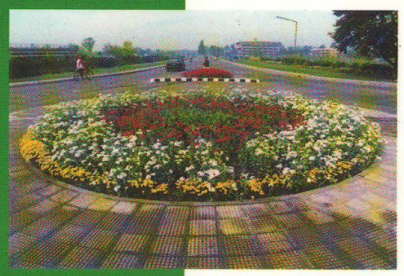
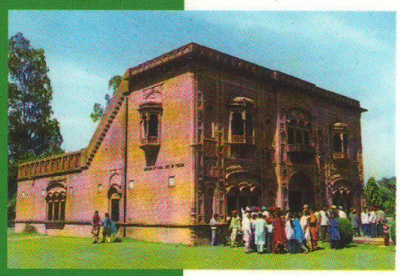
March 8-9, 2008

PROCEEDINGS OF 3rd BRAINSTORMING SESSION ON AGRICULTURAL EDUCATION POLICY





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INDIAN AGRICULTURAL UNIVERSITIES ASSOCIATION, NEW DELHI

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PUNJAB AGRICULTURAL UNIVERSITY, LUDHIANA-141004

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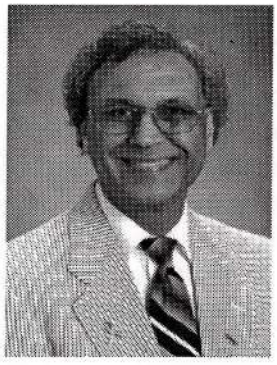
CONTENTS



WELCOME ADDRESS

Dr M. S. Kang
Vice-chancellor, PAU

Considering the rapid pace with changes taking place in the social, economic and technological sectors, the old educational concepts that have long been in place have become obsolete. A number of studies in recent years have drawn attention to the declining state of professional agricultural education in the country. Symptoms of this decline include a significant reduction in funding for educational institutions, inability to attract talented students, low student enrollment from rural areas, reduced demand for pure agricultural graduates, etc. Although agriculture accounts for a significant portion of the Gross Domestic Product (GDP) and employment in the country, it is diminishing rapidly because of the fast growth rate of industrial and service sectors.

Confronted with the rapidly changing circumstances, adoption of survival strategies like changes in curriculum, improvement in teaching methodologies, development of research partnership with industries and networking with other research and educational institutions have become essential.

There have been some systematic efforts to analyze the problem and remedy the situation. Reinventing agricultural education in a different form requires more concerted efforts than carried out by educational institutions within their limited capacities. Traditional agricultural education has largely concentrated on the supply side of the equation and assumptions that justified the production of "more of the same" have become less tenable and need to be revisited.

In a knowledge hungry society, increasingly more knowledge and skills are being acquired from outside the formal system of education. The monopoly of educational institutions as knowledge providers faces a serious threat. Educational institutional today are confronted with the challenges of finding innovative ways to attract and retain students and to improve course quality and flexibility.

Keeping these concerns in view, Indian Agricultural University Association has planned this brainstorming session on "Agricultural Education Policy" on 8th and 9th March, 2008 in which vice-chancellors of various agricultural universities are participating. Punjab Agricultural University, Ludhiana has been given the responsibility to host this important event.

I extend a warm welcome to the vice-chancellors from State Agricultural Universities or their representatives who are participating in the brainstorming session. I hope that significant recommendations for an improved agricultural education system will emerge from the two-day brainstorming session.

M.S. Kang

Punjab Agricultural University, Ludhiana – An Overview

The Punjab Agricultural University (PAU), an autonomous body, which came into existence on December, 20, 1962, enjoys the distinction of being the torch bearer of new innovations in agricultural education, research and technology transfer in the country. The university was established at a time when the country was facing the acute shortage of food grains. In a span of 45 years, PAU has made unparallel research contributions in agriculture and related fields. The PAU has played a key role in not only making the country self-sufficient in food grains but also enabling it to export agricultural commodities and has totally transformed the rural scenario in the Punjab State. The state has been contributing a share of 45-65 per cent to the central food stocks for the period of more than three and half decades. In recognition of its outstanding contributions in agricultural teaching, research and extension, The PAU was adjudged as the First Best State Agricultural University by the Indian Council of Agricultural Research (1995) and got Rs one billion special grant from Central Government for its contribution to the Green Revolution.

The University campus at Ludhiana is spread over an area of about 580 ha and has about 2000 ha land at Regional Research Stations, sub-stations, Seed Farms and Krishi Vigyan Kendras. The research, teaching and extension activities of the university are implemented through four colleges i.e., College of Agriculture, College of Agricultural Engineering, College of Home Science and College of Basic Sciences and Humanities. University has well equipped laboratories, computer facilities, elaborate farm facilities, Library and well managed sprawling play grounds.

In addition to serving the Punjab farmers, the technology developed by the university has crossed the state and even national border. University is actively involved in research at National level through its participation in several coordinated research programmes and collaboration with institutes of Indian Council of Agricultural Research. The PAU has always endeavoured to promote research in collaboration with advanced centre of learning outside India, especially the international agricultural research institutes through cooperative projects, exchange of germplasm, information, and scientists. The University has long standing collaboration with Ohio University, Florida University, California University, Moscow University, etc. in agriculture and allied sciences.

The PAU developed/recommended 545 commercial high yielding, disease resistant varieties/hybrids of different crops, 95 of which were released at national level. Technologies have been developed for the crop cultivation in irrigated and rainfed agro-ecologies. Technologies to reclaim salt affected and waterlogged area have been developed. There is strong research-extension worker-farmer linkage between PAU and State Development Departments. Kisan Melas at PAU are attended by about 0.25million farmers every year. The PAU has excellent programme of quality seed production and during 2006-07, university produced about 55000 quintals of seed for the farmers.

During the last four decades of its existence, the university has held the distinction of having competent faculty, who in recognition of their outstanding achievements, have brought laurels and won prestigious awards at the national and international level, which included Rafi Ahmed Kidwai Memorial Prize (52), Fakruddin Ali Ahmed Prize (1), Hari On Ashram Trust Award (11), Shanti Swarup Bhatnagar Award (2) and Team Research award of ICAR (37). In addition, the elite faculty have also been decorated with Padam Bhushan (4) and Padam Shree (8). The College of Agriculture and College of Agricultural Engineering received the Federation of Indian Chamber of Commerce and Industry Award.

In view of rapidly changing face of agriculture and WTO regime, the University has the focus on key areas of research like production of transgenic crops, natural resource management, low input-cost technologies, post harvest management and agro-processing for value addition, precision agriculture, recycling of crop residue, household management, etc. to achieve the food security, nutritional security and environmental sustainability.

Indian Agricultural University Association - A Profile

The Indian Agricultural Universities Association is a Registered Society under Registration No.3498 of 10 November, 1967. It was established in November with nine agricultural universities as its founder members, viz. PAU, Chandigarh (now Ludhiana); A PAU (now ANGRAU), Hyderabad; JNKVV, Jabalpur; UPAU (now GBPUAT) Pantnagar; UAS, Bangalore, KU, Kalyani (now BCKV, Mohanpur); OAUT Bhubaneshwar; UU (now MPUAT, Udaipur) and IARI, New Delhi.

During this long span there has been phenomenal increase in the number of member universities, especially during the late 90s and onwards. At present, the strength of association membership is 46 agricultural universities, i.e. 39 State Agricultural Universities, 5 deemed to be universities (AAI, IARI, CIFE, IVRI and NDRI) and 2 Central Agricultural Universities. All these are regular members of the Association.

The main objective of the Association is to promote agricultural research, education and extension in the universities and states, and thereby rural development in the country. It also acts as a bureau of information to facilitate communication, co-ordination and mutual consultation among agricultural universities. The association also acts as a liaison between member universities and government departments to facilitate communication and expedite the needed action in matters of importance.

All the universities and institutions (deemed-to-be universities) in India, which provide an integrated programme of teaching, research and extension education in agricultural sciences, are qualified to become regular members of the Association.

Vice-Chancellor of member universities or institutions constitute the Association's General Body. The General Body meets once a year to decide the agenda for the next convention and also for adoption of its audited accounts of the year and approval of budget estimates for the next financial year, besides the election of the office-bearers for the following calendar year. The Executive Committee of the Association consists of President, Vice-President, Secretary-Treasurer and three members. The Executive Committee meets quarterly.

The office of the Association is manned by Executive Secretary, who implements the decisions of General Body and Executive Committee on behalf of the Association. A quarterly newsletter is also being published by the Association since 2000, giving important news, events and achievements by member universities for the information of all the members.

The main source of revenue of the Association is the annual subscription from member universities. The ICAR also provides a nominal grant annually.

IAUA Executive Committee Members

1.	Dr. S.A.Patil, Director, IARI, New Delhi	President
2.	Dr. Rajendra B. Lal, VC, AAI, Allahabad	Secretary-Treasurer
3.	Dr. C.Ramasamy, VC, TNAU, Coimbatore	Member
4.	Dr. Nagendra Sharma, VC, SKUAST, Jammu	Member
5.	Dr. Anwar Alam, VC, SKUAST, Srinagar	Member
6.	Prof. C.S.Chakrabarti, VC, WBUAF&S, Kolkata	Special Member from East
7.	Dr. M.P.Yadav, VC, SVBUA&T, Meerut	Immediate Past President
8.	Dr. S.N.Puri, VC, CAU, Imphal	Ex-Officio Member (Past President)
9.	Dr. S.P.Tiwari, DDG (Edu.), ICAR	Invitee (ICAR representative)
10.	Dr. R.P.Singh	Executive Secretary, IAUA

Executive Summary

Agricultural education continues to face a double challenge. Preparing quality professionals and targeting its efforts towards the improvement of food availability and income for the very poor. In this dynamic context, agricultural organizations must provide education and technology relevant to the society by capturing opportunities to address relevant issues and problems.

Planning for change is therefore a key issue as agricultural scenario is quickly and continuously changing and unless we respond agilely and appropriately to changed circumstances we tend to lose our relevance as an educational and research organization. The single most appropriate issue to work in this dynamic context is capacity building to increase impact and efficiency. If an organization has to stay relevant and efficient it must develop strategies to remain in that position. Otherwise, any organization functioning efficiently but producing knowledge and outcomes of low relevance would need to reorient it through strategically oriented planning. Also, any organization with low relevance and low efficiency would risk being left alone to break down gradually unless it reinvents itself. SAU's and other agricultural organizations must therefore, evolve appropriate planning and management strategies to increase their relevance and efficiency.

In light of this changing context, reassessing the relevance of education and research in agricultural institutes and SAU's has become the pivotal element in the educational planning process.

Globalization has also put pressure on agricultural organizations to remain or become competitive in the increasingly open world. It has important implications for key agricultural education concerns. Quality and competence of teachers, continuous training of teachers, curriculum for quality education, autonomy & accountability, empowerment of women in agriculture, distance learning, objective and valid evaluation procedures etc. The education planners must therefore analyze the globalization process and plan strategies for global relevance by identifying their niche areas and accordingly reposition themselves.

It was against this backdrop that a two day brain storming session attended by 26 participants was hosted by PAU, Ludhiana on 8th and 9th March, 2008 under the aegis of Indian Agricultural University Association. It aimed at stream lining Agricultural Education policy in which around 26 Vice chancellors or their representatives from different SAU's participated. Inaugurating the events Dr. Jairup Singh, Vice Chancellor of GNDU, Amritsar called upon focusing the Agricultural Education policy of the country on overall food security of our burgeoning population and constraints of Agriculture. He further emphasized that SAU's must revamp their curricular programmes so that job creators and not job seekers are produced. Delivering the key note address Dr. M.S. Kang, Vice Chancellor of PAU, elaborated on current status of agriculture education and its policy in India.

Agricultural Education policy papers on the following disciplines were received and discussed. Fishery and sea food, Policy on management and role of social sciences in Agriculture Education & capacity building in India, education policy on Horticultural crops and Medicinal plants, Agricultural Engineering Education in India, Biotesting for safety and export of Agricultural /Livestock products, policy on the role of basic sciences (Livestock) in Agricultural Education etc.

The following is a condensed version of the original papers and deliberations based on which the agricultural education policy document may be prepared to guide the future course of action.

