first of these products is heat processed and does not resemble raw products in any way. The major advantage is in the way the thermal treatment is carried out. The second type of process seeks to destroy or eliminate unwanted microorganisms without significantly changing the basic character of food, so that the consumer can utilize it as a fresh product without the fear of food-borne disease.

The most promising among these emerging technologies are

- Microwave Processing/Drying
- Food Irradiation
- High Electric Field Pulse (HEFP) treatment for food preservation
- Ohmic Heating of Foods

- Hydrostatic Pressure Treatment of Foods
- Osmotic Dehydration
- Quick Freezing Preservation of Foods
- Extrusion Cooking
- Cryogenic Grinding of Spices

Value Addition of Agro Wastes/Byproducts

It is not fair to delink the by-product industries from the main food processing industries. The by-products from sugar industries, like alcohol, paper and press mud are well known. The other crops also generate a lot of biomass, which are either unutilized or under-utilized at present. For example, coconut husk or coir can be used for making various coir-products, particle boards; coconut shells can be used for making activated carbon; arecanut leaf sheaths can be used for making cups & plates; Oil cakes can be used for making fish meals; Cashew nut shell liquid is of high commercial value; rice bran can be used for extracting edible oil, making fish meal, furfural, etc; fruit & vegetable processing industries generate a lot of wastes which can be used for making a number of chemicals, fermented products, pectin, etc. Commercial ventures in these areas should be encouraged in order to effectively utilize our agricultural production as well as to safeguard our environment apart from supplementing the income of the farmers.

Thrust Areas

Considering the various aspects of requirements of crop processing and post harvest practices of agriculture and horticulture crops, the following thrust areas can be identified.

i. Development of improved machineries / equipment for various unit operations of crop processing which reduces the drudgery to the labourers, higher output, efficiency and economy.
ii. Increasing the shelf life of fruits, vegetables and cut flowers by suitable packaging methods like, modified atmosphere packaging, controlled atmosphere storage, vacuum packaging, drying, preservation, etc.
iii. Quality up gradation of the processes and mechanization of the process for the export orientation and global competition.
iv. Utilisation of wastes and by-products for increasing the revenue of the farmers and entrepreneurs and to convert into usable products.
v. Transfer of technology from laboratory to the industry / field is important which can be achieved through proper extension activities, training in the pilot plants etc.

Conclusion

Though different new technologies have been advocated for food processing, one technology (or) combination of technologies suitable for a particular food to be processed / preserved has to be identified experimentally and then strictly adopted the same for the production / preservation of quality food. This food processing operation not only going to reduce the post harvest losses but also increases the shelf life of fresh food material or value added food products produced out of it. In turn, products with increased shelf life will increase the availability of the same in the market for longer time and thereby stabilize the price in the market and meet the consumer requirements. Reduction in loss and increase in the availability of food will finally reduce the millions of population in hungry, present in our country.

Paper.2 Biotechnology Education in Agricultural Universities

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In 1995, the developed nations accommodated 1.3 billion people out of a total world population of about 5.7 billion. Most of the inhabitants of these very diverse nations are better fed, housed, clothed and educated than those of other nations; they are more healthier, they live longer and their average incomes are larger. On the other hand the developing nations, had a 4.4 billion population. They are poorer than the people in developed countries in respect of all World Bank indicators. The human population of our planet is expected to reach about 8 billion by the year 2030. Over 6 billion of them will be living in the developing countries, and it is predicted that developing countries like China and India will have to import large quantities of food to meet their food security needs.

The green revolution began in early 60s and late 70s has put India in a comfortable position in food grain production. The food grain production is now, four times that was produced in 50s. However, we cannot be complacent with the achievement and stick to the conventional system of agriculture because of the threatening escalation in population and more alarming by diminishing farm lands. India now has more than a billion stomach to be fed. Thanks to the health care programmes, the longevity of the people has increased more than two fold from the time of independence. The consumer preference and quality awareness of the people are the other compulsions to reconsider our agricultural production strategies. So, it becomes essential to add new tools to agricultural research so as to push up the food grain production from the present plateau. The agricultural scientists and planning experts are convinced biotechnology is a powerful tool, which could help us at this critical moment.

Biotechnology in Agriculture:

The developments in biotechnology have dramatic impact on the growth of science on the whole and in particular to agriculture and medicine. In agriculture, the tools of biotechnology can be applied starting from seed certification through food processing. Biotechnology can be used to

- test the seed purity
- introgress the gene of interest
- equip the crop plants with defence genes to fight against pest and diseases
- increase the content of the select nutrient in the required organ of the plant
- bestow the tolerance quality to withstand drought and other adverse abiotic stresses
- introduce characters suitable for specific purposes like that of processing
- make the plant grow inspite of the presence of the harmful weedicides
- catalogue and preserve the biodiversity of our green wealth and
- produce human proteins, vaccines or therapeutic proteins.

Biotechnology Education:

Hence, it becomes imperative to teach biotechnology to the students of agriculture. Biotechnology is being taught at various levels in Indian Institutes. Many science colleges and conventional universities have started postgraduate and undergraduate programmes in biotechnology. Anna University, Chennai offers B.Tech Industrial Biotechnology. Of course M.Tech biotechnology is also available in a few institutes. However, in agricultural universities, only a few have postgraduate program in biotechnology and only one course is offered at the undergraduate level in some agricultural universities.

The five agricultural universities which offers M.Sc. Agricultural Biotechnology are

- Birsa Agricultural University, Ranchi
- Ch. Sarwan Kumar Krishi Vishvavidyalaya, Palampur
- G.B.Pant University of Agriculture and Technology, Pantnagar (Nainital)
- Indira Gandhi Agricultural University, Raipur and
- Tamil Nadu Agricultural University, Coimbatore

A course on agricultural biotechnology is offered to the undergraduate students of agricultural sciences in TNAU and a few other universities with a 2+1 credit load. The undergraduate students also study basic microbiology, biochemistry and genetics prior to learning biotechnology.

A case study

A department in biotechnology was stated in this university in 1987 and later elevated to a centre in the year 1989-90. The first batch of students was admitted to M.Sc. Agricultural Biotechnology programme in 1987. Till date 108 students have taken the postgraduate degree in Agri. Biotech from this university. They are all well placed in different institutes as post doctoral, Ph.D students, R&D employees, teachers and Senior Research Fellows. The admission to M.Sc. is through an All India Level Entrance Examination conducted by the Jawaharlal Nehru University on behalf of DBT, GOI. The students thus admitted are given a stipend of Rs.800/- per month and DBT, GOI is kind enough to support this programme from 1987-88 to till date. With the funding from the State Government, through a plan scheme, the Ph.D programme was started in the year 1993. Till date, 20 students have taken the Ph.D degree and 10 are in different years of study.

The Ph.D. students are given scholarship from the various schemes operated in the centre. There are 20 well qualified scientists, drafted from different disciplines, work in the centre and they were trained in one or the other field of plant molecular biology in advanced laboratories, abroad. They get funding from DBT, GOI, The Rockefeller Foundation, USA, CSIR, ICAR, DST and the State Government for research. The research programmes range from gene isolation to transformation. Thus, the strong base in research supports the teaching programmes. The centre has the required facilities like the equipment, cold room, transgenic greenhouse, tissue culture lab, net-house, library, biotechnology information sub centre with computers and internet facility and audiovisual lecture hall. Since we have an experience of more than a decade in running the postgraduate programme in biotechnology, we intend to venture into the under graduate programme. This will be a 4-year degree programme after +2 leading to B.Tech (Ag. biotech). It is proposed to teach them the basics of agricultural sciences and build up with the biotechnology knowledge so that they will become perfect agricultural biotechnologists.

Novel approaches to teach biotechnology

As biotechnology is a subject of the latter half of the 20th century, it has to be taught in a modern way, employing all new tools of educational technology.

Video Lessons/Teaching modules

In biotechnology the structure, function and manipulation of genes are taught. Genes are invisible and hence experiments give indirect evidence and high imagination are required for understanding of the subject. Hence, the modern gadgets help to explain the intricacies of life in a simple, elegant and pictorial manner.

The video lessons and teaching modules combine both sound and pictures, moving and still, grip the attention of the viewers and has great motivating power. It makes the past alive. It can bring distant objects, places, events and processes to the classroom. This method can magnify small objects,

which can be seen by several students at a time. Many video lessons on biotech subjects like tissue culture techniques, DNA: The molecule of life, photosynthesis, protein biosynthesis, molecular cell biology, plant mitosis and meiosis, molecular techniques, genetic transformation etc. are available. Similarly, teaching modules makes the learning process easy for the students. A module on protein synthesis developed at this centre attracts attention of the students in the biotechnology course at the UG level.

Computer aided education

Computers are used in all fields and have great impact in education especially in fast expanding sciences like biotechnology.

Scanning and storage for learning

Photographs of gels, live tissues, cells, restriction maps etc. may be stored in the computer in any suitable form for learning purpose.

Molecular models

Macromolecule like RNAs can be viewed in three-dimensional form in the computers. To teach the structure of macro-molecules, computers are highly useful.

Data analysis and interpretation

Computers are of use in recording, processing and analyzing data and for pictorial representation of the data for better interpretation. Data analysis computer software packages like NTSYS-PC, UPGMA, PAUP, POPGEN, MEGA, MAPMAKER are useful in diversity analysis, fingerprinting and linkage and molecular map construction.

DNA sequencing

Sequence analysis programs are available to do gene sequencing, genome characterization etc. The rice genome map and human genome map are available in databases. For example, GENSCAN is a software program used to predict complete gene structure, including exons, introns, promoter and poly-adenylation signals.

Internet

Internet is a global collection of interconnected information, which allows sharing programs, messages and information available at one site. Several activities can be performed for effective teaching if access to the Internet is available. In addition to routine benefits derived from Internet, the equipments, chemicals and enzymes can be ordered through Internet.

CD-ROM retrieval

One can get scientific information retrieval in a short time from CD-ROM's. Some of the popular literature search titles are AGRIS, AGRICOLA, BIOTECH, etc.

Experiential Learning

Learning by doing inspire the learners to know things in a practical way and to solve problems since we remember what we do rather than what we read. Since biotechnology is oriented towards laboratory experiments a full-fledged biotechnology laboratory is highly essential for effective teaching. The laboratory facilities, equipments and chemicals should be available in required

numbers/quantities to do the experiments by the learners themselves. The teacher should be able to mobilize the requirements in a preplanned manner.

Research based learning

For postgraduate programme in biotechnology, research based learning is essential. The learners will know the technology by doing themselves. In Institutes having full fledged research facility, the learning of biotechnology is more successful as compared to institutes having only teaching. Research facilities motivate the students to learn more practically. A separate course on research methodology for PG students is very much helpful to carry out their research in a planned way and to present the results in a suitable form. Generally the learners in biotechnology are in the laboratory during off time. Working at out of office hours not only makes the student a responsible researcher but also helps to develop individuality. The student thinks freely without any stringent schedule and makes observations in a time bound manner.

Industry visit

Field visits to biotech industries help the students to have an exposure to industry set-up, infra-structural facilities, and practical skill involved in conversion of research finding to technology and product. Since the present learners are expected to become future managers of industries/private entrepreneurs, industry visit is very much useful if it is treated as part of curriculum.

Training in other laboratories

Biotechnology students are placed in other biotechnology research laboratories during summer vacation. This helps the student to learn outside the campus in a different atmosphere. Also, it helps them to get to know the research activities of other institutions and the facilities available.

Team Teaching

In biotechnology, the integration of many sciences in a particular course necessitates team teaching. The teachers are professionals in their area of research and well equipped in their subjects. So, for effective teaching, the teacher should have the talent to perceive, posses mental orientation to identify, to observe, to predict, to hypothesize, to act, to solve problems, and to impart training in coordination in a team. A single course may need 5 or 6 teachers to cove the syllabus (For example Molecular Techniques). In a team teaching course, at the end, the student is the beneficiary. The students get what could not be gained from a single teacher or a single textbook.

Special features of a 'biotech' teacher

In addition to the basic qualities required of a teacher, biotechnology teacher should possess the following:

- A firm background in biotechnology
- Ability to develop analytical skills
- Expertise in problem solving exercises, designing experiments and analysis of data
- Preparedness for collaborative learning with students
- Computer knowledge to work on DNA sequences, macromolecule models and pattern recognition
- Basic knowledge on instruments used in a biotechnology laboratory
- Mind set for team work
- Love for the subject and teaching. With all the above qualities acquired, he or she will be a successful biotech teacher.

Professional

The biotech teacher should have a sound knowledge in his/her subject. Since biotechnology is a fast expanding science, one has to cope up with the new developments. The biotechnology teacher has to learn through the facilities available in and outside the campus. Attending summer school, refresher courses, seminars, symposia and other training programmes can also do periodical updating of knowledge. Professionalism in biotechnology alone is not enough for an effective teacher. He should be aware of the modern trends in educational technology. Thus a biotechnology teacher is a professional by his subject and teaching.

Partner in a team

Biotechnology is a broad term, encompasses many subjects. Hence one may not be master in all subjects of biotechnology. For example, for a course in molecular biology many scientists will take part in classroom teaching as well as in practical classes. A biotechnology teacher should have the quality to act along with other teachers in organizing the classes. Any friction in team teaching will result in the failure of the learning process. Hence, a biotechnology teacher has to have the spirit of working together in a team.

Researcher

In order to improve teaching to suit the needs of the learners a teacher has to conduct regular research based on careful and systematic observations guided by tentative hypothesis. As far as the biotechnology teacher is concerned, he/she should always be involved in research to motivate the learners and to update his own knowledge. The involvement in research will have direct impact on the teaching and indirectly motivate the learners.

Innovator

In professional education system, the role of a teacher in curriculum development is gaining importance. He is at liberty/flexibility to introduce innovations in the curriculum to enable the students to face the challenges in life by improvising his knowledge, skill and attitude by new ideas. He should have the ability to accept and introduce innovative ideas in course curriculum, evaluation system or any other thing related to the educational system. For example, a biotechnology teacher, by his experience and exposure to latest techniques, can modify an existing protocol with new ideas.

Instrumentation technician

A science teacher has to act as an instrumentation engineer to explain the principles of an instrument. The biotechnology teacher has to have a basic knowledge on different techniques like microscopy, centrifugation, refrigeration, filtration, transformation etc. A biotechnology teacher has to handle many sophisticated research equipments like ultracentrifuge, spectrophotometer, microscopes, lyophilizer, particle gun, thermocycler, deep freezer, imaging system, computer, growth chamber etc. To operate these equipments, he should have a working knowledge on all these. He may not be an instrumentation engineer to rectify the defects in faulty equipments but he should be able to locale the fault. Thoroughness in instrumentation will give him confidence to teach.

Collaborative learner

In high-tech subject like biotechnology, a teacher must have the quality to learn many things during the class. During teaching, he should have the open mind for accepting analytical thinking skills and to get solutions. The two-sided mutual benefit approach results in better learning between the teacher and the learners. The regular lecture classes may not be an effective forum for collaborative learning. However, the assignments, seminars, term paper presentation will create good opportunities for collaborative learning. At post-graduate level, the research carried out by the students is yet another opportunity for collaborative learning.

Manager

The important responsibilities of a manager are planning, organizing, leading and solving problems. These four functions are to be performed by the teacher also. The biotechnology teacher has to plan for his time in the theory and practical classes so as to complete the envisaged syllabus in the curriculum. He has to organize the practical classes and lead the students in an effective manner to the learning process. The teacher has to act immediately in times of problem eruption and should motivate the students to overcome the problem. Man management and time management is very important for a biotechnology teacher apart from budget management for purchase of equipment, chemicals and enzymes.