- The various inputs suggested for rejuvenating agricultural education policy included uniform, relevant and updated curriculum, education for entrepreneurship, exchange programmes with other universities within the country and abroad, opening doors of the University to International students, education for emerging markets, students amenities and development of communication skills, graduate teaching assistance programmes, effective learning methodology, professional competency development, adequate infrastructure, clear-cut policy on student selection in SAU's,

recruitment of quality teachers, effective instructional delivery system and revising internal evaluation system among others.

- In line with this focus the participants envisaged the need for school drop outs and graduates from traditional Universities to be trained in agro based enterprises such as dairying, goatry, poultry, horticulture, beekeeping, fish farming, agro forestry, mushroom cultivation etc .as these enterprises have vast potential to provide self employment. Youth can also be trained in maintenance of agriculture equipments like tractors, farm implements, plant protection equipment etc. to run their service centres for self employment in their own villages.
- Internationalization of Agriculture Education and research is long overdue. There is need to develop exchange programme among Agriculture and other Universities so that students may take courses not only within the campus but also across the campus within India and outside the country for a term or two.

The quota of International students needs to be increased to give cosmopolitan outlook and improve educational environment of the campuses.

- Students' amenities and development of common skills is a neglected area that needs urgent attention. There is a need to standardize hostel space and classroom space to the level of International Institutes. New facilities such as computers, photocopying, e-mail, computer facilities, internet surfing and telecommunication should be provided in the hostel premises.
- To elevate the standard of PG education attempts should be made to introduce graduate assistant ships to PG students, with the help of either the state or central governments. This will make available teachers to fill the deficit on affordable basis. In the process these Postgraduates will develop common skills and their knowledge level will also increase.
- Institutional boundaries must be erased to pave way for collaborative approach in a particular field cutting across individual disciplines to develop more cutting edge technologies in a shorter span. Modalities must be worked out to develop globally competitive technologies and patents with emphasis on intellectual property licensing to benefit the elite scientific community.
- There is a need to strengthen extension activities and programmes by providing staff, infrastructure and other logistical support. Proper mechanism for coordination between the state government, grass root extension functionaries and the University experts and trainers and for running continuing education programmes must be evolved.
- The University Industry linkages must be strengthened as this symbiotic relation between the three is mutually dependent and beneficial to all.
- Social Sciences must play an important role in agricultural curriculum as most of the graduates coming out of the system do not have an iota of ground realities of society and its people. Therefore, subjects like Sociology, Psychology, Agricultural Extension, and Agricultural Economics must be allocated at least 40% of the total contents. This will make students appreciate the importance of inter-personal relationships, build confidence and help poor farmers to overcome their low morale.
- The issue of fisheries education needs to be addressed holistically keeping in view the salient regional features.
- Current share of Agricultural education within the total budgetary provisions needs to be enhanced as 90% of a University budget gets consumed in payment of staff salary. This does not leave much scope for effecting improvements in content and delivery of instructions.

- The agricultural universities must enjoy complete academic freedom to work without facing threats to their autonomy from government and other quarters.
- The administrative Staff must be recognized as one of the stakeholders in research accountability so that they feel responsible and do not create unnecessary hurdles.
- Training of teachers must receive adequate attention as knowledge base of a teacher and his / her competence to deliver that knowledge are the key determinants of effective teaching and learning. Therefore, investment for training and re-training of faculty is necessary.
- A clear cut policy for minimum standard of education is needed. The focus must be to train students for active research, discuss and apply new knowledge in the context of problem situations rather than being passive recipients of information.
- Teaching should be aimed to promote student's analytic skills, self education skills, inter-personal and communication skills, professional behaviour and attributes through techniques such as group discussions, seminars, workshops, buzz sessions, case study, electronic based education etc.
- Hands on training should be a compulsory part of the curriculum. Students should select some villages for practical studies and demonstrations during their course of studies. This is needed for confidence and capacity building of students and their exposure to real conditions of the people. Besides, sufficient efforts to harness the benefits of modern information and communication technologies must be made to improve education and training standards.

The following policy initiatives need to be specifically considered:

- There is a need to reconsider monitoring of teaching quality, evaluation and to revisit the internal evaluation as existed earlier than shifting to external evaluation.
- Course curriculum should be made demand-driven to prepare students, to face the newly emerging challenges, and lay due emphasis on practical.
- Like foreign universities SAU's should have more diverse range of relevant courses which the students can choose viz. Biotechnology, Nanotechnology, Information and communication technology, Space, IPR, WTO, Agribusiness etc.
- For the sake of quality education, thrust should be given on Human Resource Development (HRD) in cutting edge technology areas as it is used to be in the 1970s.
- There is a need to establish relation/ collaboration with traditional universities, IITs, IIScs, IIMs and industry for perfect wide range updated education.
- There should also be a separate fisheries, live stock and animal husbandry education policy integrating education, research and extension.
- Accreditation process needs to be speeded up and extended to private agricultural colleges. Simultaneously SAU's should be equipped to handle the affiliation of private agricultural colleges to keep up the academic standards.
- There is a great need to have open door policy to encourage students and teachers from basic sciences to join SAU's and basic sciences students be admitted to agricultural PG programmes.
- Course curriculum should be made demand driven to prepare students to face the newly emerging challenges. Curriculum delivery should be in tune with global developments. Teaching should lay

due emphasis on practical hands in experience so that students are imparted real opportunities of learning.

- For enhancing cross fertilization of ideas, SAU's should take steps to reduce inbreeding. One third faculty (or at least 20%) needs to be taken from outside the state jurisdiction like JRF. The post filling may be taken up by ICAR. If need be salary may also be taken care of by ICAR.
- Fifty percent faculty positions lying vacant in SAU's/ICAR may be filled up so that the work does not suffer.
- To keep pace with private sector, SAU's should encourage tie ups with industry in agricultural education, research and transfer of Technology.
- SAU's should start new courses for Para veterinary through formal or informal education and diploma and certificate courses for training community health workers.
- Active linkages of agricultural engineering colleges with poly -techniques and Industrial Training institutes be promoted and skill oriented and vocational engineering diploma programmes to be started.

Considering the above, there is a feeling that the agriculture education is suffering because of the following weak spots: lack of basic infrastructure, inadequate laboratory equipment, space and financial support, lack of training facilities, lack of public-private interaction and collaboration, lack of proper counseling and placement of graduates, lack of linkages among industry and institutes and inadequate hands on experience and opportunities of experiential learning. These issues need to be addressed holistically keeping in view the salient features of regions. The ICAR must play very crucial role in revamping and rejuvenating the agricultural curriculum, generating self employment opportunities and providing able leadership to put agricultural among the top rung of the ladder in future. Comprehensive agriculture education policy document must be prepared which should provide a definite direction to the growth of Agricultural Universities and institutions to make them locally relevant and globally competitive.

Specific strategies to face the challenges and produce competent professionals may be planned to harness the full potential of agricultural sector while sustainably managing it.

Policy initiatives to create centres of academic excellence, ensure quality education, formulate minimum uniform standards for curriculum, faculty, infrastructure, budget etc. and promote best academic practices within the overall goal of sustainable agriculture development must be taken. The policy document must also provide the required R & D back up to the policies and programmes of the state development departments for creation of skilled and enterprising human resources.

Agricultural Education Policy

C.R. Hazra

Vice-Chancellor, Indira Gandhi Agricultural University
Raipur 492006 Chhattisgarh India

Modern agriculture is knowledge-based, in which education at all levels, particularly in agricultural education. This sector will have a very significant role not only in the capacity building but in the overall economy of this country. Agriculture education should aim at equipping farm graduates to undertake the task of precision agriculture, intensification, diversification and value addition in an integrated manner. The graduate should become job creator and not always remain in search for white collared jobs. Agriculture education will have to pay more emphasis in building technical skills, professional competency, self-confidence, managerial abilities and entrepreneurship to meet the new challenges of globalization in agriculture.

The agriculture education system needs to prepare graduates to be more flexible than traditional graduates, since agricultural graduates are involved in food security and natural resource management.

Industry - University linkages will ensure that Universities produce what is required of them and industries in turn cater to the needs of the Universities. The University - industry tie up is beneficial not only both for the education centres that is universities and the work centre that is industries but also the student and worker that is individuals. It is a symbiotic relation where the three viz. University, student and industry depend on each other are benefited mutually by this dependence.

Agriculture and its allied fields have tremendous potential of providing self-employment and scope of earnings through varied enterprises. If the school dropouts and graduates from traditional university are trained in vocational courses like dairying, goatry, poultry, horticulture, bee keeping, fish farming, agroforestry, mushroom cultivation etc. they can develop their own enterprise and earn livelihood at their own village without migrating to other areas. This will greatly facilitate them to use their own infrastructure like, farm building space etc. to develop their enterprise. If they migrate to other areas, creation of such facilities needs substantial investment. Also, if the youth are trained in other courses like maintenance of agricultural equipments, like tractors, farm implements, plant protection equipment etc. they can run service centres for self-employment. The agriculture university can not do this gigantic work it alone, but the huge human resources available in traditional universities, laboratories, industries, NGOs, social service organizations like NCC, NSS, scouts etc. can be involved to transform this mega project into reality to fulfill the aspirations of the society.

Following aspects/areas are suggested for the betterment of agricultural education policy development :

1. **Education for Entrepreneurship:** The fact that most universities do not have short, medium and long term courses for entrepreneurship development indicates how much out of touch we are with the realities of our society. This inadequacy must be overcome urgently and existing undergraduate programmes for agriculture and other disciplines must incorporate content for business development, market research and financial management as optional stream.

2. **Exchange Programme:** We need to develop exchange programme among agricultural and other universities so that students could take courses not only within the campus but also across the campus within India and outside the country for a term or two. Internationalisation of agricultural education and research is long overdue. We need to increase the quota for international students on priority so that the cosmopolitan outlook of the campus improves the educational environment also.

3. **Education forEmerging Markets:** Every student of agriculture knows that when economy grows and incomes increase, the proportion of processed food in the consumption basket increases

Imbalance in fisheries education is also visible in states like Madhya Pradesh, Rajasthan, Punjab, Haryana, Himachal Pradesh and Jammu& Kashmir, which yet do not have a fisheries college. Depending on the available resources and their potential , M. P. and Rajasthan can support a full fledged fisheries college each under their SAU's , while Punjab, H.P., J&K and Haryana can have one regional fisheries college collectively.

Students Amenities and Development of Communication Skills

It is generally a neglected area and needs urgent attention. The hostel space, the classroom space needs to be standardized to the level of International Institutes. New facilities, such as, computers, photocopying, e-mail, internet surfing and telecommunication should be provided in the hostels. For education to be a continuous process, computer facilities should also be provided in the hostel premises equipped with learning programs, video interactive modular programs. In order to reap benefit of the expertise available in outstations, facility for real time video interactive classes need to be developed.

Graduate Teaching Assistant Programs

In order to elevate the standard of post-graduate education, attempts should be made to introduce graduate assistantship to post-graduate students, with the help of either the state or central government. This will make available teachers to fill the deficit on affordable basis. Additionally, these post-graduate will develop communication skill, and their knowledge level will also increase.

Establishment of The "National Fisheries Council"

Establishment of the Fisheries Council is necessary to ensure quality in fisheries education and for the development of the fisheries profession along the lines of the Medical Council and the Veterinary Council. Again, the ICAR could play a catalytic role in the establishment of the Fisheries Council of India. The council could oversee availability of infrastructure facilities, recruitment and selection, staffing pattern and requirements of curricula and standards.

Provision of the following facilities to the colleges would also help them:

1. Linkages between the colleges and ICAR fisheries research institutions to make use of the facilities of the later by the former.
2. Research and Training support by the Industry to the colleges.
3. Teacher competence and evaluation.
4. Internship for the fisheries graduates, as is the case with medical and veterinary education.
5. Fisheries Law needs to be incorporated in the syllabi.
6. Funding support for publication of text Books, Training manuals, pamphlets, etc. in regional languages by the faculty of the colleges for proper popularization.
7. Interaction among the fisheries colleges
8. Fisheries education could be introduced in school itself under an appropriate system like vocational stream.
9. Separate fisheries schools may also be considered.

Research Systems: Research and investigations are supplementary responsibilities of the University, but there are inherent constraints in fishery research. Recently the demarcation between disciplines and faculties has blurred and therefore on innovative science efforts demand a design-board multidisciplinary approach. The fishery science research, however, is still restrictive to the faculty and there are inherent institution-created barriers for scientists from other faculties to become part of the team. Establishment of separate universities for each faculty, if not tackled in right spirit, also inherently negates the concept of multidisciplinary approach to education and research, which would cause more damage to science, if enough windows for collaboration are not kept open.

The research carried out in most of the disciplines are primarily the 'student research' which has a definite objective of training the students in research methodology and ends with graduation of the students. These research programs, unless made part of larger research initiative, would not inherently be directed towards technology development. Thus, the research programs are focused on process or product development. There is no administrative support to facilitate research program implementation. The administrative staff is not yet recognized as one of the stakeholders in research accountability and hence they get away even after creating willful obstacles.

The extension education program also lacks vision and although the universities are mandated to carry out extension, no staff or infrastructure support from the Government has been given in the past. This is therefore being run as an 'outreach program'. There is lack of coordination between the state government, which is de facto the 'ground-level extension agency' and the university, which is at best the technology developer or 'trainers training agency'. The continuing education program is yet to take off the ground. There has been no effort so far to harness the benefits of information technology into fishery continuing education programs.

Augmentation of Research and Development and Resource Mobilization through Institutes-Industry Linkage

Anticipated growth in all spheres of fish farming would be achieved only through infusion of latest technical know-how derived from organized research and development programs in fishery science sector. To evolve more economically viable and vibrant R&D, integration of institutes with various facets of Agro business industry is essential. Importance may be given to applied and industrial research for generating significant proportion of funds from potential consumers of our industrial technologies. This in turn will expand the base for R & D instead of depending exclusively on state funding. Institutional boundaries must be erased to pave way for collaborative approach in a particular field, cutting across individual laboratories to develop more cutting edge technologies in a shorter span. Modalities must be worked out to develop globally competitive technologies and patents with emphasis on intellectual property licensing to benefit the elite scientific community.

Although, fisheries scientists have accomplished a commendable task of increasing fish production in the country, both the number and quality of their publications suffer at the international level due to poor visibility. An important reason for this is that our fisheries scientists publish mostly in non-indexed journals. An all-out effort must be undertaken to improve the image of the premier fisheries research journal of the ICAR, namely, *Indian Journal of Fisheries.*

Considering the above, one would be tempted to suggest that the issue of fisheries education and development is not simple. It needs to be addressed holistically keeping in mind the salient features of the regions. Where the colleges are functioning and the need for having uniformity in development. A policy paper on Fisheries Education at the National Level could be prepared after detailed deliberations with all concerned including the fisher folk, fisheries entrepreneurs and the NGO's. Including the National Commission on farmers. The role of ICAR regarding fisheries education revamping, employment generation and an able leadership to put fisheries among the top rung of the ladder should be the goal for future.

Job Oriented Agricultural Education

V.K. Suri

Vice-Chancellor, C.S.Azad University of Agriculture and Technology, Kanpur (UP)

In a rapidly changing social and natural environment, agricultural education is being asked to play a critical role. What are the changes and adaptations, in structure, strategy and policy, that agricultural education institutions need to make to face the new challenges of the twenty-first century?

Faculties of agriculture and agricultural colleges and universities were first formed in the belief that farm production could be increased as a result of the systematic application of current technology and agricultural research findings. The mission of these early educational institutions was to scientifically study agriculture with the participation of the farming community; to carry the results to a broad range of farmers who could use them; and to train farmers, extension workers, agricultural teachers and researchers so that agricultural production could continue to be increased on a sustained basis.

Intermediate and higher education in agriculture continues to play a decisive role in rural development and sustainable agricultural production. An increasingly interdependent world, however, is producing new challenges for institutions where agriculture is taught. Over the years, the world has changed and, in many of the developing countries, agricultural education have failed to adapt and respond to the realities of rural societies.

Curricula and teaching methods and tools often have been developed that are not relevant to the development objectives of individual countries, to the needs of farmers and to the labour market in general. The situation has further deteriorated as a result of economic crisis. In many developing countries, the public sector used to absorb the large majority of agricultural graduates. This is no longer the case. Agriculture graduates are finding it increasingly difficult to become employed. Their education in agriculture has not been oriented to the needs of an increasingly sophisticated commercial sector. Environmental degradation, rapid changes in scientific and technical knowledge, the changing role of women in society and the increasing marginalization of agriculture and rural life all call for changes in agricultural education.

Right since independence, the country laid maximum emphasis on the development of its human resource through education. In support of that slowly and steadily a comprehensive system of higher agricultural education has been evolved and developed. Compared to a total intake capacity of about 1,500 students per year at the time of independence; currently, 21,000 agricultural graduates and postgraduates are produced every year. Despite this whooping rise, hardly there is an attempt that links trends of employment needs of various sectors of economy (public, private or self-entrepreneurship) and clients (students, farmers, agri-industry) against the kind and number of manpower produced by the system of higher agricultural education. With that persisting neglect, there is no visible concern on making projections on manpower demand and supply at the national level. Also, the system lacks a country level computerized manpower information system with the facility of updating, retrieval and dissemination of information to serve the policy objectives corresponding to development and utilization of graduates and postgraduates that education system churns out every year. As it exists, the emphasis is achieving the set targets of admission capacity without matching it with the changing market demand for employment. Already there is an air of all round concern for rising unemployment among agricultural graduates and postgraduates.

Until early 1990s, number of graduates and postgraduates produced by the agricultural education system was not large when seen from the employability point of view. With maximum absorption of graduates and postgraduates in government jobs, problem of unemployment was hardly an issue. Public sector was absorbing more than 50 per cent of the total stock of graduates and postgraduates. This situation has changed dramatically with the spin-off effects of liberalization and opening up of the economy becoming

clearer and clearer. Currently, unemployment among graduates and postgraduates is so rampant that it can hardly go unnoticed or remain unattended. Many reasons are behind this development. With food situation becoming comfortable, agricultural S&T is no more a priority sector of government funding. This has adversely affected the availability of jobs in public sector. Opening up of economy lays for greater emphasis on the development of private enterprise; reducing thereby the over dependence on public sector for employability. Accordingly, number of government jobs in public sector has been on the decline. Also, growth in processing industry and services sans updating of conventional course curricula and methods of its delivery to support these ventures has dichotomized the kind of marketable and produced manpower.

Since, consequences of ongoing shifts in world economic order and associated trends in surge of sectors and activities are seen to grow in future, reengineering of agricultural education to suit their requirements for graduates and postgraduate is a must. Significant adjustments in syllabi and time for practical and practice sessions also become necessary, in that, products of our agricultural education setup are professionals who do not hunt around for jobs but can create jobs for themselves. On the one hand, self-employable individuals are answer to problem of joblessness, on the other, they are projected to play a crucial role in extending applicability of S&T for eradicating poverty by making farming cost effective and its produce more diversified, market appropriate and profitable.

In order to introduce more time for practical classes and practice sessions, there is need for liberal investments to create appropriate physical plant and built relevant competence in teaching faculty. Against this perceived exigency, public funding for agricultural research and education, in reality, has tightened as the food situation has eased. Falling investment was viewed with concern, since, it was neither conducive to fight scourge of poverty nor for infusing greater application of R&D for sustaining growth in agricultural productivity. Current share of agricultural education within the total budgetary provisions does not seem all that impressive.

With 90 per cent of a university's budget consumed for payment of staff salary and committed establishment charges and the remaining appropriated by research, hardly much is left for effecting improvements in content and delivery of education. In fact, distinct provision for education improvement is unheard of in the existing broad heads of budgeting in the SAU system. Education is treated as a routine and casual activity involving a professor lecturing students herded in a classroom. Use of modern information and communication technologies for enhancing student professor interactivity in teaching and learning during practical and practice sessions is either nil or very low. In fact, teacher-taught coalition is a model adopted in other parts of the world to effect intended improvements in agriculture through products of education.

In order to unshackle education of the existing passive mode of teaching, investments on upgradation of course curricula by refreshing the content and refashioning the mode of delivery were considered necessary. The importance of overarching knowledge needs in emerging areas of frontier sciences, economic activity and environmental concerns and competence of teaching faculty needs to be appreciated. Since, knowledge base of a teacher and his competence to deliver that knowledge are the key determinants of effective teaching and learning, investment for training and retraining of faculty is necessary.

Nearly 12 per cent share of education, within the overall budgetary provisions of ICAR, constitutes merely 2 per cent of the total budget of SAUs. There is an urgent need for raising investments by State and ICAR to institutionalize reforms for building quality of agricultural education.

The proportion of agri-sector contribution to GDP is going down, whereas value addition is on the rise. Accordingly, emphasis needs to shift for developing manpower in industrial agriculture than in general agriculture. Apart from the expanding job possibilities in private sector, there are some planned programmes of GOI for environmental conservation and employment generation. Besides, there are focused changes in the Extension Policy of GOI. Whether these are setting up of farmer call centers, launch of agricultural

channel or establishing one Krishi Vigyan Kendra in each rural district of the country the avowed purpose is to take agricultural technology to farmer's doorsteps.

Suggestions

There is a need for establishing a regulatory authority within ICAR/DARE to sustain quality of agricultural education on the lines of UGC and AICTE. ICAR/DARE in alliance with Indian Agricultural Universities Association may develop a draft policy paper for creation of a statutory but autonomous authority within former's ambit. Once this draft is vetted from legal angle, it can be converted into a bill for approval of the Parliament. Since an Accreditation Board to assess quality of agricultural education already exists, what is now required is to empower it with legislative authority to enforce quality. As it prevails, agriculture, including higher agricultural education, is a state subject. This situation contrasts with other professional courses, whose regulation of growth and quality vest constitutionally with the Union government.

In order to assure a steady flow of takers of the government sponsored agri-business and agri-clinic schemes for selfemployment of graduates, there is a need for introducing business management, trade, marketing, cooperatives, banking and credit related subjects in the existing syllabi.

Simultaneously, in-vogue exclusive emphasis on formal degree programmes should be harmonized with non-degree skill oriented certificate and diploma courses to bolster village based technical services.

Introduction of lower-tier education to create a cadre of para-professionals who can serve as an interface between farmers and graduates professionals. These lower level professionals are crucial in enabling farmers in knowledge application and giving feedback on relevance and applicability of the existing knowledge and in developing new knowledge.

In line with the focus of the brainstorming discussions on reorienting agricultural education to support employability, participants envisaged the need for developing professional competence and capability through integration of teaching in modern subjects with learning in real life situations. Unfailingly, the new syllabus must be relevant, responsive and sensitive to serve the needs of various stakeholders. In that endeavour, reengineered education ought to support selfemployment (individuals), employability in upcoming sectors of economy (private e.g., business houses, processing industry, transfer of technology through NGOs or consortia of specialist individuals) and development of graduates and postgraduates well versed with issues and concerns arising from WTA, IPR, GATS and other conventions and treaties ratified and signed by India.

- Practice training will cover every aspect of a chosen vocation from beginning (cultivation) to end (consumption) and will be closely supervised and periodically evaluated.
- Training for appropriate period, preferably one year, is desirable with flexibility in training type.
- PG research should be as per national priorities, institutional mandate and stakeholders' needs.
- Entrepreneurship training to prepare graduates for setting up farm advisories and services (agri-business and agri-clinics) should not be treated as a separate activity of teaching and learning.
- Specific entrepreneurship trainings for faculty should be organized at the leading institutions.

Conclusion

Educational development in the country should be integrated in such a manner that it brings about a social transformation and reduction in the ranks of the unemployed. Our objective should be to enable our students to inculcate the dignity of manual labour, and to encourage initiative and creative work. Acquisition of some skill is as important as possession of academic knowledge for an all-round development of students; they should also have material to cultivate basic values of humanism, secularism and democracy.