Evaluator

Evaluation is an effective feedback and a yardstick with which the teacher can measure not only the student's performance but also how far he has succeeded in his teaching efforts. So, evaluation helps the teacher to reorient or reschedule or revise his method of teaching and other accessories. The age old 'question and answer pattern' will make the students a memory machine. But the role of a biotech teacher is to mould his/her student for analytical skill and thinking. Hence, the evaluation procedure should motivate the students to learn beyond classroom teaching.

ISSUES EMANATED FROM DISCUSSIONS AFTER PRESENTATION OF PAPERS IN SESSION VI

Paper 1.

- Creation of Post harvest Technology centers in the country
- Focus should be given for primary processing rather than secondary processing technologies.
- Establishing Inter-institute linkages for value addition of farm produces within the country.
- Milk processing and cold storage facilities to be established throughout the country
- Inclusion of post harvest technology in the curriculum
- Establishing training centers for developing human resource for post harvest technologies

Paper 2.

- Biotechnology can be strengthened in the country through inter university linkages
- ICAR should support in a big way especially by offering fellowships for the institutions offering PG programme in Bio technology,
- Undergraduate and Postgraduate programmes in Bio technology are to be introduced in all the SAUs.
- Investment on Agricultural Bio technology should be enhanced.
- Bio safety of biotechnological products are to be heavily addressed.

Session VII

The session VII was chaired by Dr.S.N.Puri, Vice-Chancellor, Mahatma Phule Krishi Vidhyapeeth, Rahuri, Maharashtra. Dr.Abdul Rashid, Dean (PGS), SKUA, Jammu and Dr.R.S.Azhakiamanavalan, Dean (Horticulture), Tamil Nadu Agricultural University , Coimbatore acted as Rapporteurs. In this session, following papers were presented.

1.	Cyber Extension : The Extension approach for New Millennium	Dr.M.H.Mehta, Vice-Chancellor, GAU
2.	Agricultural Research and Education - Improvement through institutional linkages.	Dr.V.M.Pawar, Vice-Chancellor, MAU, Parbhani

Paper 1 'Cyber Extension' - the Extension Approach for New Millennium

Dr.M.H.Mehta
Vice-Chancellor,
Gujarat Agricultural University
Sardar Krushinagar
Gujarat

Access to information and improved communication is a crucial requirement for sustainable agricultural development in India. Modern information and communication technologies including the Internet, when applied to conditions in rural areas can help improved communication, increase participation, disseminate information and share knowledge and skills. It is being said that 'Cyber Extension' would be the major form of technology dissemination in the near future.

It is observed that the rural populations still have difficulty in accessing crucial in formation in order to make timely decisions. It is essential that information availability is demand driven rather than supply driven. The challenge is not only to improved the accessibility of communication technology to the rural population but also to improve it's relevance to local development.

Considering the critical need for access to timely information and improved communication, this paper focuses on Harnessing IT for Agriculture and Rural Development. Indian Scenario, the context of Agricultural Extension and rural Development Limitation of Traditional Extension methods and potential Advantages of Cyber Extension are discussed. Attempts made in different countries to transfer information to the rural population and success stories of such attempts are narrated. Bridging the 'Last Mile' between the information rich and information poor will ensure that remote rural communities are adequately powered with information.

Now it is the job of scientists particularly the extension professionals to collate, edit and package the technical information and put it on the net. The cyber extension provides excellent opportunity to make your messages reach far and wide very quickly. IT is very important to re-check the information you put on the net, as the credibility of YOU (whether you are a scientist or in institute) will be in long run as good as your message. The experience worldwide proves that the sites providing unauthentic information loose credibility very fast. National, regional and state level institutes like NIRD/MANAGE/ State Agricultural Management and Extension Training Institutes (SAMETIs)/KVKs/ZRS/SAUs have a very important role to play in taking lead to package the information on Agricultural Extension and Rural Development Policies, schemes, programmes and working mechanism at the grass-root level and host the same on their WEB sites. These institutions may also take up large scale training of Extension and Rural Development functionaries at District, Taluka and village level to effectively use the IT connectivity at various levels. We need to facilitate the task of taking the information access to the village level. There is already a concern that the gap

between the information access to the village level. There is already a concern that the gap between the information rich and information poor is getting wider.

Hence it is incumbent on all of us, the administrator, Non Government Organizations (working for Rural Sector), trainers and scientists, all who are involved in the task of facilitating the upliftment of the rural communities to provide information access to the last farmer in the farming community. Gujarat Agricultural University GAU), which is one of the largest and multi campus university realized early the vital need for introducing information technology. Having set up an information network at all its campuses greatly helped administration and internal communication on one hand and gave an excellent support to students, faculties and research scientists for the scientific knowledge. GAU as next step entered in to an MOU with RESECO- and established GAU- Satellite Krushi Gosthi. Such a satellite based interactive system has a two-way dialogue system. The video and audio from teaching end in digitally transmitted to the class room/GAU centers. The return audio is available through STD lines. At present, 78 DRS (Direct Reception Station) to receive transmission are already established through out the state.

Such a system has given a quantum jump in transfer of technology and reaching to a large number of people. From the feedback received continuously from farmers and scientist in all corners, it is proving beyond doubt that "Cyber Extension is really successful" and will be a major tool of communication & technology transfer in the coming years.

Paper 2. Agricultural Research and Education – Improvement through Institutional Linkages

Dr.V.M.Pawar[1] and Dr. P.S.Borikar[2]
[1]Vice Chancellor, Marathwada Agricultural University, Parbhani
[2]Technical Officer to Vice Chancellor, Marathwada Agricultural University, Parbhani

Agricultural Education:

One of the major factors which has contributed to the rapid growth of agriculture in India is the integrated functioning of Teaching, Research and Extension. Agricultural Universities are complex institutions with responsibilities for education, research and extension education and with linkages to serve the society they serve. The progress of an Agricultural University is the result of an interaction between its teachers, students, researchers, farmers, administrators, leaders and politicians. For ameliorating the statutory of education research and extension, an ideal integration of teaching research and extension education is sine-qua-non (Fig.1).

An effective Agricultural University must have a number of functional linkages, linkages to organizations that supply inputs and take outputs. The high schools and Junior colleges that supply incoming students are functionally linked to the Agricultural University (Fig.2). There are a host of functional relationships through the outputs of the university, to organizations of several types through graduates of Under graduate and Post graduate programs and to State Government Department, and agricultural processing and marketing organizations, through research findings. The renovative linkages of an Agricultural University may be relationship to Central Government Research Institutions located within the State and to other research and educational institutions out side the Sate. There may also be Agricultural Colleges with interests closely allied to. If properly managed by the University Leadership, these institutions may serve in a complimentary way to the Agricultural University has many diffused linkages to individuals, informal groups to parents of present or prospective students, to farmers and businessmen, to teachers in primary and secondary schools while these linkages are diffused, they are not to be considered unimportant.

Integration is a social process. It is the creative invention of how the individual and organization come to terms with each other. Integration of triple functions (TRE) in Agricultural

Universities and research institutes and then with State Department of Agriculture and development is a Herculean task. The concept of division of labour, team work and co-ordination mechanisms are important ingredients of integration. Fusion process in which administrators have to deal with individual first and physical gadgets of the organization latter. An optional balance between individual and organization goals will lead to good division of labour, team work and co-ordination.

Agricultural University and Indian Council of Agricultural Research, Research Institutes have been working on integration of TRE. Integrated working and proper linkages in Agril. University/Institute demand integration within departments/disciplines and colleges, between departments and among departments as the case may be. Associate Dean & Principal of colleges are functionally and administratively linked with HODs on one hand and Director of Research, Dean, Director of Extension and Education on the other which in turn are responsible to the Vice-Chancellor of their respective functions (Fig.3). Linkages between universities/institutions and State Department of Agril. in respective States is extremely vital. Linkages at all levels will improve political will and highest levels of administration emphasize upon this basic organizational functional necessity.

Stronger linkage between TRE systems of ICAR and T and V and R and D systems of Union Ministry of Agriculture and Rural Development at Central level will improve linkages down the line. Linkages with allied Ministries and Departments including NGOs should be emphasized. This would mean management of complementary and supplementary roles of institute.

For functional relationship between and among concerned functionaries, institutions and departments following points should be considered.

1. Understanding concept of integration/linkage as a social process as applied to applied biological sciences has to be promoted among scientists. Initial as well as intermittent orientation and training programs are necessary in this direction.

2. Division of labour is at the root of the integrated working. Roles must defined, assigned and points of linkages explained.

3. Co-ordination, effective supervision and team work are processes for which scientists need/orientation.

4. For administration, following functional linkages are essential.

   - creating favorable atmosphere – appreciation of team work, encouraging joint ventures, reward for such efforts etc.
   - creating mutual respect, trust among staff and good human relationship – both formal and interactions would help.
   - balanced division of labour – role defined, distributed, appreciation of role.
   - effective forum for consultative – decision making, decentralized responsibility.
   - clear cut channels of communication both top-down as well as bottom up, the latter though vital is very difficult and often ignored by top authorities. Participation of rank and file, field staff, are specially important for feed back.
   - Planned and well designed programs, projects with understanding and basic need of integration.
   - Wherever feasible, dual responsibility may be promoted. Teaching and Research (TR) and Extension and Research (ER), Training and Extension (TE).
   - Occasional changes of responsibility or even positions-exchange of staff between universities and state departments of Agriculture will be useful.

5. Compulsory extension courses specially at PG level with emphasis on field work should be introduced. Reorientation of education program making them more subject matter oriented vis-à-vis social science orientation.

6. Mass media play crucial role in building institutional relationship-radio, TV, newspapers.

7. Already existing co-ordination committees be made to function regularly and well tuned to the ongoing programs and needs.

8. Both regional and national level interactions at least biennial for the national one will help in understanding process of implementation of program, limiting factors if any;

9. Co-ordination committed at national level for functional linkages, between R and E be healthy. Union Minister for Agriculture and RD Director, General Secretary, ICAR, such committees at State, and district and field level must function on similar lines. Linkages between these 4 levels would ensure needed follow-up.

10. Programming of R, E and screening messages/information for dissemination among farmers are important points of integration, there should always be joint efforts.

11. Feed back and constraint analysis should influence TRE programs making them more applied pragmatic and productive.

12. Complementary and supplementary role of allied institutions devoted to TRE must be appreciated and functional linkage between and among them will have synergistic and multiplier effects.

13. Historically extension profession came late vis-à-vis research and education and hence this area could not get the best of resources and talents. This is why TOT has always lagged behind. Now that of the
research findings accumulated, only 30% of them have gone to farmers. Government should divert added attention and resources to this selected area – TOT.

14. By and large, two categories of extension workers, extension professionals who are weak in subject matter and second subject matter specialist who are weak in extension. This group must be bridged by appropriate short and long duration training courses.

With globalization of agriculture, major emphasis is laid on increasing the productivity, improving quality standards of raw products, judicious use of production inputs, processing of farm produce, recycling of farm waste, value addition and marketing of products in international market. There is an urgent need to reorient and manage the agricultural research, education and extension systems to meet these new challenges.

Strategy of educating farmers envisages demonstration centers, farm planning, skill oriented training, special training, use of mass/electronic media, entrepreneurship development and market intelligence/information cell.

In recognizing the enormous potential of products, services and processes both in public and private sectors there is a need for building partnership between researchers in developing countries and to those in industrialized nations to harness scientific progress.

Agricultural Research:

Existing extension programs will have to be modified according to the needs and resources available. There is an increasing awareness about sustainable agriculture. We have to shift our priorities

from exploitative agriculture to organic farming which is in tune with the nature. Diversification in farming generates employment and additional income. The new research technologies need to be tested under actual farming situations with more emphasis on on-farm-research involving scientists and extension professionals. Indigenous technology which farmers have developed through experience and continuous practice should receive apt attention for remodeling. Effective feed back from field must be used by research and extension personnel in planning, developing and implementing different agricultural programs. For TOT all agencies, Central/State Governments or NGOs should work in close co-ordination (Fig.4). When research extension is stronger, the TOT becomes more effective. Participatory approach can play an important role in implementation of extension programmes. There is also a need to encourage farmer-to-farmer extension. It is also necessary to expose extension personnel to modern training methodologies to expedite TOT.

Agricultural Extension:

There is a growing realization that technology generation, dissemination and adoption cannot be taken up in isolation. Participatory approaches are bottom-up, people centred and demand driven compared with the top down, government centered supply-driven development of the past. Analyzing location specific problems through participatory rural appraisal are major consideration of current research and development programmes.

Linkage Priorities in Agricultural Education, Research and Extension:

Linkages could be between scientists and farmers (top) and between students and teachers or parents (bottom) for Agricultural Education as also between institution and policy makers (Central Government/State Government) to get the feed back from students and farmers for improvement in instruction program.

The Agril. Education is the primary function of SAUs which is in close link with institutions (Secondary high schools and primary schools in that order).

For research – Research stations, ICAR, SAU, other Agricultural Institutions, private research institutes are the main linkages. Input supply services like fertilizer, pesticide firms, seed producers may be vital to bring about the improvement. For good quality research, education or training is necessary to accommodate new technologies. Such linkages should be essentially creative or prominent and sustainable. Linkage is the creative exchange between the two institutions/individuals/persons/firms for mutual benefits, then only such interaction becomes sustainable.

In education, need for education will have to be specified looking to the infrastructure/resources available other wise it may lead to growing frustration among the students. Now students lacking agricultural background are flocking the gates of SAUs lowering the standards of agricultural graduates. The need for agricultural graduation in every discipline has to be assessed fully before admission.

Agricultural research and education should be tuned looking to the drawbacks or limitations and search for selection of proper linkage be made. Nowadays there is a direct rapport between farmers and scientists without any intervention by the extension agencies.

Transfer of technology acceptance by farmers is low because there is a gap between recommendation and adoption due to adoption gap developed between existing practices and recommendation.

Linkages between Agricultural Universities and Input suppliers or Industries:

Education merely for the sake of education is luxury which we can hardly afford. Traditional Universities, Agricultural Universities and Institutes of higher education have to work together with the industries determining the content and gamut of study.

We need to redesign our educational programmes and academic bodies of the higher agricultural education. System must struck a chord/balance in academic content of courses and help the youth infused with professional skills for self employment.

This necessarily implies close and intimate linkage between research in Universities in general and Agricultural Universities in specific and that in big industrial houses and concerns.

In CIS (Commonwealth of Independent States) educational institutions work in close and active collaboration with industry. This is very much feasible for Universities and Agricultural in India. Industry must be made to spend lavishly on research in Agricultural Universities from which they would directly benefit. Cross fertilization between Agricultural Universities and industrial organization is more than just desirable. It is also necessary to develop industry – oriented centers of excellence and to make it tenable.

Basic and applied research are related with each other. Basic research without applied dimension is theory without measurement and applied research without basic research is measurement without a theory. A sound judicious wed lock between the two is essential. Any agricultural research or education for that matter must be both light- giving and fruit – bearing. This perspective provides a rationale for forward and backward linkages between Agricultural Universities and the industry.

The University Grants Commission, DST, CSIR, ICAR support setting up of infrastructure in Universities and reach out to industries to be mutually helpful. Agricultural Universities have the young trained man power and facilities (libraries and laboratories) and the industries can give the requisite financial support for R and D activity that could be commercially useful.

The present status of efforts made by SAUs to strengthen linkages with industries is briefed hereunder.

1. Location relevance of research project to avoid duplication.
2. Advanced infrastructure facilities, exchange of planting material, product testing, training facilities are sought after by Agricultural Universities.

To strengthen the linkages following plan is necessary

a) Identification of priority areas and seeking help of other industries
b) Participation in extension programmes conducted by manufactures / input supply services
c) Organizing seminars and symposia on topics of practical significance.
d) Conducting sponsored trials on the University farms to test their products.
e) Offering technical consultancy service
f) Placing RAWE/ Internship / In plant training students with industries
g) Free exchange of researchers and faculty scientists
h) Staff students visits to firms
i) Establishment of liaison cell and advisory committee to streamline and coordinate interaction.

Measures for Strengthening Linkages :

1. Farmers' hostel
2. Farmers' fair
3. NARP
4. T & V system
5. Adaptive trials
6. Feed back

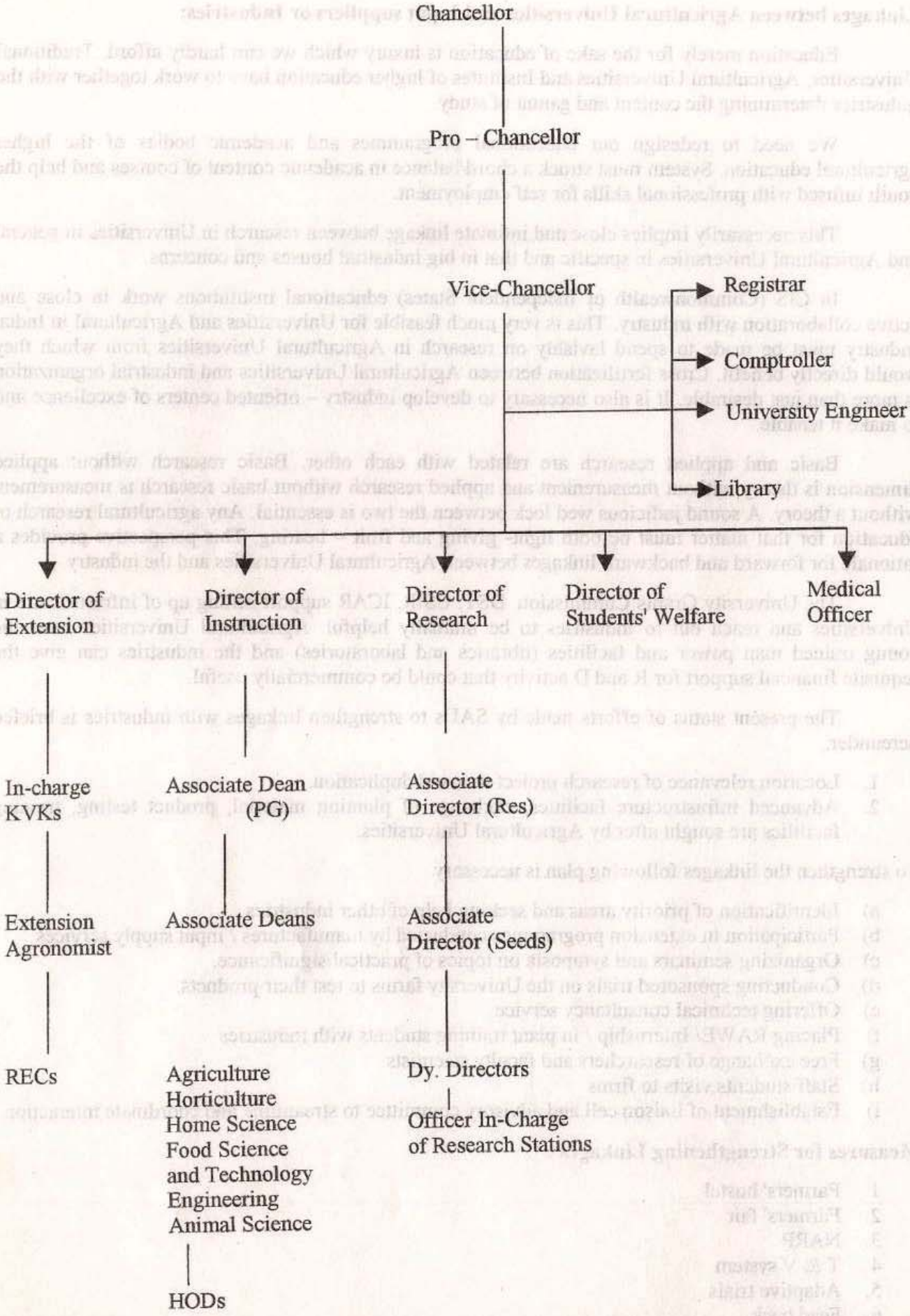
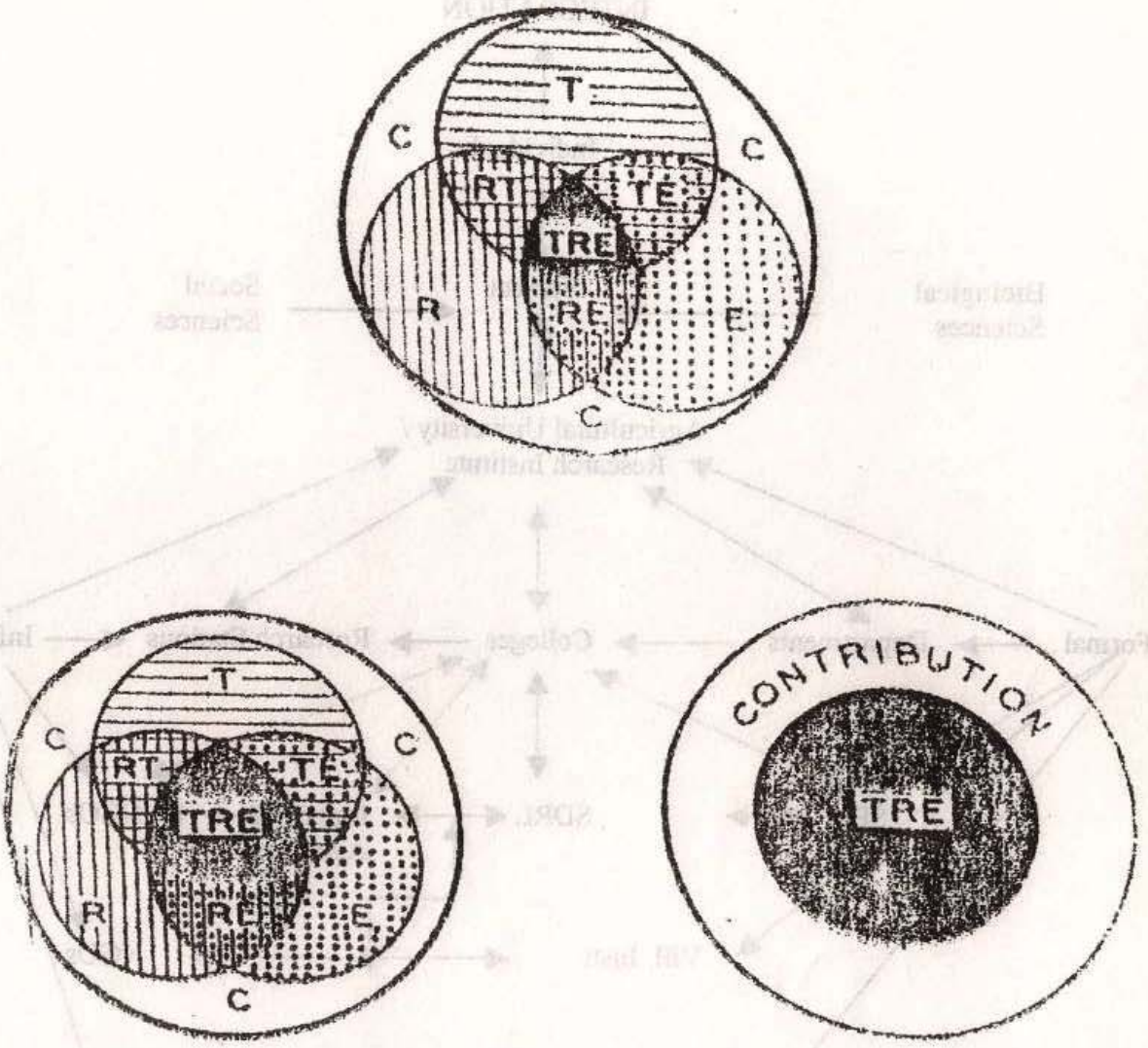


Fig. 1. Organizational structure of Marathwada Agricultural University, Parbhani



T - TEACHING
R - RESEARCH
E - EXTENSION
C - CONTRIBUTION
● - INTEGRATIO

Fig. 2. Teaching ⇌ Research ⇌ Extension
Interactions and Contribution

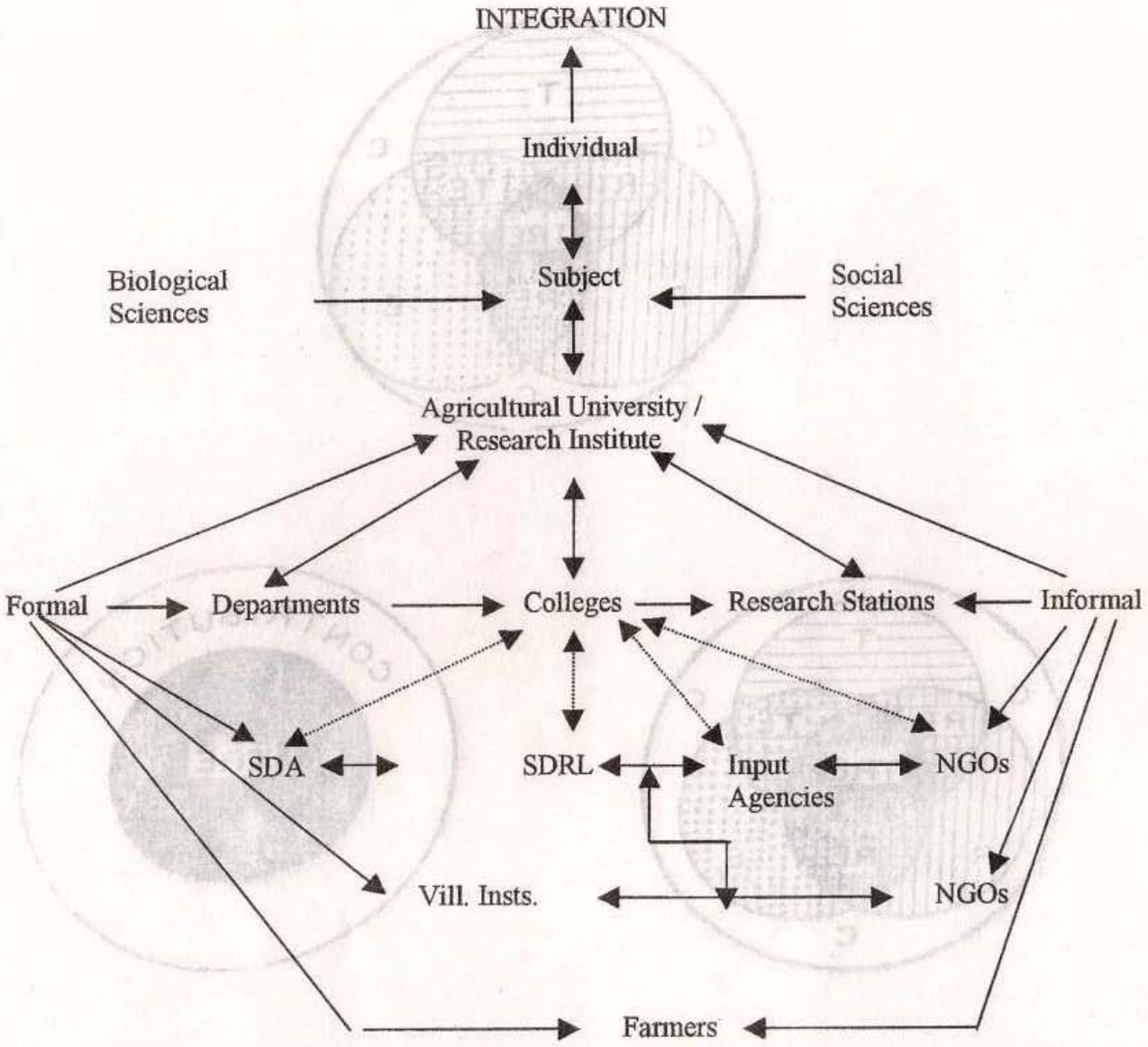


Fig. 3. Levels and Nature of integration between State Level Institutions

ISSUES EMANATED FROM DISCUSSIONS AFTER PRESENTATION OF PAPERS IN SESSION VII

- The Satellite based interactive system as established by GAU may be replicated by other SAUs to bridge the gap between information rich and information poor.
- Establishing National/ State Agricultural knowledge centre to provide information access to all the categories of farmers.
- Reorientation of Educational programme making them more subject matter oriented Vis-à-vis social science orientation
- Feed back and constraint analysis should influence the programmes of teaching, research and extension so as to make them more applied and productive.
- Appropriate training courses may be offered to add strength to extension professional in subject matter area and subject matter specialist in Extension Education.
- Traditional universities, Agricultural Universities and Institutes of Higher Education have to work together with industries in relevance to the appropriateness of the programmes.

Session VIII

The session was chaired by Dr. M.H. Mehta, Vice-chancellor, Gujarat Agricultural University, Banaskantha, Gujarat. Dr. C. Surendran, Director, Centre for Plant Breeding and Genetics, TNAU, Coimbatore and Dr. M. Muthusamy, Dean, Agrl. College and Res. Institute, TNAU, Killikulam acted as Rapporteurs. The following papers were presented :

1.	Improving the ASRB functioning	Dr. M. Mahadevappa, Chairman, ASRB, New Delhi. (Full paper not received)
2.	Problems relating to Agricultural Universities with regard to teaching and research	Dr. V.M.Pawar, Vice-Chancellor, MAU, Parbhani

Paper.2. Problems Relating to Agricultural Universities with regard to Teaching and Research

Dr. V.M. Pawar[1] and Dr. P.S Borikar[2]
[1]Vice – Chancellor, Marathwada Agricultural University, Parbhani
[2]Technical Officer to the Vice – Chancellor, MAU, Parbhani.

Agricultural education

Contents of agricultural science courses have to be developed and taught in such a way that students would be in a position to **relate learning with their environment**. Teachers will have to highlight this relationship so that what the students learn becomes meaningful to them.

Equipment and laboratory facilities for agricultural education which are at presently available on a limited scale in colleges and universities will have to be substantially augmented so that students would get adequate practice in agricultural science practical. Due to inadequacy of equipment in colleges and universities, practicals are done by students either in groups or are only demonstrated to them. Use of audio – visual aids has to be emphasized for effective agricultural teaching.

Opportunities will have to be provided to faculty members from colleges and universities to undergo **refresher courses** in the agricultural subjects as well as in educational technology, at least once in five years. This would help to keep them professionally up-to-date and to perform their job effectively.

Students and teachers are encouraged to participate in **agro-exhibitions**, which can be organized at different levels. This participation is expected to involve students and teachers in innovative scientific work and would help in fostering curiosity and creativity as well as in the understanding of agricultural subjects.

Students should be involved in **work experience practicals** in rural and urban communities which would enable them to relate what they have studied in their classes with the actual situations in these communities. These work experience courses should be carefully planned and conducted and should be assigned credits or marks in academic programmes.

The agricultural universities and colleges need to be **adequately funded** to elevate the standard of agricultural education, which should aim at dealing with the problems of the community. These institutions should have **extension wings** with adequate **infrastructure support** so that the findings of research carried out by the universities and colleges reach the communities speedily and effectively. Further, this would help these institutions to become aware of the needs of the

communities. An understanding of the **problems of the communities** and the technologies developed through research for solving these problems can provide very **useful content** for teaching programmes.

Social science education which is at present more of pedantic nature is required to be fostered by linking with the experiences of actual life situation at the college and university levels which would facilitate the student's perfect understanding of their social environment and their **adjustment** to it in a better way.