Policy on Management and Role of Social Sciences in Agricultural Education and Capacity Building in India

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Even after 60 years of independence there is no specific or focused policy of Management and Role of Social Sciences in Agricultural Education has been made yet. Though sporadically various related issues have been discussed in various forums. The UGC has taken stock of the situations on higher education, State Agriculture Universities and several higher learning organizations have thought of modifying their curricula but we are yet to receive a focused guidelines on the same. This directives when come definitely will help and facilitate our systematic development process of using social sciences in agricultural education resulting in overcoming various bottlenecks and limitations of capacity building of agricultural scientists, teachers, education professionals, extension personnel, farmers and other development administrators concerned to agriculture. Hence, there is an urgent need to address these issues and formulate a strategic action plan to accomplish our goal of effective and meaningful objectives for the cause of agriculture and agriculturists in the country.

Agricultural Research and Education found enough prominence in the tenth five-year plan, which stated to improve the education for agri-professionals in terms of infrastructure and advanced curriculum and also provide required extension services. There are currently 49 Agricultural and Veterinary Universities in the country including Deemed Universities. Over 21,000 Agricultural Graduates and Post Graduates are becoming available each year. Farming has become knowledge intensive and there is need for retaining Farm Graduates and Home Science Graduates to achieve the desired technological upgrading of farm enterprises. At present, most of the Farm Graduates are either taking jobs in Government or Financial Institutions or in Private Sector industry. They are seldom taking to farming as a profession. Question is why it's happening? Answer to this perhaps lies on the role of social sciences in Agricultural education.

In this circumstance, there is need to motivate agri-graduate and enhance their professional skill and expose to social science perspective to enable them to contribute for consistent growth of the sector. Therefore, following issues could be pointers for discussion on the subject.

- How to increase the contribution of agricultural graduates in agriculture sector by making farming stimulating and rewarding?
- What could be the scope for extending professional extension services through agri-graduate to the farmers in the fast transforming scenario and accelerated pace of agricultural production envisaged in the current XI Plan document?
- How can we foster the public private partnership and what could be role of agriculture graduate in this endeavour?
- What social science perspective could be included in Agricultural course curriculum in UG/PG courses of SAUs and other Agriculture College?

The Problem

The fundamental problem seems to be lack of comprehensive vision at the policy level on sustaining small farmers. It is also seen that they run with a very low morale. Everyone says farmers don't want their children to take up farming. No agriculture scientist want their children to become an agriculture scientist, no extension worker want their children to become extension worker. Many studies in the agriculture universities on career choices says, continuing in agriculture research or extension is not in the first five priorities of students.

Even after post graduation and Ph.D. getting into research and extension is the last priority for majority of the students. One can imagine what can be expected from such a system. At least the old generation staff who came from village/farming communities still have that flavour. Approach was always driven by technology rather than problem solving. Professional interests (no. of papers published, no. of demonstrations conducted etc.) are driving the career till recently. Now it is only the business interests (patents or developing bottled technologies). Largely agril. Education and most of the graduates coming out of the system do not have iota of ground realities of society-community-its people and their social psychological perspective.

What Needs to be Done?

There is no two opinions that comprehensive policy on management and role of social sciences is of utmost importance in agricultural education. The agriculture graduates and the scientists engaged in agricultural research and teaching must have an idea of social science perspective as they have to work with farmers and also provide professional and needed services to the farmers and other rural folks for which they are meant for. Social science is not a hard science but it involves feelings and consideration, sympathy and empathy and intrinsic observation from the part of agricultural graduates so as to help the people living in the rural area of the country and support them for their livelihood security. Agriculture Professionals only with social science understanding can perform better and take up proactive roles in this kind of endeavours to help support rural populations and farming community to achieve their life objectives. Therefore, it is reiterated that the subjects/disciplines like sociology, economics, psychology, anthropology and behavioural sciences must form the part of core curriculum of the agricultural education.

Following Specific Measures could be Thought of to Address the Issues

- The curriculum as per time and need of the society must be made in the undergraduate agricultural education.
- Globalisation of agriculture and the certain upsurge of economic and technological revolutions coupled with knowledge explosions must be kept in mind in formulating curriculum for the undergraduateand post-graduate studies in agriculture. The teachers of State Agriculture Universities and Agriculture Colleges must have up to date knowledge and skills with present days information and techniques for imparting meaningful training and teaching to the students.
- All the teachers must have capacity enhancing or capacity building training on education technology, subject matter orientation, teaching learning methodology and human psychology for effectiveand purposeful teaching and training in the class room and field situations.
- Social science disciplines particularly human and social psychology, adult learning, motivational theory, and ragogical techniques, gender perspective, women empowerment and rural sociology mustform the part of curriculum in agriculture education as supportive subjects.
- Periodic review, tours and visits of the students to rural areas and interactions with the farmers, peasants and rural artisans will help immensely to have a holistic perspective of the society by the graduates coming out of the State Agriculture Universities to serve them.
- Together with farm management, general personal management and human resource management also should be taught – may be in a smaller module in both UG and PG course in agriculture.
- Management of agricultural education is a professional activity in which the entire world (both developed and developing) is interested and engaged in for various reasons and objectives. Ours cannot be of exception.
- Agriculture and agricultural education are construed as human process of constantly improving life and livelihood security. And therefore agricultural education is to be human faced and the processes can not ignore the well being of human life and society.

Policy on Management and Role of Social Sciences in Agricultural Education and Capacity Building in India

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The ultimate goal of agricultural education for sustainable development is to impart the knowledge, values, attitudes and skills needed to empower people to bring about the changes required to achieve sustainability. No doubt science is the fundamental of the any education or discipline but arts gives shapes to them. Social science is one of the part of arts but especially from agriculture point of view it ultimately join with the capacity building of the peasantry and rural people. Therefore, in present days one has to put overwhelming efforts on strengthening the social science to reach towards the end users.

The 21st century is the part of not only business out sourcing but also knowledge outsourcing too. A that time why we have to remain in the immobile or statue for reforming the social science in agricultural education? Basically social science includes in behavioural science and psychic part also but different important concept are engaged in policy management are as under:

1. Research
2. Innovation
3. Application of High technology
4. Communication skills
5. Leadership and Training
6. Emotions, Logic and Character

Some creative pro-poor policies have been introduced such as the National Rural Employment Guarantee Act (NREGA), which guarantee 100 days of paid employment to every household in selected districts to work on public infrastructure projects. Furthermore, the government has given assurances that the resources necessary to achieve the Goals will be forthcoming and that the targets will be reached in advance of the 2015 deadline. More careful civil society observers might however point out that water table levels throughout India have collapsed, that teacher absenteeism in primary schools is 25% with pupil drop-out rates of 40% and that the UN Special Rapporteur on the Right to Food reported in March 2006 that "food insecurity is growing".

To formulate the policy on Management with special reference to the capacity building in social science context the underlined items should be taken in to the care of.

1. Knowledge as Power

This millennium would be for the knowledge & knowledge is a power (Bill Gate). Demands on the quality of human resource are changing rapidly in view of the explosion of knowledge in many areas. Most of the developing countries are rich in natural resources but are technologically poor. Therefore, newer technologies are to be developed and adopted so as to harness the natural resource of the country could for the benefit of large segment of society. The future agricultural science must train graduates in the frontier areas the contemporary issues and in the light of newer developments the courses need to be restructured. The focus should be laid on Bio-technology, Post-harvest technology, Agricultural Management and Agri-business, Bio-diversity, Bio-resources Technology, International Agriculture, Systems Agriculture, Career Planning, Commercial Agriculture Horticulture, Export of food grains and food products and Food processing engineering with special emphasis on quality concern and value addition at graduate level.

2. Qualities and Competence of Teachers

Student-teacher interaction needs greater attention through effective advisory system for the career development and placement. Training of teachers has never received adequate attention in the past. Time has come when only trained teachers are capable of good teaching should be employed or trained after recruitment. Pedagogical skills, positive attitudes and sound thinking abilities should be given emphasis while selecting teachers. Appointment of teachers at various levels should be made through open selections to promote academic mobility and to provide incentives to talented and good teachers.

3. Training to Teachers

Agricultural Teachers in Agricultural Colleges and Agricultural University are selected and employed mainly on the basis of their agricultural professional degree and experience. This is not enough for effective teaching and, therefore, the teachers should be trained through continuous in-service training by way of strengthening their teaching methodology as well as training them in their subject matter to cope up with the current science and technology developments in agriculture.

4. Continuous Training of Teachers

Learning, a life long and continuous process, is very important for everyone, especially for teaches. The types and forms of learning may be varied like self-directed learning, participating in a distance learning, attending workshops, seminars, symposia, etc., based on the requirements of the teachers. Continuous training of the agricultural teachers and continuous learning are quite essential to update their knowledge on the emerging innovations in agricultural sciences and also to equip with the modern technologies. In general, continuous learning should cover few important areas such as

i) Advances in agricultural science and technology
ii) Educational innovations;
iii) Educational technology;
iv) More in depth understanding of students;
v) Eco-technology;
vi) Social ecology;
vii) System approach;
viii) Agri-tech skill;
ix) Leadership qualities;
x) Agricultural rural development; etc.

5. Curriculum for Quality Education

The Semester/Trimester system followed by the agricultural universities has been appreciated by one and all. Experience has shown that semester is better than trimester and thus most of the universities have now adopted semester system. Agricultural universities have been updating the curriculum from time to time. In view of fast changing scenario and advancement in science and technology and thrust on biodiversity, bio-technology, bio-resources technology, computer application, bioclimatology, agro-meteorology, systems agriculture, remote sensing, post-harvest technology, liberalization in export and import of commodities, food processing engineering, agri-business management, environment, agro-forestry, natural resources management, integrated pest management, biological fertilizers, embryo-transfer technology, use of plastics in agriculture, watershed management, eco-friendly agriculture, integrated nutrient management, commercial agriculture, organic farming, career planning, work experience international agriculture, etc. updating of curriculum both at UG and PG levels is the need of the day in the coming decades.

6. Experiential Learning Education in Agriculture

It is saying that "if I will hear and see I will forget but if I do I will remember". In this way experiential learning is the approach towards problem solving or situation improvement in which learning is for improving interactions with the outside world. The learning process imparts a direction to the students to think and act which create self-confidence and it focuses more on environment, situation and social ecology (Kannalyan, 1996). Self-confidence is the keyword in experiential learning which primarily trains the students at different phases to "create self-confidence". It offers a direction to the students to develop their competence, capability, capacity building, acquiring skills, acquiring expertise and personality development. But it requires interest of an individual with total commitment, total involvement, participation, reception, active interest, dedication, hard work, curiosity, vision and wisdom (Kannaiyan, 1996)., The future growth of agriculture should be essentially knowledge based and application of technologies would be essential for income generation. The increasing trend of commercial "agri-hort" business would pay better revenue for the farmers.

7. Autonomy and Accountability for Quality Education

The agricultural universities are 'autonomous' in nature. But in actual practice threats to autonomy are posed from several quarters affecting the freedom to work and develop the institution to meet its objectives. Most universities have the freedom is laying down the admission criteria, developing academic programmes, framing of curriculum and methods of teaching facilities required for teaching, eligibility criteria and procedure for selection of teachers and such other academic matters.

8. Empowerment of Women in Agricultural Education

Agricultural education is treated as gender controversy issue however an integrated education programme at undergraduate level covering all areas of Agriculture, Veterinary Science, Agril. Engineering, Fisheries and Home Science which can include knowledge and skill required for human, animal and crops can be thought of at undergraduate level since the functions of rural women at household level are interlinked. Combination of curriculum of all the three faculties, namely, Agriculture, Veterinary and Home Science are required for any women graduate produced by Agricultural University to serve the cause of women in agriculture.

9. Distance Learning

A number of different terms are used here within the broad area of non-traditionally delivered courses including open learning, distance learning and distance education.

Open learning is a form of education in which the restrictions places on students are minimized, and where decisions about learning are taken by the learners themselves. These decisions may include any or all of the following:

- Whether or not to begin and continue study.
- What to study-content/skills, courses
- How to learn-method and media, route through courses
- Where to study (not necessarily a classroom)
- When to study-when to finish, how rapidly to progress, and when to finish and
- How to be assessed-formal exams, continuous assessment, interviews or even no assessment. Since in this system study does not necessarily needed to lead to formal qualifications.