Linkages

There is considerable scope for **interaction** and co-ordination **between agricultural universities, research institutions and industry**. Non-agricultural universities and **research institutions** can undertake basic research which would be useful to agricultural universities and industry for pursuing their applied research programmes. **Coordinated research** can be undertaken by them in areas such as development and testing of agro-chemicals, tissue culture for large scale multiplication of quality planting material of crops, plant and animal breeding, water conservation, drought tolerance, biological control of pests, utilization of farm bye - products and farm wastes, microbiology, immunology, biotechnology, etc.

Technologies developed by universities and research institutions can be utilized by industry for manufacturing products on a commercial scale. Industry can pass on **technology problems** to these research centers for investigation and can increasingly look to them for assistance in solving its problems and obtain highly competitive and cost effective production technology. It should provide substantial **financial support** to the latter to undertake research for this purpose.

Agricultural Universities can organize **training programmes** for selected categories of personnel from industries whereas **students** from the universities can be attached to industries for practical training.

Industries have their own research division. They can collaborate in research programmes undertaken by research institutions and universities. Besides **providing funds** to these centers for undertaking need based research, industries can also provide scholarships/**fellowships** to research scholars of the universities.

Universities, research institutions and industries can share their sophisticated equipment as well as library and computer facilities.

Each university and research institution should develop close linkages with **extension agencies** so that technologies developed through research can be expeditiously communicated to the potential beneficiaries for use.

Consortium comprising representatives of universities, research institutions and industry need to be established to develop **inter – institutional linkages** as well as to plan and co-ordinate programmes of education, research and transfer of technology to be undertaken by them. A separate consortium may be established for each of these three functions.

ISSUES EMANATED FROM DISCUSSIONS AFTER PRESENTATION OF PAPERS IN SESSION VIII

Paper 1

1. For the post of Directors, accessing the candidate through interview may not yield good result and hence scrutinizing *biodata* followed by selection will be more appropriate.
2. NET examination in all the subjects may be conducted every year to facilitate the candidates to seek appointment in SAUs.
3. Quantification of the contributions made in the entry level may sometime mislead and hence the use of CGIAR system of selecting managers can be adopted.
4. Interviews to be conducted for the post of scientific cadre and managerial cadre may be different.
5. Brief summary of the appearing candidates, if circulated earlier, will help the committee members to assess the potential of the candidate rightly.

Paper 2

1. Emphasizing on more practical orientation to RAWE programme.
2. Substantially increasing the equipments and laboratory facilities for agricultural education.
3. Updating of knowledge of faculties by offering periodical trainings and refresher courses.
4. Evolving need based collaborative research programmes with private agro based industries
5. Emphasizing Intra- institutional linkages on education, research and extension.
6. Linkages with NGOs – students – farmers should be strengthened.

Session IX

The Ninth session was chaired by Dr.M.Yusuf Kamal, Vice-Chancellor, SKUAST(K), Jammu. Dr.S.Sadasivam, Director (CPMB), TNAU and Dr.T.M.Thiyagarajan, Director (SCMS), TNAU were the Rapporteurs.

The following paper was presented in the session.

a. Problems relating to education in the Agricultural Universities b. State Government funding and overcoming the sick financial position	Dr.S.R.Patil, Vice-Chancellor, UAS, Dharwad

Paper a. Problems relating to education in the Agricultural Universities

Dr.S.R.Patil,
Vice-Chancellor,
UAS, Dharwad

1. Common Entrance Test (CET) : The admissions to UG programmes in the SAUs should be done through a Common Entrance Test (CET) at State level as is being presently done in some SAUs. This ensures admission of quality students.
2. Updating the syllabus : The existing syllabi at both UG and PG levels include many outdated topics. Hence such topics may be replaced by those on issues of current and national / international importance as well as related to the requirements of stakeholders.
3. Specialization : Specialization at UG level as is presently being followed must be discouraged ; only Agriculture and Veterinary degrees may be retained. If not, atleast the first two years of course curriculum should be uniform across all the degree programmes, and should cover all practical aspects of agriculture/ animal science. Specialization should be slowly introduced 3rd year onwards. Extended specialization may exist at PG level.
4. Practical knowledge of students : Graduates at UG level are at present shy of acing farmers because of lack of confidence in the subject proper. This calls for investing more funds on practical aspects of farming and training of students rigorously on these aspects to make them "masters of general and practical aspects of agriculture" rather than "theoretical specialists".
5. Inbreeding : Normally a student should be discouraged from obtaining more than one degree from the same University. However, in any case, no student should be admitted for the third degree in the same University.
6. Dependence on public sector jobs : In view of the shrinking public sector intervention on the one hand and bulging graduate unemployed population on the other, graduates should be potential self – generators of employment, in the years to come. To build entrepreneurship in graduates, students should be extensively trained in all practical aspects not only of farming but also of related sectors like storage / preservation, processing, value addition, demand and supply potentials of different districts / states / nations, marketing/ price mechanism, agri – business management, international trade / WTO, information technology / agri – info supply (dotcoms), etc. The existing RAWE programme may be made of 6 months duration uniformly in all SAUs. Of these 6 months, one month may be spent in villages with farmers and the remaining period may be used for `placement training' on the above aspects in public / private organizations / industries/ NGOs.
7. Multiple campuses : Teaching programmes should be located in one or two campuses instead of multiple campuses in order to reduce the `overhead costs/ manpower'. Added advantages of such a proposition are : (a) better monitoring and (b) frequent and easy interaction among staff and students. Similarly, research stations which represent distinctly different agro – ecological systems / regions only should continue, while other stations (productive or otherwise) located in the same agro – ecological system / region may be phased out.

8. Research prioritization : In view of downsizing of public funding for research, the research programmes need immediate prioritization based on farmers' needs and extent of impact. Limited crops and thrust areas be mandated for research to be undertaken in a fixed time (say next 5 years). Research of routine type should be strongly discouraged.
9. Funding for research and extension : Funding for research and extension should be enhanced / strengthened for effective generation and transfer of technologies by the SAUs. In the field of transfer of technology (TOT), State Government may think of downsizing of its staff and transferring some of its responsibility to the NGOs and other socio – economic organizations.
10. Competency of staff : In order to posses competent teachers/ scientists, following measures may be taken : (a) NET should be made mandatory for selection to the post of Assistant Professor cadre : (b) Selections/ Promotions should be made strictly according to merit ; (c) Procedure for selection / promotion must involve `transparency' and `objectivity', and (d) Every teacher/ scientist may be provided with some opportunities for higher trainings/ studies /seminars / conferences /workshops (with full salary). ICAR may provide fixed annual grants under HRD component to SAUs to meet the salaries and other allowances of staff on such deputations; if not fully, atleast on an equal sharing basis between ICAR and Stage Government.
11. Development of skilled human resource for agriculture development :

Although 70% of the Indian population depends on agriculture. There is lack of skilled workers and technical staff working on field problems. Agriculture Universities can take advantage of their huge scientific human resource available and now engaged for teaching degree and post-graduate programmes by designing courses like ITI, 1 year / 2years / 3 years Diploma courses to generate middle level skilled workers to promote agriculture development. This has to become an integral component of the Agriculture University programmes of human resource development.

12) Creating employment opportunities to agriculture graduates in agricultural universities for promoting scientific agriculture to farming community.

With large number of Agricultural Universities and Colleges both in public and private sector, more than 10,000 under-graduates and more than 5,000 post – graduates are produced every year and most of these technically qualified graduates because of non-availability of jobs in the University and concerned line Departments are finding their ways in other services like IAS, KAS, IPS, Excise, Railway, Banks, KSRTC and unconcerned Departments. Although this is a very sorry state of affair; but Universities are not in a position to help them.

On the contrary, in the line Departments, because of non-appointment of technical graduates, the outdated staff is working in the transfer of technology whereas the updated graduates do not have jobs. To match the agriculture development in all the states and under different agro – climatic situations to promote scientific cultivation, processing and export technical graduates should dominate in the scene ; but they are invisible in the process. Therefore, Universities have to develop an *inter – alia* system so as to bridge the unemployed graduates with agro – based industries with 1-2 years contract working arrangement so that students will develop corporate culture and entrepreneurship to take the risk of starting their own business/ consultancy.

The second way in which the University can take the responsibility is in promoting seed production, IPM and other agricultural technologies, each University can employ its graduates through a contract programme and money to be collected as consultancy fee from farmers to pay their salaries. For example, (1) Grape consultants, (2) Pomegranate consultants (3) Mango consultants, (4) Sapota consultants, (5) Guava consultant, (6) Medicinal and Aromatic Plants consultants, (7) Sugarcane consultants (8) Chilli consultants (9) Cotton consultants (10) High value plantation crops consultants (11) Cotton IPM consultants, (12) Rice IPM consultants, (13) Groundnut IPM consultants, (14) Pigeon pea IPM consultants, (15) Water Management consultants, (16) Drip Irrigation specialist / consultants, (17) Protected cultivation consultants, (18) Watershed Management consultants (19) Agro Forestry

Consultants, (20) Fisheries consultants, (21) Dairy consultants and many more consultants as the case may be. To take up the work of consultancy, each Department can have a small Unit of training graduates for particular jobs as consultants with participatory approach with farmers, industrialists and companies interested in contract farming. This will go a long way in generating / creating employment for agricultural graduates under the guidance of experienced Scientists of the University.

The consultant when they become experts, they can wean away from the University programmes and start on their own. Therefore, Universities have to design programmes of consultancy on contract basis atleast for a period of 3 years for the graduates at a minimum salary ranging from Rs.3000 to 5000 per month. This single factor of putting agriculture graduates on the field through consultancy services will not only push the image of Agricultural Universities, but also will help the farming community in increasing the production and productivity and reducing the expenditure to a considerable extent. For example, UAS, Dharwad produces 250 agriculture graduates, out of which, more than 50% are entering post –graduation. Whether graduates or post – graduates at a time, the strength which comes out from UAS, Dharwad is 250 per annum. Taking each graduate's contract salary Rs.5000/- per month for 13 months for 250 comes to Rs.1,50,000,00 ; but even if a gradate monitors 1000 ha, the additional benefit through reduced cost of cultivation and increased income can be any way around 5000 per ha. which automatically takes care of their consultancy changes and a greater benefit to farming community and to the state and the nation.

I feel very confident that this type of service can be rendered only under the University system ; but not by the line Departments. Therefore, this item can be considered as a very important item of improving agricultural productivity and employing agricultural graduates for the benefit of farmers and the country. Similarly, this concept can be extended to other graduates viz., Veterinary, Agricultural Engineering, Forestry, Dairy, Home Science and Agricultural Marketing etc.

Paper b. State Government's funding to the Agricultural Universities to overcome sick financial position

1) Clearing of deficit : Many SAUs have deficits accumulated over years mainly due to cut in the allocated state budget towards the end of each financial year. To revitalize the SAUs in terms of financial soundness, a one-time *adhoc* grant should be given by the State Government once in a decade to each SAU to clear off its deficits. Further, as far as possible, State Governments should not make a last minute cut in the allocated budget.
2) Matching grants to income generated : SAUs may be encouraged to generate income from internal resources by way of providing matching grants by the State Government to the extent of income generated by the University, In this direction, SAU may think of (a) varied ways of income generation like, royalty on patents, sale of farm seeds/ produce / publications, consultancy, contract research, contractual services, etc. and (b) cost reduction by way of closing down unproductive farms/ stations, right sizing of staff strength, judicious traveling of staff, changing over to contract system of security and transport, project based budgeting, etc.
3) HRD Grants : State Government may provide fixed annual grants to SAUs to meet the salaries and other allowances of staff who are sent for higher trainings/ studies / seminars conferences / workshops, etc. ; if not fully, atleast on an equal sharing basis between State Government and ICAR (if agreeable to ICAR).
4) ICAR should provide special grants in the form as "Development of Teaching Programmes in State Agricultural Universities" and also one time catch up grant phased over a period of 5 years for infrastructure development.

ISSUES EMANATED FROM DISCUSSIONS AFTER PRESENTATION OF PAPER IN SESSION IX

Problems relating to education in the Agricultural Universities

- Admissions to UG programmes in SAUs should be done by a common entrance test.
- Updating of syllabus at UG and PG levels.
- Specialization at UG level as is presently being followed in some SAUs must be discouraged. Only Agriculture and veterinary degrees may be retained.
- Efforts required to strengthen the practical knowledge of students
- Inbreeding should be avoided
- Students should be given training on becoming potential self generator of employment.
- Teaching programmes should be located in one (or) two campuses to reduce the over head costs / man power
- Research agenda may be prioritised and effectively executed.
- Funding for research and extension should be strengthened for effective generation and Transfer of Technologies by SAUs

State Government's funding to the Agricultural University to over come sick financial position.

- One time *adhoc* grant should be given by State Government once in a decade to each SAU to clear off its deficits.
- SAUs may be encouraged to generate income from internal resources. Matching grants by the State Government may be given to SAU to the extent of income generated by the University.
- State Government should provide fixed annual grants to SAUs to meet the salaries and other allowances of staff.
- ICAR should provide special grants in the form as `Development of teaching programmes in SAUs' and also one time catch up grant phased over a period of 5 years for infrastructure development.

Session X

The session X was chaired by Dr.M.L.Madan, Vice-Chancellor, Panjab Rao Deshmukh Krishi Vidyapeeth, Krishi Nagar, Akola. Dr.V.V.Sreenarayanan, Dean, College of Agricultural Engineering, T.N.A.U., Coimbatore and Dr.K.Palanisami, Director, WTC, T.N.A.U., Coimbatore were the Rapporteurs. The following paper was presented.

1. Agricultural Human Resource Development – Some Emerging issues	Dr.A.M.Krishnappa, Vice-Chancellor, UAS, Bangalore

Paper 1. Agricultural Human Resource Development – Some emerging issues

Dr.A.M.Krishanappa
Vice-Chancellor
UAS, Bangalore

Education and Research

Of late, the outlook for agricultural education and research in India is under going a shift. System of agricultural education had more welfare content in the past, this is slowly being replaced by market orientation. This need to be viewed in the context that the contribution of agriculture to GDP is declining over years though the farm sector continue to provide lively hood for 65 per cent of the population. Thus the future agricultural education and research in the country need to have two pronged strategy. First, to ensure sustainable food and livelihood security. Second, to prepare Indian agriculture to take advantage of liberalized environment to reach pre-eminent position in the global agriculture trade.

It is time that the agricultural Universities need to shift their priorities from quantitative achievements. As a step towards quality improvement common entrance test for the students to be admitted for programs in agricultural universities may be introduced. This will help in attracting young talents as we well pave way for cross fertilization among various teaching campuses. Educational programs of the agricultural universities in the recent years have not been commensurate with the requirements of field situations. The universities are placing more emphasis on providing theoretical knowledge and less on technical skills, building up professional competency, self-confidence, managerial abilities, entrepreneurship etc., There is need to lay greater stress on practical field training to infuse confidence among the outgoing graduates. In this endeavor, reorientation of higher education to equip students to meet new challenges and advanced technological requirements of different sectors of the economy. A greater involvement of employers in the curriculum design is necessary to meet the challenges.

Apart from quality improvement to be brought in curricula, teaching methods to be sharpened to meet the mental challenges and needs of students. If one of the major goals of higher education is to train students in identifying practical problems and solving them effectively, the capacity of students to think critically and creatively needs to be developed. This demands that teaching – learning – evaluation procedures be continuously improved sensitizing the changing needs besides taking up human resource development on top priority for improving quality of education, research and extension.

The present system of agricultural education is multipurpose one that exposes to various spheres of agricultural development. The number of courses that are proposed for the degree program is too many. It is necessary to reorient the curricula keeping in view the emerging agricultural scenario. The newly emerging sub sector in agriculture need Professionals specially trained in the sectors. For example, food processing, post harvest processing & value added technologies of fruits, vegetable,

medicinal and aromatic plants, export of agricultural commodities non timber forest products, agribusiness management, information technology, IPM, Biotechnology, Application of remote sensing etc.,. The most important task of agricultural universities is to prepare farm graduates for self – employment. Greater emphasis should be given for introduction of commercial agricultural courses for self – employment. Simultaneously we need to develop entrepreneurship among agricultural graduates.