India has to rely upon the agriculture, as about seventy per cent population is engaged in the agriculture profession. After independence great stride has been attempted by establishing the various agricultural programmes to boost agricultural production and it was supplemented by establishing 38 State Agricultural Universities (SAUs) in the country with different faculties in order to strengthen teaching, research and extension education for the pursuit of national goals.

Agricultural Education Policy on Horticultural Crops and Medicinal Plants

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Horticultural crops have assumed importance in human nutrition, employment and export earning in recent years. Food safety again has attracted our attention in case of high value crops like vegetables, fruit crops, spices and condiments having scope for export. India is fortunate to have varying agro climatic conditions where scope exists for production of different tropical, sub-tropical and temperate fruits (including plantation crops), vegetables, medicinal plants, spices and flowers. Realizing the importance of horticultural crops in providing much needed livelihood and nutritional security and economic empowerment of the farmers it was thought worthwhile to develop technically trained manpower in this specialized field to give a boost to production and profitability of these crops. The first College of Horticulture was therefore established in Kerala in 1972. Since then 12 more Colleges of Horticulture and one Horticultural University namely, Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni (Himachal Pradesh) have been established. Now two other Universities of Horticulture are being established at Andhra Pradesh and Karnataka. A College of Horticulture is to start from the academic session of 2008-09 in Orissa University of Agriculture and Technology.

Wide variations in B.Sc. (Hort.) courses offered by Horticulture Colleges exist with regard to total credit load, admission procedure, internal evaluation, RAWE credit hours and minimum attendance requirement.

The IVth Deans' Committee had also recommended restructuring the under-graduate horticulture courses with the following objectives:

- Equip the graduates with current trends and requirements of horticulture Industry.
- Enabling them to help and guide the farmers or involve themselves in achieving cost and quality competitiveness of horticultural produce.
- Enable in market intelligence and participate in world trade of horticultural produce. Keeping the above points in view the following policy initiatives are suggested.
- There is a need to bring uniformity in the course syllabus of the colleges offering Horticulture degree.
- The graduates coming out must have adequate practical experience/exposure on different aspects of horticulture for which the final year B.Sc. (Hort.) programme be restructured to provide for six months of Experiential learning and six months of attachment with Horticulture related Industries /Commercial farms.
- The Hands on training/Experiential learning programmes are to be in specialized areas like Protected cultivation of high value horticultural crops, Nursery production and management, Post harvest technology and value-addition and Floriculture and landscape gardening.
- Inclusion of new courses like Organic farming, Cultivation & processing of medicinal and aromatic plants, Farming systems, Post harvest processing and value addition, Storage packaging and transport, IPR, Communication skill development, Entrepreneurship development, Horti-business management and Biotechnology may be considered.
- Regular monitoring (once in five years) of the functioning/performance of the colleges through Monitoring Team/Accreditation Team. There is a need to monitor outcome of these initiatives.
- Identifying overseas partners and collaborating institutions for student and faculty exchange programmes.
- Course curriculum need to be revised regularly to exclude the redundant ones and include emerging ones.
- Newly recruited faculty members have to undergo induction training for effective curriculum delivery.
- More specialized market driven courses need to be developed.

Agricultural Engineering Education in India – Status and Policy Issues

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Agricultural Engineering (AE) has evolved to apply engineering principles and practices to natural resources conservation and development, production agriculture, agro-processing and rural living. It enables optimal use of natural resources, increased production and productivity with reduced cost of production, efficient handling, processing and storage of agricultural produce and by-products reducing post-harvest losses, establishment of agro-industries generating additional income and employment. It also stands for modernization associated with conventional method of farming, imparting dignity to work, removal of arduous labour and drudgery in farm operations; development of infrastructure, rural water supply and sanitation, ultimately improving quality of rural life. Engineering methods were in use in agriculture and allied activities long before the term Agricultural Engineering (AE) came in use as a subject matter mostly derived from civil, mechanical, electrical and chemical engineering. Dr. Elwood Mead, a leader in land reclamation who later became head of US Bureau of Reclamation is credited to have provided rational for AE as distinct profession and discipline. When the Land Grant Institutions were established in USA the colleges of agriculture were termed as College of Agriculture and Mechanics Arts. Late in 1909 a Conference was held at the University of Illinois to discuss teaching techniques and to develop instructional materials for the new field of AE in which Prof. F.R. Crane from Illinois, Prof. JB Davidson from Iowa and Prof. C.A. Ocock from Wisconsin participated. In 1910, Iowa was the first State Collage to confer degree of Bachelor of Science in Agricultural Engineering in USA or for that matter anywhere in the world. By 1925, there were 10 such institutions conferring UG degrees, and PG and Ph.D programmes followed them soon.

AE Education in India started in 1942 at AAI, Allahabad. Since then it has come a long way (Table 1).There are 37 institutions that are offering formal education leading to various degree programmes in AE. There are 33 institutions in public sector that offer UG programme, 19 M.Tech/M.E Programmes and 10 Ph.D. Specialization that have emerged are soil and Water Engineering / Irrigation and Drainage Engineering, Farm Machinery & Power, Agric Structures and Process Engg., Agric Structures & Environment Control, Agric Process and Food Engineering, Dairy Engineering, Food Engineering & Tech, Bio Engineering & Food Technology etc. Some of the colleges / faculties could be called world class. However, there are colleges of AE that have weak spots, institutions unable to maintain themselves. Their academic programmes lack practicals, hands on experiences and opportunities of experiential learning. Curricula do involve in-shop/in-plant trainings. In order to be employable in globalized economiy there are new skills that are required for which colleges have to equip themselves, offer opportunities of learning and acquiring skills to the students. Colleges should acquire capacity of proper counseling and placement of these graduates.

Growth of Agricultural Engineering Education in India

Allahabad Agricultural Institute (AAI), Naini, Allahabad an affiliated college of the Allahabad University at that time has the distinction of starting a course leading to the degree of Bachelor of Science in Agricultural Engineering (a two-year course) in 1942, for the first time in India and for that matter in Asia. Prof. Mason Vaugh is considered father of Agricultural Engineering in India. He was an Agriculture graduate from USA came as a missionary and was convinced India needed Agricultural Engineering inputs. He returned to USA, earned a Bachelors' degree in AE and returned back to India. Ten years later in 1952, as per Dhar Committee, the Indian Institute of Technology (IIT), Kharagpur, the first IIT of the country, started

B.Tech.(Agric Engg), a four-year programme, an important landmark in the development of AE education in India. Soon after (1956) it started PG programme also for the first time in India, and yet an another important landmark when it awarded the first Ph.D. degree in Agric. Engineering in India in 1965.

Dr. Radhakrishnan Committee recommended establishment of Rural Universities, a concept that gained momentum. Indo-US Joint-Team came up with the recommendation of establishment of SAUs in each major state on the pattern of American Land Grant Colleges integrating teaching, research and extension education. GB Pant University of Agric and Technology (GBPUAT) as the first SAU of India structured itself- with Agricultural Engineering and Technology as one of the faculties, starting UG program in 1962. Subsequently majority of the SAUs created faculties of AE (Table-1). Some of them have just recently created many years after the establishment of the University. By the time most of the AE colleges were established as a result of two wars and resultant inflation the universities had started experiencing financial constraints which came in the way of proper establishment of these colleges of AE. Barring exceptions, Colleges of AE have poor infrastructure, inadequate faculty and staff and insufficient operational grants, lack of mobility with adverse affect on AE education and discharge of proper mandated function of teaching, research, extension education and technology transfer in this field.

Start of M. Tech. and Ph.D. programme at IIT Kharagpur and subsequently at IARI, AAI and SAUs have enabled considerable self-sufficiency in human resource development in AE in India. Faculty improvement under TCM, USAID, NARP and NATP has provided large number of faculty members who have foreign degrees or have had exposure abroad. It is estimated, there are about 15,000 graduates of AE, 5,000 PGs and about 500 Ph.Ds that have passed out from these 37 institutions of AE in India. There is annual induction capacity of 1068 UG, 370 PGs and 91 Ph.Ds of which about 600 UGs, 150 PGs and 50 Ph.Ds pass out each year.

Emerging Scenario

India with over a billion population with globalized economy is faced with daunting challenges of ever increasing demands of food and nutritional security of the country, global competitiveness in every economic activity that we do. As a nation we have target of annual growth of 10% for which we have to have an annual growth of 4% in the agricultural sector. Inspite of developments in manufacturing, trade, commerce and service sectors, still about two-third of our people live in the villages drawing sustenance from land and water resources. India that aspires to be amongst the global leaders has to have capacity to share with less fortunate nations besides eradicating hunger from its own land. India did succeed in bringing Green Revolution and proving prophets of doom wrong by acquiring self-sufficiency in food. It had spectacular growth in allied sectors too achieving White Revolution in milk, Blue Revolution in fisheries and Yellow Revolution in Horticulture. However, it is faced with new generation of problems that of factor productivity declining in Green Revolution areas, yield level plateauing and in certain cases due to exhausted soils, overuse of natural resources. There is increasing trend amongst the rural youth especially capable educated men and women to look for alternate job opportunities for which they are migrating into urban areas for less arduous and less risk-prone livelihoods shunning agriculture and rural life. It is a social phenomenon that needs to be curbed for peace, harmony and equitable growth in the society. Agriculture has to be made remunerative through increased production, productivity of land, labour, capital, water resources and increasingly becoming costlier inputs. It requires scientific use of land, water, human and animal resources; acquisition of most modern technologies with its essential elements of sophistication, precision in input application, timeliness, computer aided designs, manufacture, quality control and ICT for assured quality and keeping unit cost competitive in agricultural produce and processed products and have capacity to market in remunerative markets with least risks and losses.

Agricultural Engineering inputs to agriculture are required in development and optimal utilization of soil and water resources, irrigation and drainage, carrying out field operations of crops, livestock husbandry and fishery with desired level of operational efficiency – achieving timeliness, precision in metering and

placement of costly inputs of seed, fertilizer, pesticide, irrigation water, using farm machinery and power practicing precision farming. Application of GPS/GIS, Laser land leveling conservation farming and variable late applicators are increasingly becoming necessity to modern agriculture. AE graduates should be made fully aware of their applications. High production and productivity cannot be sustained without matching harvest and post-harvest technologies that enable conservation of produce and by-products from qualitative and quantitative damages, that create capacity at farmer level to hold their perishable and semi-perishable commodities without excessive losses to negotiate with the forces of marketing, packaging and transport to remunerative markets, wherever possible transforming the perishables in to semi-perishables or durable products through appropriate agro-processing leading to additional income and employment. Predominance of small and marginal farms in India creates constraints of financial resources and management skills which can be overcome by national banking providing loans on preferential terms and venture capitals to rural entrepreneurs and create custom service centres as well as advisory centres, , websites and portals, private as well as cooperative owned, catering to the needs and aspirations of weaker sections of the society. With fossil fuels depleting, new and renewable sources of energy need to be harnessed for production agriculture, agro-processing, and rural living based on draft animals, solar, wind, hydro and geothermal energies, biomass of crop and agro-processing industries. Animate energy use though in practice since times immemorial needs to be rationalized based on principles of ergonomics, physiology of operators and draft animals with a human touch.

These engineering and technological needs demand highly trained agricultural engineers, equipped with knowledge, skills and practices of engineering and technology with full appreciation of bio-sciences, ICTs, national and international rules and regulations governing crops and commodities in order to handle the challenges ahead. Courses and curricula of AE programmes need to be revised at relatively short intervals looking to the demands of growing private sector, advancement in agricultural production, processing, energy and power and ICT sectors. Even remote control equipment and robotics are increasingly finding application to handle hazardous situations in agriculture and allied activities.

The Fourth Deans' Committee appointed by ICAR has deliberated and tried to update the courses and curricula; however, much needs to be done in terms of updating the infrastructure and skills of the faculties to bring about changes required in production agriculture, agro processing and rural living at this point of time and emerging scenario in near future. The efforts of ICAR and ISAE (Indian Society of Agricultural Engineers) the professional body of AE profession have brought uniformity to a great extent (Table 2-4) and evolved measures to assure quality. The Accreditation Board of ICAR and AICTE (All India Council of Technical Education) are also playing regulatory and accreditation role in AE Education. Employment potential of AE graduates, post-graduates and Ph.Ds has been good and professionally they have competed well within India and abroad so far. Many of them have diversified in other allied fields. However, massive modernization, infrastructure development and faculty improvement are needed to meet the challenges of tomorrow. Measures are required to ensure skills of modern jobs for them.

Lead Institution in AE

B.Tech, M.Tech and Ph.D programmes in Agri. Engineering are well set except for the capacities generated are not fully utilized for various reasons. Some of the Employers raise questions of employability for certain jobs. There is no Agri. Engineering University or deemed university in Agri. Engineering Education yet to play a pivotal role in continued excellence. However, till such date there is a possibility of establishment of Agricultural University in the country as in some of the other disciplines. There is a possibility of elevating CIAE Bhopal and CIPHET Ludhiana to a deemed university status which may not involve much additional expenses. These institutions could acquire excellence and in turn train out faculty members at the colleges of Agri. Engineering in the country especially those which have been recently established in the past decade or so.

Vocational and Supporting Education in AE

As far as the vocational education in AE is concerned it is unorganized and relatively less attended to. Trained field and shop supervisors, skilled technicians, good mechanics are in short supply. There is also dearth of skilled operators and craftsmen which are in need in a very large number to promote mechanization and agro-processing. The Agri. Engineers as professionals as in other branches of engineering like civil, mechanical, electrical need diploma holders in AE as well as ITI Certificate holders to form a team to execute AE activities in an organized manner on a large scale. Diploma in AE is offered by Polytechnics alongwith diploma programmes in other branches of engineering. ITIs are turning out craftsmen and technicians trained in various crafts. However, diploma and ITI training programmes are not as well focused for agricultural and Agri. Engineering vocations as in other branches of engineering and crafts. Often they lack requisite skills. In absence of such manpower graduate engineers are requisitioned for whom it amounts to under-employment. In order to benefit from AE technologies, it is also imperative to have a massive training of the farmers and rural craftsmen and entrepreneurs in modern methods of farming and produce management, utilization of renewable energy sources etc., for which colleges of Agri.Engineering, Krishi Vigyan Kendras and TTCs of Govt. of India need to be properly equipped and mandated alongwith stipend for the trainees for their maintenance during their period of training and travel.

Conclusion and Recommendations

Agri. Engineering education in India starting in 1942 has made good progress with about 40 institutions imparting education in Agri. Engineering Education, 34 offering UG programmes, 19 PG and 10 Ph.D programmes. The employment prospects of AE graduates are good. Indian agriculture is at cross roads where for many rural youth especially educated it is no longer attractive because of the arduous labour and hard work required with agricultural profitability reducing day by day. Therefore, it is required to modernize Indian agriculture and improve its profitability and sustainability through engineering inputs increasing production, productivity and profitability for which massive strengthening is required in AE human resource – both formal degree holders, diploma holders, mechanics, crafts and skilled operators. Following recommendations are made to bring about policy changes in AE education in the country:

1. The existing UG programmes be strengthened stabilizing at annualoutput of 1200.

i. Fourth Deans' Committee Recommendations / AICTE norms be adhered to reorienting course and curricula.

ii. Infrastructure of the colleges of AE be improved in terms of labs, computers, pilot plants, training in field operation etc., to give sufficient hands on experience and training in various skills required.

iii. Evaluation be made more rigorous and transparent.

iv. Faculty technical staff be continually trained in new knowledge and skills.

v. Career Advancement Scheme should be refined to make the evaluation of faculty and staff based on proven performance and skills acquired.

2. Existing PG programmes be strengthened increasing annual output to about 400 post graduates per year.

i. Provision of more Jr. Fellowships in Agri. Engineering as well as assistantships.

ii. Proactive Advisory Committee mechanisms.

iii. Combat inbreeding by forcing graduates moving to other institution for PG/Ph.D and atleast 25% faculty from other states.

iv. Joint programmes between SAUs and ICAR Institutes be properly institutionalized.

v. CIAE and CIPHET could be elevated to Deemed University status offering M-Tech/Ph.D and play pivotal role

vi. Higher allocation for thesis work because of the cost escalation has become necessary, say atleast Rs.20,000 per thesis.

vii. PG Labs be reequipped with modern equipment.

viii. PG degrees without course work should be discouraged and derecognized.

3. Ph.D programmes be strengthened to an annual output of about 100 Ph.Ds.

i. Provision of more Sr. Fellowships and Assistantships

ii. Proactive Advisory Committee system.

iii. Increased allocation for Ph.D. thesis work, say atleast Rs 40,000 per thesis

iv. Publication / Presentation of research papers based on thesis work in professional journals, seminars, symposia to be encouraged and TA/DA for participation be provided.

v. Combat inbreeding; promote joint programmes between SAUs and ICAR institutes.

vi. Libraries be well equipped with access to all national and international periodicals through subscription and other modes.

vii. Inbreeding be curbed

4. Development of diploma and vocational education in AE.

i. Active linkages between the colleges of AE and polytechniques and ITIs in the region.

ii. Provision of positions of Training Associate and Training Assistant, Mechanics and Shop Technicians in AE colleges.

iii. Every Directorate of Extension of SAUs/KVKs should have AE Training mandate with atleast one Joint Director for overall coordination and training units with SMS and Training Assistant.

iv. Financial assistance to colleges of AE for vocational education and training in Land Development, Agricultural Mechanization and Post-harvest technologies.

v. Financial assistance to AE colleges for such programmes and stipend to the trainees during training period alongwith TA to trainees and trainers..

vi. Revision of recruitment rules giving place to diploma and certificate holders in AE.

Symbols and Acronyms

AAI	-	Allahabad Agricultural Institute
AE	-	Agricultural Engineering
AICTE	-	All India Council of Technology Education
BE	-	Bachelor of Engineering
B. Tech	-	Bachelor of Technology
BCKV	-	Bidhan Chandra Krishi Vishwavidyalaya
CAU	-	Central Agricultural University
CIFE	-	Central Institute of Fisheries education
GAU	-	Gujarat Agricultural University
GBPUAT	-	Govind Ballabh Plant University of Agriculture & Technology
HOD	-	Head of the Department/Division
HPKV	-	Himachal Pradesh Krishi Vishwavidyalaya
HAU	-	Haryana Agricultural University
HRD	-	Human Resource Development
IARI	-	Indian Agricultural Research Institute
IIT	-	Indian Institute of Technology
ITI	-	Industrial Training Institute
IVRI	-	Indian Veterinary Research Institute
KAU	-	Kerala Agricultural University
KVK	-	Krishi Vigyan Kendra
MPKV	-	Mahatma Phule Krishi Vidyapeeth
M.Tech	-	Master of Technology
M.E	-	Master of Engineering
NDRI	-	National Dairy Research Institute
NDUAT	-	Narendra Dev University of Agriculture & Technology
OUAT	-	Orissa University of Agriculture & Technology
PG	-	Post-graduate
Ph.D	-	Doctor of Philosophy
PAU	-	Punjab Agricultural University
PKV	-	Punjabrao Krishi Vidyapeeth
RAU	-	Rajendra Agricultural University
RAJAU	-	Rajasthan Agricultural University
SAU	-	State Agricultural University
TNAU	-	Tamil Nadu Agricultural University
TTC	-	Trainers Training Centre
UAS	-	University of Agricultural Sciences
UG	-	Under Graduate/Bachelor's degree

Table 1: Agricultural Engineering Education Infrastructure in India (9)

S. No.	Name & address of the college/	Faculty/University/Deemed University offering degree	Year of start of UG programme	Annual intake capacity		
				UG	Master	Ph.D
1	2	3	4	5	6	7
1.	Agric Instt.,- DU Allahabad-211007	Department of Ag. Engg.,Faculty of Engg, Allahabad University.	1942	90 (1465)*	30 (29)	10 (U.P.)
2.	Deptt. of Agric. & Food Engg. IIT, Kharagpur – 721302	Faculty of Engg. IIT, Kharagpur	1952	35 (666)	64 (1055)	10 (153)
3.	Pant College of Technology, Pantnagar – 263145 (UP)	Faculty of Technology, GBPUA & T, Pantnagar	1962	35	40	12
4.	College of Agric. Engg. Ludhiana – 141 009 (Punjab)	Faculty of Agric. Engg. Punjab Agric. Univ., Ludhiana	1964	50 (1224)	36 (264)	12 (54)
5.	College of Tech. & Agric. Engg., Udaipur – 313 001 (Rajasthan)	Faculty of Agric. Engg., Rajasthan Agric. Uni., Bikaner	1965	48 (14)	12 (175)	15 (5)
6.	College of Agric. Engg. & Tech., Bhubaneshwar-751003 (Orissa)	Faculty of Agric. Engg., Orissa University of Agric. & Tech. Bhubaneshwar	1965	40	20	6
7.	College of Agric. Engg. Jabalpur- 482 004 (MP)	Faculty of Agric. Engg., JNKV, Jabalpur	1967	50 (758)	20 (75)	3
8.	Deptt. of Agric. Engg., IARI, New Delhi – 110 012 721302 (WB)	Faculty of Agric. Engg., IARI, New-Delhi	1967	-	6	6
9.	NDRI Karnal –1320 02 (Haryana)	Faculty of Dairy Tech, NDRI, Karnal	1967	-	6 (DE)	5 (DE)
10.	Dr. Anna Sahab Shinde College of Agric. Engg. Rahuri – 4137 22 Distt. Ahmednagar (Maharashtra)	Faculty of Agric. Engg., Mahatma Phuule Krishi Vidyapeeth,. Rahuri	1969	55 (516)	16 (92)	-
11.	College of Agric. Engg., Akola – 444 104	Faculty of Agric. Engg. Punjab Rao Deshmukh Krishi Vidyapeeth	1969	60 (685)	8 (61)	-
12	College of Agric. Engg., Coimbatore – 641003 (TN)	Faculty of Engg., Tamil Nadu Agric. Uni., Coimbatore.	1972	35 (Till 93)	16	12
13.	College of Agric. Engg., Pusa, Samastipur – 84125 (Bihar)	Facuulty of Agric. Engg., Rajendra Agric. Uni., Samastipur.	1983	45	12	-
14.	Kelappaji College of Agric. Engg. & Tech., Tavanur – 679 573 (Kerela)	Facualty of Agric. Engg., Kerala Agric. Univ., Thrissur	1983	33 (140)	08 (44)	-
15.	College of Agric. Engg., Bapatla – 522 101 (AP)	Faculty of Agriculture, ANG Ranga Agric. Uni., Hyderabad	1983	35	-	-
16.	College of Agric. Engg., & Tech., Junagarh – 362001 (Gujarat)	Faculty of Agric. Engg., Gujarat Agric. Uni., Banaskantha	1984	40	30	-
17.	College of Agric. Engg., Parbhani – 431 402 (Maharashtra)	Faculty of Agric. Engg., Marathwada Krishi i Vidyapeeth, Parbbhan	1986 (184)	32	-	-
18.	College (Institute) of Agric. Engg., Raichur–584101 (Karnataka)	Facualty of Agric. Uni. of Agric. Sci., Dharwad	1987	30	12	-

19.	College of Agric. Engg., & Tech. Hissar- 125 004 (Haryana)	Faculty of Agric. Engg., CCS Haryana Agric., Univ. Hissar	1987	30 (88)	12 (06)	-
20.	Instt. of People Sci. & Tech., Chitrakoot – 485 331, Distt. Satna (M.P)	Facualty of Engg. MG Gramodaya Krishi Vishwavidyalya, Chitrakoot	1992	30 (13)	-	-
21.	Dr. B. R. Ambedkar College of Agric. Engg. & Tech., Etawah, U.P	Faculty of Agric. Engg., CSUA&T, Kanpur	1994	50	-	-
22.	College of Agric. Engg., Tumkur – 621 712 Distt. Tiruchirapalli	Faculty of Engg., Tamil Nadu Agric. Univ., Coimbatore	1994	100	-	-
23.	Deptt. of Agric. Engg., College of Agric., GKVK – 500065 (Karnataka)	Faculty of Agric., Univ. of Agric. Sci., Bangalore	1996	25	6	-
24.	College of Agric. Engg., P.O. Krishi Vishwavidyalaya, Mohanpur – 741 252 Distt. Nadia (W.B)	Faculty of Agric. Engg., BCKVV, Mohanpur	1995	20	-	-
25.	Faculty of Agric. Engg., Raipur – 492 012 (M.P)	Faculty of Agric. Engg., IGKVV, Raipur	1997	30	12	-
26.	College of Agric. Engg., & PHT Rangpo (Sikkim)	Faculty of Agric. Engg., Central Agric.	2006 Uni., Imphal	25	-	-
27.	Aligarh Muslim University, AligarhM	Institute of Agric.	2000	-	10	-
28.	CCS University, Meerut	Divn. of Agri. Engeering PG-Faculty	2006	30	-	-
29	SKUAST-K, Shalimar,Sgr.	Divn. of Agri.Engineering	2006	15	-	-
		Total		**1068**	**370**	**91**