There is little emphasis in the present curricula on preparing our undergraduates for career in agriculture business outside government service. Private employers often have to invest significantly both for the induction and on-the –job training of young graduates in order to make good for the existing weakness of the educational system. There is need to strengthen student placement counseling. In this regard strengthening institutional linkages in the form of MOU need to be worked out with identified organizations (Public or Private) to ensure that students get exposed to latest art of the technology. In this endeavor post graduate research in agricultural universities should sharpened so as to make them more clientele and location specific.

Updating the competency of faculty is another important requirement where agricultural universities need to focus their attention. The present faculty improvement and staff orientation mechanism are very much insufficient. A dynamically growing system must update the managerial skills and competency of personnel. The long term and short term training on technical as well as managerial topics, training on teaching methods, refresher courses, provision for sabbatical leave, exchange of personnel between Universities/ Institutions/ Government organizations, agribusiness sectors are to be planned systematically. Creation of opportunities for consultancy services are essential inputs for human resource development. Adequate provisions for faculty participation in seminars workshops, etc. could be some of the measures required for faculty improvement.

One of the pre-requisites to turnout quality graduates from the universities good physical facilities many departments have outdated equipment's / instruments which will not enable the students to learn/ use latest technology in particular branch of science. Laboratories need to be re-furnished and equipped with the latest gadgets and instruments, which are used in laboratories of well – known organizations of the respective disciplines.

Financial Management

Norms adopted by State Governments while allocating resources to Agricultural Research and education has often become point of debate in most of the forums. As per the recommendations of the XVII meeting of ICAR regional committee no VIII, at the State level 15 per cent of the total budget of agriculture should be allocated for agricultural research and education as a vital support to SAUs. In this endeavors all the line / development departments should earmark some percentage of their budget to research activities and release to the SAUs. Presently Agriculture University is brought under the budget head of Agricultural department, and part of the agricultural department budget is being allocated to research and education. There are other departments like Animal Husbandry, Forestry, Sericulture, Cooperation, APMC and Rural Development which can also contribute some portion of theirs budget to research and education.

It is also necessary that the State Government to release plan / non-plan grants on time so that the programs can be implemented effectively.

During the successive Five – year Plans most of the SAUs have created new staff positions and filled under plan budget. As per the National Planning commission the expenditure on these staff positions have to be shifted under non – plan. Most of the State Governments have not considered transfer to expenditure from plan to non- plan. The staff positions created during seventh and eighth five – year plan still continues to be under plan head there by developmental activities under plan is affected due to due to inadequate funds. The matter of shifting some of the posts created in earlier Five year plans needs to be reviewed & discussed with State Governments atleast when tenth plan exercise is under taken so that more plan funds are available for developmental works.

Agricultural universities have to become more outward looking to meet the growing financial needs. They need to tap non-conventional financial sources to augment the receipts. The option the agricultural universities can exercise to tap resources is, through collaborative research with commercial organizations and providing consultancy service to private business firms. Universities have to initiate interactions and establish effective linkages with industries, private agencies and non-governmental organizations which are engaged directly or indirectly in supporting the development of education and research. There are four broad areas of concern where university-industry collaborative research arrangements can be considered; (i) Involvement of public & private industries and NGOs in commercialization of technologies developed (or in pipe line) by universities. (ii) Potential research areas which need funding for further testing before releasing technologies for commercialization (iii) mutual sharing of the research facilities for result oriented projects that would benefit the end users and (iv) provision of training and expert guidance to industries/private agencies/NGOs by university scientists.

Further Agricultural universities can attract more funds by encouraging the teachers to operate outside funded projects. In this regard it is necessary to create competitive sprit among scientists and improve the productivity of scientific manpower by instituting incentives and rewards.

In the wake of sever budgetary crunch being faced by State Agricultural Universities present, a proposal for "Mobilizing Local Financial Resources for Agricultural Education and Research in Karnataka" formulated by University of Agricultural Sciences deserves mention. According to this proposal, farmer who sell their produce in Regulated Market be required to pay 50 paise for every hundred rupees value of produce which they sell in this markets. This payment by the farmers may be called Agriculture Education and Research cess. Contribution of financial support by farmers through payment under proposed cess and the local participation in defining priorities for spending this money could usher in anew era of agricultural education and research.

Ways and means should be explored to increase the revenue generation from the resources of the university. The university farms can be made more productive by putting the non-research lands to commercial use like seed production/ Livestock production/ commercial crop production etc., Reducing expenditure is another area where agricultural universities need to concentrate upon. Reorganization of certain units, sections, departments in teaching, research, administrative wings of the university by identify redundant positions may help universities to judiciously use the available manpower and financial resources.

During the IX five-year plan ICAR Provided development grants only towards maintenance and to meet recurring costs and there was no provision to under take any fresh works. ICAR should consider to provide development grants to take up fresh works during tenth five year plan on a participatory basis from the point of view creating infrastructure crucial for the growth the agricultural universities.

Apart from developing technologies, the infrastructure available in the agricultural universities like, land, irrigation, plant & machinery and most important the scientific manpower can be utilized to produce quality seed/planting-material required by the farming community on a limited extent. Though the universities were taking up such activities, of late funds are not available for such production-oriented activities. State government may provide one time loan (revolving fund) repayable in five equal yearly installments from sixth year (as per ICAR guidelines) for supply of quality seeds and planting materials to the user agencies.

ISSUES EMANATED FROM DISCUSSIONS AFTER PRESENTATION OF PAPER IN SESSION X

- The occurrence of shifts noticed through the HRD efforts such as capability to compatibility, quantity to quality, professionalism to profitability, production to productivity etc.
- Setting of priority in Research and Extension
- Documenting manpower requirement
- Restructuring the curricula
- Introduction of commercial agricultural courses for self employment
- Strengthening Institutional linkages in the form of MOU with identified organizations.
- P.G. Research in SAUs should be made more clientele and location specific
- Re-christening the title and restructuring the content of B.Sc.(H.Sc.) programme offered in SAUs to make it more need based to serve the farming clientele.

Session XI

The Session XI was chaired by Prof. Dr.S.Kannaiyan, Vice-Chancellor, Tamil Nadu Agricultural University. Dr. V.Sundararaju, Registrar, TANUVAS, Tamil Nadu and Dr. M.Swamiappan, Registrar, TNAU were the Rapporteurs. The following papers were presented.

1. AHRD issues of SAUs	Dr.Agarwal, CCS HAU, Hisar, Haryana (Full paper not received)
2. Biotechnology in Animal Health and Production	Dr.M.P.Yadav Director, IVRI, Izatnagar

Paper 2. Biotechnology in Animal Health and Production

Prof. M.P. Yadav
Director
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Izatnagar –243 122

Preamble

Livestock sector, ever since independence , has been a recognized sector, among the few growth sectors in rural India. It has contributed significantly towards "Green Revolution" by providing draught power for agricultural operations, organic manure and quality nutrition for farming families. Employment output growth rate has been encouraging as a result of growing market for livestock and livestock products. Livestock sector generates massive employment opportunities, both directly and indirectly, particularly for the rural population with 18-35 years age group and provide work solely to about 9.8 million people and 8.6 million people in subsidiary status. The animal husbandry sector annually contributes about 8.5% of national GDP. It contributes over Rs.1,80,000 crores or nearly Rs.500 crores a day to national income. Contribution from livestock sector to national income is consistently increasing over the period of time through planned breeding, feeding and health management. While percent share of agriculture to national GDP declined from 34.7% in 1980-81 to 23.9% during 2000-01, the share of livestock in agricultural GDP increased from 18.63% to 30% during the same period. Foreign exchange beamed by the export of meat, wool, hides and skin, milk powder, butter, ghee etc is to the tune of Rs.3382 crores per annum.

Animal productivity is adversely affected by infectious diseases and inadequate supply of fodder and feed. While pasture area is less than 5% of the agricultural land, shortage of green fodder, fry fodder and concentrate is about 53%, 41%, and 80% respectively. In spite of the constraints, India is No.1 in milk production, 3rd in egg production and 15th in broiler production. Improvement in productivity is synergistically dependent on animal husbandry and needs to be supported by better healthcare and management. For the sustained livestock production, the various strategies include better livestock health management (disease forecasting, diagnosis, control and treatment), besides improved breeding methods, adequate supply of feed and fodder and improved farm managemental practices.

Strategies for Augmenting Animal Productivity

Various strategies for augmenting animal productivity will include the following:

1. Improving animal health by developing improved
   1.1 Diagnostic assays

1.2 Immuno-prophylactics including vaccines
1.3 Immunobiologicals
1.4 Disease control

2. Improved breeding methods/strategies
3. Animal feed/fodder and neutraceuticals
4. Improved farm managemental practices.
5. Quality control and ensuring safety of animal origin foods and other products

Role of newer biotechnologies will be very crucial in achieving these objectives.

1. Improving Animal Health

Animal diseases adversely affect the animal productivity. There is a need to reorient the animal health program so as to ensure the containment/eradication of the existing diseases and also to check the emerging diseases, in order to have an aggressive export growth-oriented policy. For controlling infectious diseases, it is essential to develop new-generation diagnostic assays, vaccines, immuno-biologicals, and drugs or other therapeutic strategies.

1.1 Development of improved disease diagnostic assays

Prevailing diagnostic methods are mostly conventional, time consuming, less sensitive and fail to clearly distinguish/differentiate between closely related diseases. Disease diagnosis is further complicated by importation of germplasm, unrestricted movement of livestock, emergence of new diseases and changes in manifestation of disease symptoms due to emergence of new variants. To facilitate quick and precise diagnosis there is a need to develop sensitive and cost-effective diagnostic kits. Sensitive diagnostic tests like ELISA, PCR, Nucleic acid Hybridization and DAN Fingerprinting need to be standardized for various important animal diseases. Use of mono-specific/monoclonal antibodies and recombinant antigens will result in the development of very sensitive diagnostic assays that can also be used for molecular epidemiological studies. Several of such state-of-the-art tests might have been developed and suitable new generation immuno-biologicals might exist but the impact of these developments will not be felt unless they mare used at field level wherever appropriate. Disease Diagnostic Labs need to be strengthened with personnel trained in modern immunological/ molecular diagnostic assays and developing suitable infrastructure facilities required for carrying out modern diagnosis.

Accurate disease diagnosis and prophylaxis play important role in improving the sustainable animal productivity, international trade of animals/animal products, control of zoonosis and eradication of infectious diseases. Therefore, there is a need for developing improved diagnostic assays that will result in timely detection and application of control strategies against infectious diseases. Conventional diagnostics are effective and reasonably specific but often slow and expensive. At times, pathogenic organisms either do not grow well or can not be cultivated at all making it difficult to produce large amount of antigen or antibodies required in conventional assays. False negative results pose another problem that may arise after conventional assays. Diagnosis in the absence of the organism is erroneous while detection of the presence of the organism results in unequivocal diagnosis.

An ideal diagnostic test should involve minimal number of operations and rely, whenever possible, on pre-made devices. Such assays should also be rapid, specific, inexpensive, simple and easy to perform. To make the tests viable at field level, it is essential that they are cost-effective and simple to perform. The following elements will result in reduction of the overall cost of the diagnostic tests:

- Reduction in tissue or fluid sample volumes
- High intake capacity for samples
- Reduction in contamination
- Increased use through automation

The automation will ultimately result in the development of easy-to-perform assays employing user-friendly computer interface.

1.1.1 Classification of diagnostic assays

Diagnostic assays fall under mainly two categories viz. immunological assays or DNA – based assays. Details classification of various assays is as under.

A. Immunological assays

- Serological assays like AGPT using recombinant antigens or Mabs
- Radio – immuno assays (RIA)
- Immunofluorescent assays (IFA) using monospecific /monoclonal antibodies
- Enzyme linked immunosomrment assay (ELISA) – (many variants)
- Fluorescence activated cell – sorting (FACS) analysis.

B. DNA-based assays

- Nucleic acid hybridization (Southern/Northern/dot/slot -blot).
- Polymerize chain reaction (PCR)
- Nucleic acid sequencing
- DNA Fingerprinting
- DNA chips

1.1.2 Steps in micro-diagnosis leading to the development of DNA chips

In the recent past, significant developments have taken place in the area of diagnostic biology. We now have diagnostic assays that require micro-quantities of reagents and wherein various steps are performed under automation. For automation, it is essential that the reagents are used in micro-quantities. This allows savings in terms of money and also time because small reaction volumes can be handled quickly which is ultimately the idea behind micro-diagnosis. Elements that will reduce the cost pf a diagnostic assays are:

i) Sample Preparation

Miniaturization results in small sample volume requirement

ii) Sample Reaction

Miniaturization of reaction chamber results in faster reaction using nl-to-J.11 volumes of sample

iii) Separation

Less time for separation More efficient separation

iii) Detection

Less sample volume necessary for measurement

Combination of the above micro-systems in one micro-fabricated device creates a single Micro-Total Analysis System (μTAS).

1.1.3 Bio-electronic chips

Bio-electronic chips (also known as DNA chips Micro-chips) are the best examples of miniature diagnostic devises that constitute micro-total analysis system. Bio-electronic chips are micro-miniature analytical devices that constitute the trail blazing miniature "POINT -OF-CARE" diagnostic system. These will not, in the main, be DNA- based tests but a miniaturized lab protocol for fully automated immuno-assay, cell count or PCR on a tiny chip. These "LAB-on-a-CHIP" devices permit diagnostic testing at the POINT -OF-CARE i.e. Doctor's Office or Outpatients clinic. Such assays reduce the time for diagnosis that, in turn, saves time of the Doctor as well as patient and also avoids unnecessary medication. There are a number of micro-chips in the market.

1.1.4 Micro-chips in the market

i) Five-min. Diabetes test: This detects glucose calorimetrically while glycated hemoglobin by affinity chromatography. The whole test takes only five minutes giving diagnosis of diabetes immediately.
ii) Two-min., 4-part hematology test: using this chip, complete blood count, hemoglobin, haematocrit and white cell count values can be obtained in 2 minutes.
iii) Detection of multiple mutations
iv) Transcriptional profiling
v) Sequencing-by-Hybridization
vi) Detection of polymorphism
vii) Nucleic acid scanning-by-hybridization (NASBH)

The above chip-based diagnosis has already been commercialized and similar . chips are needed in veterinary field.

1.1.5 Applications of DNA chip technology

Main applications of DNA chip technology include various chemical or enzymatic reactions including PCR amplification, electrophoresis and detection of microbes. A few of the applications are described as under:

- Chemical/enzymatic reactions like ligase chain reaction (LCR) and polymerase chain reaction (PCR).
- Direct amplification of human genomic DNA from lymphocytes introduced directly into the micro-chambers. Same principle and instrument can be used for animal genomic DNA amplification.
- Capillary electrophoretic separation of antisense oligonucleotides and restricted DNA fragments results in the fastest analysis of the products.
- Detection of microorganisms in disease diagnosis, guaranteeing the safety of food and water supply and encouraging public safety from the threat of biological warfare agents

1.2 Development of New-Generation Vaccines

The need to develop vaccines against annually recurring acute, chronic-active bacterial, viral, fungal and parasitic diseases is one of the most important global objectives of the vaccinologists. A large number of vaccines are already available which have helped in controlling several diseases. Tissue culture rinderpest vaccine has helped the country to reach to a status of eradicating rinderpest from India. There are several vaccines which need improvements over the existing ones or even there may be need for developing altogether new vaccines. Various approaches of vaccine development need to be adopted to meet the demand for new generation vaccines in the livestock sector.