Numbers in parenthesis indicate student passed till 1996.
Note:- There are also private colleges of Agric/ Food Engineering – 5 in Maharashtra, as well in Tamil Nadu (1), Chhattisgarh(1) and Gujrat (1)

Table 2: Relative comparison subject weightages in AE curricula recommended by ICAR, AICTE and as its exists

S.No.	Broad Subjects	ICAR (3rd Deens' Committee)		AICTE		Average present position	
		No. of courses	%	No. of courses	%	No. of courses	%
1.	Humanities and Social Sciences	1	2	2	5	1.7	2.5
2.	Basic and life/Agric Sciences	8	15	6	14	13.3	25.2
3.	Engineering Sciences	10	18	10	23		
4.	Professional AE	36	65	25	58		
5.	Total	55	100	43	100	52.7	100

Table 3: Break-up, number and credit hours of course recommended by Third Deans' Committee and AICTE

Sr. No.	Subjects	ICAR		AICTE	
		Credit Hrs.	%of total	Credit Hrs.	%of total
a)	Basic Sciences and Humanities	25	15.6	26	13
b)	Agric Sciences	17	10.6	21	10.5
c)	Basic Engineering	59	36.9	88	44.0
d)	Agric Engineering	59	36.9	65	32.5
i)	Farm Power & Machinery	12		14	
ii)	Soil & Water Engineering	12		18	
iii)	Processing & Agric. Storing	12		15	
iv)	Other	07		03	
v)	Project	06		06	
vi)	Electives	10		09	
	Total credit hours	160*	100	200**	100
	Total contact hours	210*	100	236*	100

* Theory of 1 hr. each and practicals– Sciences 2 hr. and Engg. 3 hr. each
** Include 37 contact hours of tutorials with credits with practicals of 2 hr. each.

Table 4: Eligibility of other disciplines to Masters Programme in AE (9)

S. No.	Institution	Soil & Water /Irr. & Drain.	Farm Power& Machinery	Agric. Processing & & Food Engg/PHT	Food Biotech Engg.	DairyEngg	AgroEnergy /BioEnergy Engg./ WM
1.	IIT Kharagpur	Civil E	Mech. E	Chem. E	-	-	-
2.	GBPUAT Pantnagar	Civil E	Mech. E	Mech. E Food. Sci. FoodTech.Dairy Tech.	Chem EBio-Chem E Food Tech. DairyTech.	-	-
3.	IARI, Delhi	Civil E	Mech. E	-	-	-	-
4.	NDRI, Karnal	-	-	-	-	Chem E Elect E Mech. E DairyTech.	-
5.	RAJAU, Udaipur (Campus)	Civil E	Mech. E	Mech. E	-	-	Mech. E
6.	TNAU Coim batore	Civil E	Mech. E	Chem. E Mech. E	-	-	Mech. E
7.	UAS Bangalore	Agric.		Agric.	-	-	
8.	AMU, Aligarh	-	-	Chem. E Mech. E M. Sc.Phy., M.Sc. Chem.	-	-	

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Criteria for Admission to Agricultural Universities in Maharashtra for Undergraduate and Postgraduate Courses

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Regulatory Mechanism

The Maharashtra Council of Agricultural Education and Research (MCAER), Pune is a statutory body which has been constituted under Section 12 of Maharashtra Agricultural Universities (Krishi Vidyapeeths) Act 1983. In exercise of the powers conferred upon MCAER vide provision in the proviso (g) of sub-section 3 of Section 12 of the Act, common regulation for admission to various degree programmes in State Agricultural Universities have been formulated.

Degree Courses, Duration, Credit Load and Eligibility

Undergraduate Courses

Sr.No.	Degree course	Duration	Credit load	Eligibility
1.	B.Sc.(Agri.)	4 Years (8 Semesters)	160	XII std.pased in 10+2 pattern from Maharashtra State Board of Higher Secondary Education or an equivalent Examination with Physics,Chemistry, Biology and English.
2.	B.Sc.(Hort.)	4 Years (8 Semesters)	165	
3.	B.Sc.(Forestry)	4 Years (8 Semesters)	163	
4.	B.F.Sc.	4 Years (8 Semesters)	180	
5.	B.Tech.(Agri.Engg.)	4 Years (8 Semesters)	183	XII std.pased in 10+2 pattern from Maharashtra State Board of Higher Secondary Education or an equivalent Examination with Physics, Chemistry, Mathematics and English.
6.	B.Tech.(Food Science)	4 Years (8 Semesters)	180	XII std.pased in 10+2 pattern from Maharashtra State Board of Higher Secondary Education or an equivalent Examination with Physics, Chemistry, Biology, Mathematics and English. Candidates, who had not offered Mathematics, shall have to complete deficiency courses as prescribed by respective university.
7.	B.Sc./Agri.Bio-Tech.)	4 Years (8 Semesters)	160	
8.	B.Sc.(Home Science)	4 Years (8 Semesters)	162	XII std. passed in 10+2 pattern from Maharashtra State Board of Higher Secondary Education or an equivalent Examination in Arts./Sci.Commerce with English. (Admission is open for Male & Female candidates).
9.	B.Sc.(A.B.M.)	4 Years (8 Semesters)	160	XII std. passed in 10+2 pattern from Maharashtra State Board of Higher Secondary Education or an equivalent Examination with Physics,Chemistry, Biology, Mathematics and English. Candidates who had not offered Biology or Mathematics, shall have to complete deficiency courses as prescribed by respective university.

Note:-

1. Those who have not offered Mathematics as one of the optional subjects at XII Std.shall have to complete 2 additional credits in Mathematics as deficiency course which will not be considered, while calculating the C.G.P.A. (For Sr.No.1,2 & 3 above.).
2. The candidates who have passed XII Std. examination/qualifying examination from outside Maharashtra State should have offered Physics, Chemistry, Biology and English subjects each of 100 marks separately.
3. Candidates from outside Maharashtra State who have passed qualifying examination of XII Std.or equivalent with Botany and Zoology instead of Biology are also eligible.
4. In respect of candidates passing higher secondary examination from any institute the candidate should have passed the qualifying examination with minimum 35% marks in each subject.
5. The candidates acquiring Diploma in Agriculture Science of Rural Institute Amaravati/Wardha under the jurisdiction of Dr.PDKV, Akola are qualified for degree courses where eligibility of Physics, Chemistry & Biology subjects is mandatory i.e. B.Sc.(Agri.), B.Sc.(Hort.), B.Sc.(Forestry), , B.F.Sc., B.Tech.(Food Science), B.Sc.(Home Science), B.Sc.(A.B.M.) & B.Sc.(Agri.Bio-Tech) in all SAU's.
6. The Candidates acquiring diploma in Agricultural Engineering from Jammu & Kashmir State with qualifying subjects mentioned in column of eligibility for B.Tech.(Agri.Engg.) will be considered for admission in the agricultural Engineering faculty.

Postgraduate Courses

Sr.No.	Degree course	Duration	Credit load	Eligibility
1.	M.Sc.(Agri.)	2 Years (4 Semesters)	50	B.Sc.(Agri.)degree or equivalent degree with four years duration of agriculture related universities & Entrance Text by MAUEB.
2.	M.Tech.(Agri.Engg.)	2 Years (4 Semesters)	50	B.Tech.(Agri.Engg.) degree or equivalent degree with four years duration of agriculture related universities & Entrance test by MAUEB.
3.	M.Sc.(Agri.Bio-Technology)	2 Years (4 Semesters)	50	B.Sc.(Agri.) or B.Sc.(Agri.Bio-Tech.) degree or equivalent degree with four years duration & Entrance test by MAUEB.

Note:

1. Postgraduate admission are on the basis of common entrance test(CET) of the current year conduced by Maharashtra Agricultural Universities Examination Board (MAUEB).
2. In respect of candidates passing graduation from an institute outside Maharashtra the candidate should have passed the qualifying examination with minimum 5.5 CGPA.

Ph.D. Courses

Sr.No.	Faculty	Duration	Credit load	Eligibility
1.	Agriculture	3 Years (6 Semesters)	70	M.Sc.(Agri.) degree in the concerned subject of the Agril. Universities in Maharashtra or degree of any other related agriculture University recognized as equivalent thereto.

Note:-

In respect of candidates passing post graduation from an institute outside Maharashtra the candidate should have passed the qualifying examination with minimum 6.5 CGPA.

Granting Recognition/Affiliation And Monitoring of Private Agricultural Education

A. Granting Recognition/Affiliation

1. The institutions, which have been considered as potential to start private colleges on non grant basis, be informed well in advance to create infrastructure facilities required for starting the colleges within six months. After which, a committee of experts under chairmanship of Dean of the concerned faculty be appointed by the University to visit the institutions to ascertain whether necessary facilities have been created by them before they are allowed to admit students for degree program.
2. After receiving letter of granting affiliation the institution shall deposit Rs.2.50 lakh to the University in the form of Demand Draft drawn in favour of Comptroller of the concerned University. Immediately after admission of students, a bank guarantee of Rs.2.50 Lakh be deposited to the university.
3. The initial intake of students for College of Agriculture should be 60 and College of Horticulture, College of Agricultural Engineering College of Agricultural Marketing and Business Management, College of Biotechnology and College of Food Technology it should be 40.

B. Admission Procedure

As per the intake capacity, 15% seats will be filled by MCAER, 70% seats will be filed by the university, 15% seats will be filled by the management. The management shall have freedom to select candidates fulfilling eligibility criteria. However, the list of such candidates be sent along with original documents for approval to the University. After approval of list, the admission of the students shall be confirmed.

Any litigation concerning admission of students (management quota), appointment of staff and service conditions shall be the responsibility of the concerned college and the university will not be responsible for such cases.

C. Re-admission

A student who leaves college with prior permission of the Associate Dean/Principal at the end of semester may be admitted by the Associate Dean of college on request of the student within three years of leaving the college provided the said curriculum of studies is in vogue. Such permission shall be granted only once during degree program. The Associate Dean shall inform the Registrar of the concerned university the name(s) of readmitted students along with details of such cases.

D. Cancellation of Admission

If students apply within one month from the date of admission for cancellation of his admission to the particular course, he will be entitled to get back his 50% of tuition fee, gymkhana fee, hostel fee and electricity charges, caution money etc, from the college.

E. Fee Structure

1. The admission to UG programs in private colleges should be done as per the existing policies of State Government. The fee structure approved by the Government of Maharashtra shall be made applicable to all education program offered by private colleges.

2. The tuition fee for non grant college shall be Rs.20,000/-per annum for Agriculture, Horticulture and Agricultural Engineering and for Agricultural Biotechnology and for Food Science and Technology it will be Rs.40,000/- per annum. For management quota (15% of total intake capacity), it will be three times the tuition fee.

3. The examination fee of Rs.1,000/- per student per year be sent to the University immediately after completion of admission process.

4. No private institute will collect any amount of fee from the students as laboratory fee/ museum fee, sport fee or any other kind of subscription from the student during entire period of study. This will be followed very scrupulously and any violation will result in disaffiliation of college by the university.

F. Transfer of Students

Students admitted to private college in any part of Maharashtra shall not be eligible to get transfer to constituent colleges of the concerned university or of any other State Agricultural University in Maharashtra. However, students may be allowed to get himself transferred to any other private college of same faculty in the university jurisdiction and any other college of same faculty of other State Agricultural University on mutual basis with the consent of both the colleges.