1.2.1 Why need a new vaccine?

- Not all infectious agents can be grown in culture
- Vaccine production requires animal cell culture system which is expensive.
- Risk of adventitious organisms through cell culture derived vaccines.
- Extensive safety precautions required with killed or attenuated vaccines.
- Reversion of virulence where attenuated agents are used as vaccine.
- Complicated disease syndromes like AIDS are not preventable by conventional vaccines
- Shelf-life of the existing vaccines is shorter. Newer vaccines with long shelf-life need to be developed.

1.2.2 Types of vaccines

i) Conventional vaccines
ii) Improvement of existing vaccines by

- Search for newer strains
- Use of Immunomodulators
- Automation of production facilities
- Good Manufacturing Practices (GMPs)
- Effective quality control

ii) Anti-idiotype vaccines useful in situations when

- Antigenic material not easily obtained
- Either the target molecule or the organism itself is only weakly antigenic
- Dangerous or difficult to culture a pathogen
- A specific determinant of a pathogen need not be targeted for neutralization
- Antigen is not a defined protein

iii) Sub-unit/Peptide vaccine

- Vaccine delivery is important

iv) Live recombinant vaccines

- Attenuated/deletion vaccines
- Vector vaccines

v) Gene/Minigene vaccines (DNA vaccines)

Sub-unit vaccine and no risk of disease spread.

vi) Combined vaccines (Mass vaccination)
vii) Edible vaccines (Mass vaccination)
viii) Chimeric vaccines

Simultaneous cloning of immuno-stimulatory genes like cytokine genes results in immunomodulation which will be useful and beneficial.

1.2 Immunobiologicals

1.2.1 Recombinant Antigens

Recombinant protein antigens expressed in either prokaryotic (E. coli) or eukaryotic expression system (Baculovirus system) have been very useful in developing diagnostic tests

specifically for diseases like African horse sickness (AHS), equine infectious anemia (EIA), bluetongue, rinderpest, pest des petits ruminants and foot-and- mouth disease. Recombinant antigen-based diagnostic assays for diseases that have been eradicated or for exotic diseases are the best bet. Recombinant antigen-based diagnostic assays will also be required for epidemiological studies or even for diagnosis of diseases where a large of serotypes, like bluetongue, are responsible for disease.

1.2.2 Mono-specific serum

Recombinant antigens can be used to develop mono-specific serum that can be used as type-specific or strain-specific antibodies for developing specific serological assays.

1.2.3 Monoclonal Antibodies

Monoclonal antibody (MAb)-based assays like immunofluorescent assay (IFA), immunoperoxidase (IPT), enzyme-linked immunosorbent assay (ELISA) and radioimmuno assay (RIA) have been developed for various diseases. Monoclonal antibody-based assays are also useful for studying molecular epidemiology of bacterial and viral agents. MAb-based assays have been developed and used against many diseases like rinderpest (RP), pest des petits ruminants (PPR), foot-and-mouth disease (FMD) and Salmonella enteritidis. MAb-based ELISA using monoclonal antibodies against bovine IFNγ has been commercialized for detection of tuberculosis in animals.

1.3 Disease Control

Effective animal health care is available since "Vedic Period" but status of veterinary hospitals in India is still deplorable and needs improvement. For effective disease control, the urgent need is to:

i) Strengthen & modernize the Hospitals with

a) Veterinary & Para-veterinary Personnel trained in handling newer diagnostic assays
b) Medicines including immuno-modulators
c) Adequate supply of vaccines
d) New generation Diagnostics

ii) Establishment of "Specialty Veterinary Polyclinics" and Mobile Veterinary Dispensaries

iii) Revival of "Ethno-Veterinary practices and medicines" because they will be cost- effective and easily accessible in remote areas.

Currently used vaccines have been effective in control and containment of the major livestock and poultry diseases but because of the changing ecosystem, new diseases or variant strains are emerging which warrant development of new generation immunodiagnostics and prophylactics.

2. Improved Breeding Methods

2.1 Biodiversity Conservation

The biological diversity has been recognized as a vital resource on which the present as well as future of the mankind depends. It is imperative that all kinds of biological diversity should be judiciously conserved and utilized in a sustainable manner for the well-being of humanity. Conservation of specific animal breeds and their natural habitat will be the key to sustainable animal productivity.

2.2 Assisted reproduction technologies

2.2.1 Frozen semen and Artificial Insemination

Semen preservation and artificial insemination (AI) have been perfected by now and used extensively in cross-breeding programme over the years. The frozen semen biotechnology and A.I. are currently among the various strategies adopted for genetic improvement of livestock. Frozen semen and A.I. have also been recognized as suitable techniques for faster multiplication of dwindling population including rare wild animals where semen collection is very difficult. Till the newer reproductive technologies like nuclear transfer/cloning, inter-species transfer are perfected, A.I. will play vital role in conservation biotechnology.

2.2.2 Sperm-sexing

The newer technologies like "Sperm sexing" developed recently (Anon, 2001) will aid in artificial insemination (A.I.) for achieving the faster multiplication of animals with pre-determined sex. Female calves, whose sex was determined before conception, have been borne in Switzerland. The Big X AG (Bern, Switzerland) used sperm-sexing techniques developed by XY Inc. (Fort Collins, CQ, USA) to produce 11 female calves. XY made the technology available to Big X under a research agreement. The technique is also being used in United Kingdom. The new technique, which used sexed sperm and artificial insemination, could transform the dairy industry worldwide. Sexed sperm is derived from semen that has been separated into sperm carries female-producing X chromosomes or male-producing y chromosomes. The sorting procedure does not involve any genetic modification. Use of sexed sperm has several advantages. Female calves are smaller than male calves at birth which makes first-time calving easier than male calves at birth, first-time calving easier for a 2-year old heifer approaching delivery of her first calf and, the technology facilitates herd replacement and genetic improvement. This technique has a success rate of over 90%. Until now, if farmers wanted to replace 30% of their herd each year, then 60% of cows had to be pregnant for the sole purpose of replacing and updating the herd quality. It's very inefficient system.

2.2.3 Embryo transfer and associated techniques

Embryo transfer (ET) is a very powerful technology for fast multiplication and increasing the productivity of animals. Exploitation of female reproductive capacity of valuable donors can be made by super -ovulating donors, and subsequent transfer after fertilization into recipients even though certain factors are limiting super-ovulation response in animals. Significant facilitation of import and export of valuable material, development of new breeding concepts, gene conservation by freezing techniques, twin production, introduction of new genes into co-closed herds, manipulation of embryos and transgenic animals have become possible through embryo transfer. E. T. has till now been exploited only for increasing the productivity. The embryo transfer technologies have, by now, been perfected and should be fully exploited for conservation programs.

2.2.4 Cryo-preservation of gametes and embryos

Advantage of cryo-preservation of embryos instead of just the sperm or oocyte is that the embryo contains the complete genome i.e. the quota of chromosomes for the individual, and it can then be transferred to a foster mother, of known or unknown genetic background without the risk of genetic change. Cryo-preservation of embryos enables animal breeding centres to carry a wider range of stocks and to store stocks not in immediate use, thereby saving space and money as well as affording protection against loss through fire, disease and other hazards. Inbred strains, mutations and special genetic combinations can be preserved which will form a valuable asset for posterity. The specimens from threatened/endangered animal species should immediately be preserved before they are lost forever.

2.2.5 Cloning

Cloning offers a way to preserve and propagate endangered species that reproduce poorly in Zoos or their natural habitats until their habitats can be restored and can be reintroduced in the wild. Cloning's main power, however, that it allows researches/conservationists to introduce old genes back into the gene pool of a species that has few remaining animals. Most Zoos are not equipped to collect and cryopreserve semen; similarly, eggs are difficult to obtain and are damaged by freezing. But by cloning animals whose body cells have been preserved, scientists can keep the genes of that individual alive, maintaining (and in some instances increasing) the overall genetic diversity of endangered populations of that species.

2.2.1 Why cloning?

The techniques of cloning allow use of cryo-preserved tissues/cells. Such cryo- preserved body cells are maintained as banks, by AICRES and San Diego Zoo's Centre for Reproduction of Endangered species, that could be used for cloning. Some critics claim that the practice could overshadow efforts to preserve habitat. Lanza et al. (2000) counter that while habitat preservation is keystone of species conservation, some . countries are too poor or too unstable to support sustainable conservation efforts. Further, the continued growth of human species will probably make it impossible to save enough habitats for some other species. Cloning by interspecies nuclear transfer offers the possibility of keeping the genetic stock of those species on hand without maintaining populations in captivity, which is difficult owing to habitat degradation and is a particularly costly enterprise in the case of large animals.

2.3 Breeding for Disease Resistance

Breeding of animals for disease resistance utilizing indigenous animal breeds recognized to have tolerance to diseases will go a long way in controlling the diseases which will help in increasing the dwindling animal population as well as animal productivity. India has a number of animal breeds, which have been thriving under harsh climatic conditions and represent valuable genetic resource for breeding for disease resistance.

3. Animal Feed/Fodder and Neutraceuticals

Adequate supply of nutrients is one of the pre-requisites for optimal expression of genetic and production potential of the animals, since feeds and fodder constitute a major input in livestock rearing. Unfortunately, livestock industry is facing quantitative and qualitative depletion and insufficiency of feed resources to the extent of 263 mt of dry fodder, 188 mt of green fodder and 37 mt of concentrates. Thus, balancing the feed supply and demand is a major challenge for the growth of Indian livestock industry.

Feed conversion efficiency of indigenous breeds is lower. This can be improved by rumen micro-manipulation, improving nutritive value of non-conventional feed/fodder by removal of tannins from oil cakes, fodder tree leaves, lignin degradation in lingo- cellulosic feeds and using probiotics. Ensuring microbial safety of feed supplements for diseases like bovine spongiform encephalopathy (BSE). Selection of suitable bacterial strains for use as probiotics and as source of single cell proteins (SCPs) has great potential. Cloning of cellulase gene in rumen microflora will result in better utilization of cellulosic and lignocellulosic fodder. Production of feed and fodders having nutritional medicinal value (Neutraceuticals) are the latest trends in nutritional medicine. Producing designer (transgenic) crops for therapeutic traits like amino acid deficiency correction, cloning of β-carotene and iron genes in crops are the latest approaches in improving animal nutrition.

4. MANAGEMENTAL PRACTICES

Computerization for creating information database on animal population, various breeds of animals and their natural habitat and farm animal inventory as well as production and disease data. This will help in devising the various modem farm managemental practices and standards. Data on disease and production will help in devising selection strategies.

5. Quality-Control and Ensuring Safety of Animal Origin Foods and Other Products

Liberalization and globalization of economic policies worldwide have posed many challenges. Domestic and export market for livestock and livestock products has expanded tremendously. Production and promotion of high standard quality products will be key to success. There is need to improve Good Manufacturing Practices (GMPs), study and utilize concept of Hazard Analysis and Critical Control Points (HACCP) and ISO certification to ensure International Standards. Indian Food Industry is to gear up to world-class hygiene and quality standards. Policy for control of contamination, spoilage and integrity of the products needs to be framed.

In view of the liberalization and globalization of economic policy by Government of India and the consequent global market potential for Indian livestock products in the post-GA TT/WTO scenario, the role of biotechnologists and other animal scientists becomes all the more important. International food laws, which are now in force, are responsible for the emphasis on quality and safety of foods. The laws are Sanitary and Phyto-sanitary Measures (SPS) and Technical Barriers to Trade (TBT); both these laws have been signed under the WTO regime. It is now imperative that national food laws are in tune with the international reference organizations, namely Codex Alimentarius Communication (CAC), Office International des Epizooties (OIE) and International Plant Protection Council (IPPC). The Codex recognizes only a HACCP-based approach to enhance food safety . By implementing HACCP based programs in conjunction with ISO 9002, a safety program and quality management system get integrated and merged into one.

Standards in food processing and food safety assume great importance. The infectious diseases of livestock adversely affect the export market potential of livestock products. There is need to reorient the animal health programs to as to ensure the containment/ eradication of the existing diseases and also to check the emerging diseases, in order to have an aggressive export growth-oriented policy-Standards need to be set for ensuring microbial safety of animal origin foods against existing as well as emerging animal diseases.

Priorities for the Millennium

To achieve the targets of complete animal health coverage and self-sufficiency in food, the priorities will have to be kept in mind while deciding animal health and production strategies:

(A) Animal Health

- Healthcare to maximum animal population
- Veterinary care awareness programs to farmers
- Information database on animal diseases
- Production of new generation immuno-diagnostics and immuno-prophylactics
- Improvement of existing vaccines
- Production of new generation vaccines
- Gene defect correction
- Field-based Diagnostic kits for rapid disease identification
- Production of new generation immuno-biologicals (e.g. Recombinant antigens, MAbs etc.)
- Improved Drug/vaccine delivery and targeting (Oral, Ocular and other mucosal routes) .
- Human Resource Development and Continuing Education in Veterinary Sciences

B Animal Production .

- Information database on Animal biodiversity
- Genetic Conservation is priority
- Intensify the efforts for identification of hotspots for species which are threatened/ endangered and select a herd of animal having enough number of animals to have a sustainable breeding plan.
- Preserve gametes and embryos followed by breeding these animals in their habitat (in situ) to increase the existing number employing assisted reproductive technologies.
- Intensify research to have breed signatures (DNA markers) employing molecular genetic tools like DNA fingerprinting and genome scanning.
- Establish "Frozen Genetic Banks" for storage of gametes/embryos, tissues, cell lines and cDNA libraries
- Breeding of animals for specific traits like disease tolerance/resistance . Database on Feeds and fodder available in the country
- Basic immuno-biotechnological studies leading to applied aspects of animal health

Conclusion

Livestock production, in a broader sense today, is a primary industry that is important from the point of national food security, national health and national economy. I There is a greater need to strengthen infrastructure and human resource to be globally competitive and orient agricultural education to encourage entrepreneurship. This new millennium will be technology driven and agricultural human resource, with new knowledge and skills in latest livestock production technologies, will be a prime need in order to meet the challenges of new millennium. Needless, therefore to stress that for sustained long-term effects education and training, particularly of youth, will occupy prime place. Major strides in all-round development in agriculture and animal fanning systems are possible through active involvement of enterprising rural youth, and they will be attracted only if it becomes intellectually satisfying and economically rewarding. The latest technologies like rDNA technology will have greater role to play in future agricultural operations and, therefore, dissemination of modem scientific knowledge and practice to fanners should be prime objective in order to harness the optimal benefits of technology advancements.

It is heartening to note that the contribution of livestock sector to the GDP was 1137.7 billion rupees during 1998-1999 and it has been recorded that the output has been increasing consistently over the period of time. However, there is no room for complacency, as there are many challenges to face. Therefore, there is a need to review the present feed and production management, livestock health and breeding services and programs to achieve the production potential of our livestock and the future growth demand utilizing newer biotechnologies in all the sectors of animal health and production wherever possible. Animal biodiversity conservation, in terms of conservation of indigenous animal breeds, needs immediate attention for sustainable animal production and reproductive biotechnologies will be of great help in this endeavor infrastructure development like setting up of the state-of-the-art hospitals, and slaughter houses, facilities for collection, storage and rapid transport of livestock byproducts and policy for credit, marketing and processing will help in commercialization of livestock products. In view of the emerging challenges and - opportunities, the aim of the scientists as well as farmers should be to ensure that livestock production system remains eco-friendly, contributes positively to biodiversity conservation and is sustainable in the long run .

ISSUES EMANATED FROM DISCUSSIONS AFTER PRESENTATION OF PAPERS IN SESSION XI

Paper 1

- Funds from ICAR should be released without waiting for Audit Utilization Certificate so as to carry out the project without any delay.
- Transfer policy and promotional policy must be rationalized so as to improve the efficiency of the system.
- ICAR grant to SAUs must be enhanced.

Paper 2

- Various approaches of vaccine formulations need to be developed to meet the demand for new generation vaccines in the live stock sector.
- Conservation of specific animal breeds and their natural habitat will be the key to sustainable animal productivity.
- Reorientation of animal health programmes, so as to ensure the eradication of existing and emerging diseases to have an aggressive export growth oriented policy.
- Standards need to be set for ensuring microbial safety of animal origin foods against existing as well as emerging animal diseases.

Recommendations of the 26th Convention of Indian Agricultural Universities Association held on 23 & 24 October 2001 in Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu

The Vice-Chancellors from various State Agricultural Universities, Deans and Directors participated. During the deliberations, the following recommendations emerged.

1. As State Agricultural Universities are facing financial crisis, adequate financial support may be provided by the State Government concerned to the SAUs as per the mandate established. Also the ICAR may provide the funding support through enhanced sanction of catch up grant/Development grant.
2. Third generation Universities are suffering from financial crisis. Hence, they may be supported by ICAR at least in the frontier areas so as to equip men and materials in such universities.
3. ICAR should make it mandatory for the private KVKs funded by ICAR to have effective linkages with SAUs.
4. The Institutes established by Government of India, ICAR and other PSUs located nearby SAUs should establish functional linkages for which MOUs may be drawn. For this ICAR can take a lead and suggest modalities.
5. Any reorientation of the policy/research programmes should have the objective of improving income entitlement of the majority of the farmers namely, small and marginal farmers particularly in the WTO era.
6. It is high time to invest more on Horticulture and non food crops since more employment generation and export advantage are observed in this sector.
7. The research focus may be on evolving suitable technologies for those crops that have both comparative and competitive advantage.
8. Future agricultural research programme must focus on reduction in cost of production of agricultural commodities so as to make them competitive.
9. Feed back from farmers must be taken into account for making transfer of technology more effective. In this regard, service Institutions like input, finance and marketing may be involved in transfer of technology.
10. Increased allocation for extension by SAUs will yield higher dividends as it is found that only 2 percent of the total out lay of the budget is allocated by SAUs for extension.
11. A task force comprising of identified Vice-Chancellors of the SAUs of the region may be formed and they may apprise to the different State Governments for the funding support needed by the SAU in the State concerned.
12. The TANWA kind of innovative model implemented in Tamil Nadu benefiting specific women clientele group can be replicated for other areas and states.
13. Mountain Universities Forum needs to be created for making in-depth analysis of mountain Agriculture and to prepare a suitable action plan to overcome the problems.

PAPERS RECEIVED FOR THE CONVENTION BUT NOT PRESENTED

Paper 1. Addressing financial constraints of State Agricultural Universities

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The financial constraint being faced at present in the management of State Agricultural Universities due to continued and increasing budgetary cut from the funding sources is not unexpected. SAUs have started seriously to find ways and means of creating their own sustainable financial strength to reduce dependence on Government sources of funding. While increasing students' fees could be considered as one of the sources in the traditional Universities since a large number of colleges with high intake including affiliated colleges come under them, the Agricultural Universities cannot expect much from this source since the number of colleges and students strength in each college are limited. An attempt is made here to identify the ways and means of mobilizing financial resources through various channels.

1. STUDENTS FEES AND OTHER COLLECTIONS:

The fees fixed in the past for various activities like registration, tuition, tours, reading room, sports, certificates etc. have not been increased for a long time. It is necessary to revise them on some rational basis taking students into confidence. Further the rent for the rooms in hostels, guest houses and land etc, are also to be enhanced from the present level. Fine and penalty can also be increased which will not only help in terms of receipts, but also cause for reducing malpractice besides bringing discipline in the student community. Further, certain percentage of the seats both in UG & PG programmes can be fixed on payment category applicants. There is very heavy rush particularly for veterinary programme followed by Agriculture and Horticulture programmes where some additional quota can be thought of in order not to deny the quota otherwise fixed to various categories.

2. RATIONALIZING THE VALUE AND NUMBER OF SCHOLARSHIPS:

The number of scholarships provided at present to the students by the university is not on any definite basis. Hence, there is scope to rationalize the number of looking to the need of the year or particular subject/area where in the human resource development is important and need based. Giving a fixed number of scholarships is likely to lead to providing scholarships to those who may not otherwise aspire for it or need it. This number should be altered periodically based on need in terms of human resource.

3. REDUCING THE NUMBER OF MEETINGS AND TRANSFERS:

There are many official committees and councils meeting more often than necessary based more on tradition and precedents rather than on need. There are also statutory as well as non-statutory subcommittees formed by the Board, meeting frequently to predacious and make easy discussion in the regular Board meetings. The meetings of sub-committees can be reduced in number and also combined with the Board meetings by having them 1 or 2 days earlier or later so that the expenditure under TA/DA can be reduced. Transfers of employees can be minimized.

4. SHARING THE COMMON FACILITIES:

The Universities are well equipped with central facilities like Guest Houses Auditoriums, Seminar Halls, Hostels etc, although all of them may not have all the facilities. Many private sector activities like seminars, research workshops, training etc. are herald in Hotels paying a very high rent.

The University can offer these facilities to the private companies at a reasonable rent which will benefit both institutions and the rent amount so collected can be used in maintaining and upgrading both the central facilities and developing such facilities campuses of the University. The TNAU has shown god lend this way.

5. LINKAGE WITH AGRO-BASED INDUSTRIES

Most of the Industries whether large or small scale invariably depend on agriculture for their raw material Industries engaged in processing of agricultural and horticultural products, Seed Industries, Industries based on commercial crops (0) Sugarcane, Cotton, Oilseeds, Maize, Chilly, etc.) have definite requirement both in terms of quality and quantity for their efficient performance. There are many facilities in the universities both for research and training of the staff of Industries and providing these facilities to industries on cost basis should generate some income for University to further develop in terms of infrastructure, laboratories and training facilities both in main and sub-campuses. Therefore, having close tie-up with industries and sharing facilities would help financially in a big way to benefit both Universities and industries.

6. FARM INCOME

All the Research Stations have their own farms for conducting research to take up seed production as well as for bulk production of fruit/grain/fodder etc. Replacing production of grain or low value with quality seed and high value planting materials and products would enhance the income of the farms besides attracting more and more of farmer clients and helping quick and effective transfer of technology. The other allied activities like dairy, fisheries, vermiculture, mushroom production culture, sericulture, apiary, horticultural planting materials and offering consultancy service can substantially increase the income of the farms. What is needed for such activities are scientific planning, creation of irrigation and storage facilities and identifying crops/products that have stability of demand Creditability earned in this direction over a period can further enhance income of the farm. The farm manager, if necessary, should have confidence to even avail bank loan for such purposes and clear off the loan as planned. Further, holding krishimela on all the farms involving all input agencies, local farmers and line departments with these resources at the state and district levels would atleast curtail expenditure being made at present by the University on krishimela, if not earn profit by charging for participation by input agencies and agriculture related commercial companies. The krishimelas of UAS, Dharwad campus are being held on this model gaining substantial support to build facilities needed for Krishimelas in better way and creating more amenities for the visit of farmers and training them free of cost, even on sub-campuses of the University.

7. SALE OF PUBLICATIONS/CASSETTES ETC

With the globalization of agriculture, there is no alternative but to go for scientific and precision agriculture, Modern technologies suitable with Agro Eco-system need to be practiced in to, if the benefit of new technology is to be fully realized. Print and electronic media play a major role in communicating the technological advancement. The publications can be brochures, filers etc., to small and marginal farmers to high cost publications connected with high value and export oriented agriculture to those who are in need of such information and packages so also audio and video cassettes. Conducting training programmes in these areas can be either free or on charge basis, again depending on the scope of technologies and the extend of benefit they are going to realize from such programmes. The UAS Dharwad has started operating the scheme the signs of success are very visible.

8. RESTRUCTURING OF TEACHING, RESEARCH AND EXTENSION DEPARTMENTS

Restructuring of college departments and research stations with optimum staff pattern taking into consideration changes like the changes in educational system, specialized degree programmes, adoption of multi-media facility and transfer of technology etc., with right size the departments of the

colleges, research stations and extension education units in the University. Initiating collaborative programmes with conventional Universities and the national institutes of ICAR, CSIR, ICMR staff strength can be reduced and some departments can even be abolished by having system of exchange of teachers, or hiring teachers from neighboring institutes on reciprocal or on contract, wherever teaching load is low. Basic science and Humanities subjects in professional colleges (Agriculture, Horticulture, Veterinary, Forestry etc.) and applied science subjects in science, Arts and commence colleges offer enormous scope for this kind of arrangements. So also sharing of costly facilities like equipments, field facilities etc. As a matter of fact, even the facilities of the private companies like the world class facilities available with the Indo-American hybrids in Bangalore and with MAHYCO in Jalna (Aurangabad district, Maharashtra state) can also be thought of with definite terms and memorandum of understanding.

There are more than one or two campuses within the same University offering degree/PG. Programmes in the same subjects as in UAS, Dharwad and TNAU. It is possible to identify strong departments and abolish PG programmes in such departments where they are weak, at the same time strengthening the faculty at the other identified campuses. Again the glamour for degree programmes like Agricultural Marketing, Sericulture, Forestry, Home Science, Agricultural Engineering fading and there are no takers in a comfortable number. Such colleges if are more than one in a state (each University in the State having one college) they can be closed or some of them converted to Veterinary colleges, since there is dearth of trained manpower both at UG and PG level in this area. Payment quota will also work in this programme since there are many takers even among NRIs.

9. OFFERING CONSULTANCY:

The technologies in the field of agriculture and allied sciences are being developed and practiced remuneratively, some among them benefiting big farmers and companies. Consultancy and selling certain products including genotypes can be a source of income to the University. Hybrid and high yield varieties developed by the university can also be offered to the private companies on the basis of royalty. The scientists who are equipped to take up revolving fund projects involving transfer of new technologies can be encouraged by giving incentives as is already offered by the ICAR with certain percentage of net profit given to them. Certain amount of money can be earmarked for this kind of activity as and when the demand comes.

10. ATTRACTING ADS:

Many farmers treat the research stations as temples and visit regularly for buying seeds and different kinds of planting material, ii) getting agriculture based information iii) soil and plant analysis, iv) identifying and diagnosis of field problems like nutritional disorders diseases caused by virus, bacteria, fungus and damages caused by insects, non-insects and so on. In campuses where large number of farmers visit and also where farms are situated adjacent to highways, the suitable spots can be offered for advertisement particularly by the input and other agencies related to agricultural production. For this purpose, suitable and attractive locations are to be identified by experts and in consultation with the users and offered on charge basis. This however, should not sacrifice aesthetic sense and research teaching priority.

11. TRAINING PROGRAMMES:

Universities have senior faculty members and technologists in various disciplines who can be drafted for conducting short, medium and long term trainings to benefit technical staff of public organizations, private companies and also big farmers who venture high tech farming land also beginners in farming. The areas of interest are to be identified in consultation with the users for training their staff and programme designed accordingly. Each trainee or batch of trainees can be charged training fee with a Reasonable margin of profit. There could also be training programmes for small and marginal farmers free cost Experts can be invited from other institutions if necessary.

12. OTHER SOURCES

- There is also scope to raise support from Government bodies and elected representatives of the people. For instance, there is a clause in the APMC Act that the APMC can support the Agricultural research and development activities of the Universities on the recommendation of the local bodies and with the permission of the Government. This has not been fully utilized so far, although a beginning has been made here and there at Dharwad, Raichur, Bidar and Hagari. There are many APMCs at taluk and district level comfortable and willing to support sound projects relating to production of quality products. Support to the extent of Ninety lakh has been utilized during the last three years in the jurisdiction of UAS, Dharwad. The agricultural produce going to the market suffers for want of quality in terms of uniformity, storability etc., and projects with specific objectives can be funded and also facilities for harvest and post-harvest operations can be built through this kind of support.

- Further the M.P.'s fund given to Lok Sabha and Rajya Sabha Members is yet another source for building up of infrastructure, research and extension particularly, training activities. While Lok Sabha Member have jurisdiction of their constituency for using their constitution for lending support, the Rajya Sabha Members have wider jurisdiction of UAS, Dharwad in the last two years. The Zila Parishads/ZPs) are yet another source for activities of the above kind specially on the rural technology application and trainings.

- There are many State and Central Government schemes where the ZP and University can work as partners and make use of the Government support for such activities one such being watershed Management under the Rural Developed Ministry. Support to the tune of Rs.2.5 crores is received from Swarna Jayanthi Rojgar Yojana from the Rural Development and Panchayath Raj Ministry, Government of Karnataka for developing infra-structural facilities.

- Commodity and other boards like Silk Board, Coconut Board, Coffee Board, Spice Board etc., could also earmark some budget for research and development and they can be harnessed for respective crop development programmes. Sugar factories, rice mills and spinning mills cab also be partners with the Universities in promoting research and development activities for mutual benefit. Banks like, NABARD and Grameena Banks too can be approached with specific projects and for soft loans. Finally, there is no reason why University should not take loan from the Bank for demonstrating and popularizing on Pilot scales particularly such technologies as having quick adoptability with high margin of profit preparing vitae revolving fund projects High quality. Planting material can be produced and sold with such loans.

- Universities should also develop self revenue generating system through:
  a) Upgrading farm benefits through precision agriculture, recycling O.M., removing pilferages etc.
  b) Launch scheme, on payment bases expensive training for entrance test.
  c) Advisory/ Placement cells to guide/furnish information on payment to the final year (outgoing) and other needy students.
  d) To look for the possibilities for opening campuses/centers in African and Gulf countries on the same lines as the advance countries are doing/ planning in developing countries.
  e) Cost oriented short term training programme for project formulation and project writing guidance to attract funds for research, teaching and extension activities in the university.
  f) Training on a cost to a group of geneticists who need help for patent writing and processing on the technology/material developed at the university.

There may be many more ways to contributing to this exercise, hence it is realized that the means suggested here are not exhaustive but may be helpful to some extent in meeting the present crises and simultaneously improving the efficiency.

Paper 2. Agricultural education and research – Linkages with industries and institutions

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With the starting of agricultural universities in India at the beginning of sixties, a close integration of teaching, research and extension was brought-in in India. Now, there are 34 agricultural universities offering undergraduate programmes in 11 subjects and about 95 subjects in PG programmes, and in about 50 Ph.D. programmes in various subjects through about 200 colleges located in different parts of the country. Annually, about 10,000 students are admitted for undergraduate programmes and about 5000 for postgraduate programmes in these universities are also carrying out the research and extension activities in order to cater to the needs of regional farming community.

These agricultural universities in India have contributed significantly in developing human resource and increasing food productivity and production. With the commencement of these universities, there has been a tremendous improvement in agricultural production which is increased from about 60 million tones, to more than 200 million tones which is quite adequate for internal consumption and also for export.

In future, the universities will have to carry out the research in complex areas to further increase the productivity and production. For this, the universities require a lot of financial support, which is likely to be very difficult. At the same time, all agricultural universities particularly in developing country like ours depend almost entirely on Government for sustenance. However, nature, form and operations of universities have to change in response to changes in Global economy if they are to be sustained and continue to be relevant to the development of national economy. Thus, a need to form partnerships with business, industry, institutions and society has become crucial now than at any other time in the history of our country. The partnership between industry, institutions and business organizations and the universities is necessary for the development of common funds, goals and objectives as well as for the shared responsibilities and accountability.

Agricultural Universities in India have traditionally dependent on respective State governments and the Indian Council of Agricultural Research for funding their research, teaching and extension activities. In the present days, the Government feels that it is more difficult to finance State Agricultural Universities because their priorities are oriented more towards social objectives and the growing economic sectors. Thus, the universities are now called upon to develop their own resources for funding research and education. Since the opportunities for mobilizing internal resources are very limited, the universities will have to be looked up for collaborating with the industry both in public and private sector for the mutual benefit of providing the industry with R & D, and obtaining the resources from the industry. Since the universities have well trained and well equipped human resources, the industries need not invest on these items exclusively for the results there by the industry can minimize the cost of R & D while universities can develop resource base where in they will be able to take up research in the larger interest of the society.

Currently, Biotechnology, Crop Improvement, Integrated Plant Protection, Integrated Nutrient Management and Business Management are the important fields where the university industry interface can exist. The cost of establishing Biotechnology laboratories with human resources is quite huge and individual entrepreneurs can not afford to invest money on equipment and laboratories equally in this type of research. The universities on the other hand are well equipped for the development of both

manpower and laboratories which are readily available for conducting and multiplication of needed technologies. Students with rich experience in the areas can get into those for employment in the industries with which the universities collaborate. Similarly, research in seed production and process technology is one area in agriculture where ample scope exists since everyday both from the private and public sector industries release large number of varieties/hybrids due to research activities. The testing of these technologies cause for investment in land, human resources and other agricultural inputs which are also time consuming but also requiring land for multiple locations. The industries find it difficult to search for individual partners at each location because they will have to deal with multiple clients whose objectives may be at different compared with that of the industries itself. The agricultural universities with wide network of research stations, teaching campuses and extension wings are best suited for the industry to try out their technologies on the multiple locations of the agricultural universities, the benefits are that they have to deal with only one establishment whose objectives are in synerge with those of the industry itself. Another important field in agriculture where the industry/university need to face can work profitably for both is in the area of plant protection, where again the industry needs research results need to be carried out at multiple locations and in multiple seasons for which universities are best suited since they have both physical and human resources to attain these objectives.

In the course of such a collaboration there is need to be convergent with business orientation by the university administration. University needs to be benefited by collaboration with the industry rather than vice-versa. Now, the universities must wake up to the fact that they assist or help the business wing and they should be made equal partners for the benefits such as funds. Hence while taking up research on a collaborative basis with the industry, they should be very clear that the benefits of this research must bring in profitable dividends to the university in the form of either testing fees or consultancy charges to the scientists. While entering into MOU with the industries things have to be made clear that it is the industry which is going to be more benefited by collaboration rather than the university and the memorandum must be prepared on purely commercial lines. There is also a need on the part of a collaborating industry to absorb at least some percentage of research students in their organizations for furthering their activities. Though the idea of collaboration with the industry is not a new concept, its orientation towards business certainly is. Hence, the administrators in the universities must train and orient themselves with a lot of business active men to be able to deal with the industry in the process of collaboration.

This would help to exploit the infrastructure facilities and the human resources available with both the organizations to meet the requirement of higher level of postgraduate and other infrastructure facilities to solve the problems of the farmers and to produce more both for internal consumption and export purpose. This would also provide an opportunity for the placement of graduates in different organizations working with the university on partnership basis. This kind of partnership becomes inevitable in future days. If the universities will have to make further progress in education and research, and to meet the aspirations of the public.

Paper 3. Problems Relating to Education in the University with Regard to Teaching and Research Concerning Students and Staff

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Agriculture is of paramount importance in a rural oriented country like India where 70% population is either directly or indirectly is dependent upon agriculture for livelihood. In India reference of agricultural practices is found as early as in Vedas. Agricultural science used to be an important subject in the universities at Nalanda and Takshshila. Systematic study of agricultural sciences at the global level was taken up in the 19th century after facing several famines such as Irish famine in Europe. In India organized courses in agriculture started in the beginning of 20th century when six Agricultural Colleges were established at Kanpur, Lyalpur, Coimbatore and Nagpur in 1905, at Pune in 1907 and at Sabour in 1908. Thereafter several agricultural colleges were opened in different parts of the country. After the great Bengal famine of 1942 and independence of the country in 1947, the Govt. of India started an extensive planning process to feed the increasing population of the country. The study teams constituted in 1955, 1959 and 1960 resulted in the establishment of first State Agricultural University (SAU) of the country in 1960 at Pantnagar. Thereafter during 1960s and 1970s one or more SAUs were established in the 17 major states of the country. At present there are 30 SAUs in the country out of which three are specialized universities i.e. two in Veterinary, Animal Sciences and Fisheries at Tamil Nadu and West Bengal and one in Horticulture and Forestry at Solan. In addition there is a Central Agricultural University at Imphal and four of the ICAR Institutes i.e. IARI, New Delhi; IVRI, Izatnagar; NDRI, Karnal and CIFE, Mumbai are deemed universities. Three Central Universities i.e. Banaras Hindu University, Varanasi, Aligarh Muslsim University, Aligarh and Vishva Bharti at Shanti Niketan also have strong agricultural faculty involved in research, teaching and extension programmes. One of the IITs i.e. Kharagpur also offers programme in Agriculture Engineering. Thus the country today has established a strong network of agricultural education offering 11 UG programmes i.e. Agriculture , Agricultural Engineering, Veterinary Sciences, Horticulture, Forestry, Home Science, Diary Technology, Fisheries, Sericulture, Agriculture Marketing and Cooperation and Food Technology and more than 90 postgraduate programmes. The strong foundation of teaching research and extension programmes in agriculture during 1960s and 1970s led to green revolution and self sufficiency and buffer stock in food which is unprecedented in world. However, the intensive and extensive agricultural practices followed during the last quarter of 20th century for the success of green, yellow and white revolution did not go without fall back. Depletion of soil fertility, environmental pollution, poor water management are some of the examples.

Importance of rural women in agriculture and introduction of newer agriculture and home science courses at middle and high school level and modification of UG level

Women are the important segment of Indian population who contribute significantly higher for agriculture production. According to a report they are the producer of food (65% in Asia0 in terms of value, volume and hours of work and are therefore an economic asset in agricultural families. Adult women in villages are not just housewives but in fact farmers and they work equally on agriculture land at home. Obviously, they play a major role in decision making regarding various agricultural practices and home activities. In spite of these facts rural female literacy is markedly lower in most parts of the country. Only Kerala stands as a unique example of high literacy in women and proved how women can contribute for household welfare at micro –level and overall economic growth at macro – level.

It will be rather late if we don not realize at the earliest that educating village women facilities easy access to knowledge and various methods of family planning helping her to determined family size. Imparting skill to women in agriculture and related activities are therefore important not only to

improve their efficiency in productivity activities but also to enhance the earning capacity. In addition to college education in agriculture it will give dividend if agriculture as a subject in introduced at the middle level specially in the village schools for skilled development of women who are already in work force. In addition short term specialized trainings for skilled development of women should also be introduced in village. Mahila programme for training of village women in mushroom production technology in Haryana is an important exampled and this was helpful in enhancing the mushroom production for commercial purpose or for family consumption. Modernization of agriculture may not move faster unless women depending on agriculture are more skilled and their management capacities expanded. It is now time to modify the course curricula in home science so as to cater to the needs of rural requirements. Teaching agriculture and home science to village women at middle and high school level respectively will inculcate the importance of the strength of knowledge in agriculture. This will lead to greater mobilization of rural girls to the home science and agriculture graduate programme in SAUs. Further to it the programme in home science should be more rural oriented and of three years. These measures will reverse the admission scenario of students specially in home science. Currently the rush in tree year home science programme in some of the established colleges in bigger cities are primarily because of their urban orientation. Farm women spend their time on production oriented work besides nurturing family members. Hence women are likely to engage themselves in land based income generating operations, therefore women need commercial orientation in their skills. Some of the areas where imparting training to women will better motivate further revolution in agriculture are:

1. Women must be exposed to latest knowledge in crop and animal husbandry, post harvest technology and agricultural marketing.
2. As there is better scope for export of agricultural commodities, training of national and international standards, packing and utilization of agricultural wastes and byproducts will be of much use for developing entrepreneurial skills of women.
3. Knowledge of value added agril. Products to fetch better income are also to be taught so as to effectively utilize the excess produce.
4. Awareness on welfare and development programme for women and right of women.
5. Women need greater access to information in socio economic development knowledge in agricultural business management.

With these measures once the women labour force in agriculture is fully equipped to take up the responsibility of agriculture based industry in each village, the male forces may be deployed towards industrial or some other growth.

Modification of courses in Agriculture:

In the high agricultural produce states like Punjab, Haryana, Tamil Nadu, Maharashtra etc. the concept of farming is shifting from survival and growth to value added agriculture. Agro based food industry has therefore assumed greater significance. Today food in India is Rs. 250, 000 crore industry. By 2005, it will grow to 480,000 crore and during this period value added food will grow from 80,000 crore to 225,000 crore. This pace of growth is likely to have strong benefit to the economy both in terms income and employment. Food Industry has a very high multiplier effect (2.4) which is greater than that of power and telecom sectors. This will provide major opportunities in high growth, mass based, high volume markets such as processed milk (Rs. 36,000 crore), poultry (27000 crore), packed atta (15000 crore) and bakery (10000 crore) in addition to small scale ventures like mushroom production, bee-keeping, fruit processing, dairy, fisheries etc. Therefore there are tremendous opportunities for small entrepreneurs and for self-employment in this sector. It is, therefore, imperative that for the second revolution there has to be need based re-orientation of the course curricula and programmes in agriculture, strong university – corporate interface leading to better equipped graduates for corporate and self employment.

Academic Standard

The first task is to improve the academic standard which ahs deteriorated due to faulty admission procedure, faulty recruitment of teachers, liberal and mass promotion, incomplete coverage of courses, inbreeding in admissions of students and recruitment of teachers inadequate facilities for class room teaching and laboratories, poor attention to practical and almost no attention to personality and communication development of students.

1. As a prerequisite there should obviously be no political interference at least in the academic and recruitment matters of the university. While recruiting teachers assigning teaching job pedagogical skills and loud thinking must be examined.
2. Entrance should be through rigorousness entrance test and at least 25% of the seats should be filled through open national completion. Recruitment should be through All India Advertisement strictly on merit and well defined selection procedure.
3. Only Ph. Ds. With publications in refereed journals should be recruited at the level of Asstt. Professor.
4. Minimum facilities for practical in each subject at graduate and postgraduate level should be identified and provided.
5. Recruitment of teachers in specialized areas to teach PG courses.
6. In view of the fast changing scenario and advancement in science and technology and thrust on Biodiversity, Biotechnology, Compute application, Agriculture information technology, Bioclimatology, Agrometerology, Remote sensing, Post harvest technology, Liberalization n export and import of commodities, Agri-business management, Environment, Agro-forestry, Integrated pest management, Embryo transfer technology.
   Use of plastics in agriculture, Watershed management, Integrated nutrient management, Organic farming etc. updating of curricula both at UG and PG levels is a continuous need for the next two decades.
7. Ten point scale for grading should be adopted at national level.

Internal evaluation

We have successfully tried internal evaluation on the pattern of American Universities, in several universities in India before the spirit of this system was undermined by dilution of rules. A review of problems faced led to the introduction of external evaluation component in UG programme. This system has to be tried in the coming years to evaluate its effectivity. Further strengthening of the academic standard and generation of advance technology depends on strong M.Sc. and Ph.D programmes. It is, therefore, suggested that the minimum OGPA for entrance to M.Sc. should be 3.2/4.00 and to Ph.D. 3.5/4.00. Programme related to M.Sc. and PH.D. are not merely an extension of UG programme but it is an advanced research oriented educational programme. It is therefore essential that the curricula be developed and designed in such a manner that it provides latest advances. Post graduate performance form a very vital parameter of the total research programme of any institution of higher education. In the recent years it has been observed that quality of the research work, presentation and interpretation of data have deteriorated to great extent. There is no qualitative and quantative evaluation therefore, the level of rejection of thesis has been negligent. It is therefore advisable that :

1. Strengthening of the advisory committee system should be done at the earliest.
2. There should be continuous monitoring and evaluation of the progress made by the students.
3. Introduction of grading of thesis and viva – voce examinations.
4. In the clinical and para clinical disciplines of veterinary sciences, the programmes should be reoriented by reducing theory and making it compulsory to do their thesis work on clinical cases.

Autonomy and Accountability

The functioning of SAUs is not autonomous in letter spirit. Since the major fund resources in SAUs come from the government therefore, it is required that the SAUs justify the investment made on it in the form of reporting its achievements and lapses including submission of audited report to the government. SAUs require academic autonomy, administrative autonomy and financial autonomy. The should have freedom in laying out admission criteria, developing academic programme, framing curricula and methods of teaching, facilities required for teaching, eligibility criteria and procedure for selection of teachers and conductance of entrance examination without any interference of the government.

The grants to the universities should be released in one lot instead of releasing in instalments and universities should have complete freedom to utilize the grant and submit account to the funding agency. Water and power supply to the university should either be subsidized or provided on the domestic rate.

SAUs should also appreciate that autonomy and accountability are two wheels of the same cart. Therefore, peformance of the universities enjoying full autonomy should be evaluated after five years to make them accountable academically, administratively and financially.

Centre of Academic Excellence

Depending upon the requirement one or two centers in each subject should be recognized as centers of excellence in each subjects at the national level and provided all facilities. It should be mandatory for such centers to organize regular refresher courses for the teachers and research scientists.

There should be at least one advanced instrumentation center in each state to cater to the highly specialized research and teaching needs of the faculty and students.

Vocational trainings:

SAUs can play vital role in promoting vocational education aimed at self-employment or employment generating programmes. These include:

1. Vocational training porgramme in advanced agriculture for farmers including women farmers.
2. Skill up gradation of graduates by reorienting the existing curricula.
3. Training in development programmes for rural entrepreneurs that may lead graduates of SAUs to opt for types of self – employment a) Self-employment on the farm and b) Self-employment as entrepreneur either relating to agricultural inputs or in the area of post harvest and food processing.

Traditional agriculture in India is gradually evolving in well developed agro business with strong linkages among agricultural inputs processing and agro based industries which result in the whole – sale and retail trade. As a result of this there is a greater need for vocational education training at different levels in poultry, bee-keeping, dairy, mushroom cultivation, piggery, fisheries, production of biocontrol agents, vegetable and fruit growing, seed production, nursery of ornamental plants, safe use and storage of agricultural chemicals, post harvest technology and packing and storage, value added agricultural products, agricultural information technology, agricultural impalements and custom hiring units.

These training programme should focus to develop healthy attitude among the graduates/ farmers/ rural youth towards dignity of work. Further the emphasis should be on development of skills like formulation, record keeping, procurement, marketing, finance etc. In addition there should be a strong agriculture information technology net work available on computer.

One year money generating diploma courses should be initiated in:

1. Seed production technology
2. Food processing
3. Post harvest technology packing and storage
4. Meat product technology
5. Pet caring and health

Accreditation Board

Accreditation Board established in 1996 with D.G, ICAR, as Chairman, DDG as Vice-Chancellor and three Vice-Chancellors of SAUs, two eminent Agricultural/ Animal Scientists, two eminent individuals representing agriculture / industry, Secretaries of University Grant Commission, All India Council for Technical Education and Veterinary Council of India, one Director from ICAR deemed University as members and ADG (Accreditation) as Secretary of the Board should be replaced by an autonomous Accreditation Board with statutory power.

The report of the Expert Committee on Agricultural Education outside agriculture university system and recommendations made therein should be implemented at the earliest.

All the SAUs should have 10% of the total budget as operational fund distributed in each department for smooth day to day functioning.

Conclusion

There is an urgent need to reorient our course curricula towards better equipping our graduates in personality building, communication skill which is more suitable to the pursuits of corporate sector and develop entrepreneurial skills for self reliance. In addition minimum facilities should be identified and provided to strengthen practicals. Courses should be continuously updated to the needs of the modern advancement and initiation of job oriented vocational training and introduction of money generating diploma courses and advanced trainings.

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