G. Conduct of Examination

The final semester end examination will be conducted by the MAU Examination Board. The date and timetable will be communicated to the college well in advance. The external examiners for conduct of examination will be drawn from constituent as well as private colleges. The recognition of a particular college as examination center will be granted after an inspection of facilities available with college for smooth conduct of examination. If college is not recognized as examination centre due to lack of adequate facilities, the students will be allowed to appear for examination at recognized centre.

H. Implementation of Academic Program

The existing academic regulations shall be made applicable in implementation of academic program including conduct of examination. The changes in academic regulation made from time to time shall come in to force from the date of approval by the Academic council of the University.

I. Constitution of Management Board

Each college shall have management board fro the supervision of functioning of college and monitoring the implementation of academic program. The representative of university shall be member of the management board.

J. Continuation of Affiliation

The team of agricultural scientists/educationalists appointed by the university under the Dean of the concerned faculty shall visit the college once in the three year and submit report to the university. On receipt of the report, the university shall place that report before the authorities of the university. The affiliation of the college shall be continued if the report is satisfactory.

K. Appointment of Faculty

The teaching faculty will be appointed as per the qualification prescribed in the Statutes of the university and as per the norms of teaching work loads prescribed by the ICAR. The selection committee constituted

for this purpose will have at least two experts from the respective subject and the representative of the university. The rules and regulations for appointment of staff followed in the university shall be applicable to selection or promotion of staff in the private colleges.

L. Recognition as Examiners

The faculty members of private colleges selected for examination work(theory or practical)need to be recognized as Examiner by the University/ Examination Board.

M. Accreditation

The non grant colleges shall be subjected to Accreditation by requesting ICAR to appoint Accreditation Committee within five years from starting of college. The report of the committee based on performance and infrastructure facilities shall be binding on the college for its implementation.

N. Representation on Faculty and Academic Council of the University

Necessary amendments in the existing Act and Statutes to have representation of private colleges on the faculty and Academic Council of the University are given below:-

Statute 4. The Academic Council

Exiting (viii) The Principals of affiliated colleges and recognized institution.

Suggested Modification

(viii) Two principals of affiliated colleges (nominated by the Vice-Chancellor) and recognized institution.

Statute 6. Constitution of Faculties

Existing (vi) The Principals of affiliated colleges and recognized institutions in the related Faculty.

Suggested Modification

(vi) Two Principals of affiliated colleges (nominated by the Vice-Chancellor) and recognized institution.

Act Section 33 (2)

The Academic Council shall consist of the following members

Existing

(vii) The Principals of affiliated colleges and recognized institution.

Suggested Modification

(viii) Two Principals of affiliated colleges (nominated by the Vice-Chancellor) and recognized institution.

O) Regulatory Authority for Agricultural Education in Private Colleges

As per the Supreme Court Judgment of October 31, 2002, Educational Institutions Regulatory Authority (EIRA) needs to be established to monitor private unaided colleges affiliated to agricultural universities.

Biotesting for Safety and Export of Agricultural Products

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For healthy living, safe water and eatables are as important as clean air for breathing, still all these are neglected commodities from sanitation point in developing countries. At international level, food safety and public health are primary concerns for World Health Organization (WHO) and Sanitary and Phytosanitary (SPS) regulations of World Trade Organization (WTO). These concerns overlap with trade regulations where agri-products are carriers of plant, animal or human diseases. Human ailments especially food-borne diseases are more prevalent in developing countries than in developed countries. Diseases like cholera, typhoid fever and liver fluke infections have virtually been eliminated in developed countries. A country's capacity to monitor and control food-borne diseases is an indicator of its capacity to regulate, monitor and control the safety of food for domestic consumption and exports.

Importing countries frequently require guarantees that exports are derived from pest or disease free areas, maximum hygiene standards have been followed during the process of manufacturing or that products are free of contaminants or residues. Recent developments in the international scenario taking into account GM foods and discussions on WTO regulations *vis a vis* Cartagena Protocol of Convention on Biodiversity are setting the stage set for major changes in the international trade of agricultural produce and in the export markets for India. Therefore the country must meet these requirements, relevant regulations and should undertake the necessary conformity of safety checks in order to gain export markets with no more rejections of consignments.

The investigation on safety and disease outbreaks due to agricultural products are multi-disciplinary tasks requiring skills in the areas of plant protection, plant microbiology, biotechnology, clinical medicine, epidemiology, laboratory medicine, food microbiology, biochemistry and chemistry, food safety and food control, and risk communication and management. Many outbreaks of diseases of such kinds, i.e. related to food (that includes drinks as well) are poorly investigated, if at all, because these skills are unavailable or because a field investigator is expected to master them all single-handedly without having been trained.

The WTO and Plant/ Animal/ Human Health Issues

The world today is witnessing the emergence of new global health threats for which control measures are still evolving. In addition many old diseases have become greater threat because they have developed resistance to the insecticides commonly used to treat them. In certain cases, when alien pest species are involved, may require trade restrictions on certain commodities such as quarantine or trade embargoes. Several new sources of food borne illness are of increasing relevance to international trade (spread of mad cow disease and its probable onward transmission to human beings). The trend towards the export of more foods coupled with consumer awareness and sometimes concern is increasing the demand relating to safety of traded foods. These issues are covered by Sanitary and Phytosanitary (SPS) Agreement, applied to any trade related measure taken to protect human life or health from risks arising from additives, contaminants, toxins, veterinary drug and pesticide residues or other disease causing organisms in food or beverages.

The SPS Agreement establishes that countries retain their right to ensure that the food, animal and plant products they import are safe and at the same time states that countries should not use unnecessarily stringent measures as disguising barriers to trade.

International Standards for Health to Facilitate Trade

The WTO states that countries should use internationally agreed standards in establishing their requirements. To meet this objective, three international standard setting bodies are identified: the Codex Alimentarius Commission for food safety, the World Organization for Animal Health (OIE) for animal health and the International Plant Protection Convention (IPPC) for plant health. By using standards, countries can reach the level of protection needed to protect human, animal or plant health. Countries may also adopt measures that differ from standards, but in these cases the measures should be technically justified and based on risk assessment.

The SPS Agreement and Health

The SPS Agreement gives governments the right to restrict trade to achieve health of plants/ animal as well as human beings, but the measures applied must be based on scientific evidences. The SPS Agreement also formally recognized the food safety standards, guidelines and recommendations established by the FAO/ WHO Codex Alimentarius Commission (Codex). The WTO beef hormone case emphasizes the international food safety regulations and international food safety standards. Article 5.7 of the SPS Agreement also authorizes the use of provisional measures when there is a lack of scientific evidence about health risks.

The TBT Agreement and Health

The WTO rules which govern technical barriers to trade (TBT Agreement) are applicable for protection of human health. Under SPS as well as TBT, health is considered a legitimate objective for restricting trade. The Agreement allows countries to obstruct trade for legitimate reasons, including health but its principles require that such measures do not unnecessarily restrict trade. One member notified a regulation, which limited the substances that are used in cosmetics and may cause allergies.

Safety of GM Food

The main food safety concerns are associated with transgenic products and foods derived from them relate to the possibility of increased allergens, toxins or other harmful compounds; horizontal gene transfer particularly of antibiotic-resistance genes and other unidentified effects. The use of genes from known allergenic sources in transformation experiments is discouraged and if a transformed product if found to pose an increased risk of allergencity it should be discontinued.

International Standards for Food Safety Analysis

These Codex guidelines indicate that the safety assessment process for a transgenic food should be conducted through comparing it with its traditional counterpart, which is generally considered as safe because of a long history of use, focusing on the determination of similarities and differences. If any safety concern is identified the risk associated with it should be characterized to determine its relevance to human health. The risk assessment begins with the description of the host and donor organisms and the characterization of the genetic modification. The subsequent safety assessment should consider factors such as toxicity, allergenicity and antinutrient.

Cartagena Biosafety Protocol and GM Food

The Protocol uses the principles on risk assessment, risk management and risk communication. It reflects the concept of substantial equivalence whereby the safety assessment should include, but should not be substituted for, a comparison between the food derived from modern biotechnology and its conventional counterpart.

Genetically Modified Crops as Animal Feed

Genetically modified crops like maize, oilseeds such as soybean and canola are used as farm, poultry feed. Safety considerations include the effects on the animal eating the feed and on consumers eating the resultant animal product, worker safety and other environmental aspects of using the feed. The major concerns associated with the use of GM products in animal feeds are whether modified DNA from the plant may be transferred into the food chain with harmful consequences and whether antibiotic resistance marker genes used in the transformation process may be transferred to bacteria in the animal and hence potentially into human pathogenic bacteria. The animals were fed a transgenic or conventional product for time periods ranging from 35 days for poultry to two years for beef cattle.

Labeling of GM Foods

The draft guidelines for the labeling of foods obtained through certain techniques of genetic modification/ genetic engineering are still in an early stage of discussion. The guideline is proposed to apply to labeling of foods and food ingredients in three situations, when they are (1) significantly different from conventional counterparts (2) composed of or contain GM/ GE organisms or contain protein or DNA resulting from gene technology and (3) when they are produced from but do not contain GE/ GM organisms, protein or DNA from gene technology. Countries differ in the types of labeling information that are mandatory or permitted.

Testing GM Food for Allergencity

Scientists agree that if a GM food contains the product of a gene from a source with known allergenic effects, the gene product should be allergenic unless tested and proven otherwise. A decision tree strategy is applied in the assessment of the potential allergenicity of the novel protein. Possible enhancement of the inherent allergenicity of the host plant food should be included in the assessment only when the intended effect of the genetic modification involves a significant alteration of the protein content of the food product derived from the host plant. When the transferred gene is obtained from a source with a known history of allergenicity, the assessment should focus initially upon the immunochemical reactivity of the newly introduced protein. A series of tests provide adequate evidence regarding the allergenicity of novel proteins expressed by genes obtained from plant sources. The concept of substantial equivalence was developed as a practical approach to the safety assessment of genetically modified foods. It does not characterize hazard, rather it is used to structure the safety assessment of a GM food relative to a conventional counterpart.

Food Safety in India

Food safety deals with microbial, chemical or pest contamination, level of toxins, food additives, allergens, residues of chemical substances (for example pesticides, heavy metals, hormones or other feed additives). Cholera and other diarrhoeal diseases traditionally considered to be spread by water are in fact food-borne. A recent survey showed 1.5 cases of diarrhea per person per year, one fifth of which require medical attention, compared with 0.03 case of diarrhea per person per year in developed countries. We stand at the threshold of a new century that brings novel methods of producing food, industrial materials, pharmaceuticals and other products. It is vital to set up surveillance system for food borne diseases and to monitor food contamination. Appropriate technologies have to be applied at suitable points in the food chain. High value crops and livestock production generate significantly more employment per unit area than do food staple crops. While significant progress has been made in some sectors, particularly increasing production, availability of food for every one; additional actions are required to strengthen country's capacity to manage food safety and agricultural health.

Transgenic (Bt) seeds of cotton were available with the farmers even before government gave permission for their commercial cultivation. Oil extracted from transgenic cotton and imported soybean is now avail-

able in the market but no has bothered to look into the practical concerns or standards on labeling and traceability so far on oil and oil cakes; though "Prevention of Food Adulteration Act, 1955 amended in 2006" has provision on GM labeling. Ministry of Health & Family Welfare chose to go to GEAC's definition of calling the Bt cotton crop as a non-food/ feed crop. The labeling is one way to comply with the Cartagena Protocol on Biosafety requires countries to take measures to ensure safe handling and consumer rights, preference or choices.

Processed GM food will now be monitored and regulated by the Food Safety and Standards Authority of India, which was established under the new Food Safety Standards Act. Till recently, GM food clearance was under the purview of the Genetic Engineering Approval Committee (GEAC).

The only abattoir (slaughter house) of some quality is coming up near Delhi and is likely to take care of domestic meat industry, otherwise for last so many years we had slaughter houses at several places for the name sake – a very unhygienic place with no standards of animals, waste disposal, storage or distribution. There are number of weakness in the fresh horticulture produce sector. Pesticides higher than permissible limits in underground water, cold drinks, vegetables (onion, cauliflower, beans) are very common. There is no comprehensive data available on use, not permissible colouring agents, adulteration of spices and unhygienic cooking conditions and surveillance figures on food and water borne diseases.

Table 1. : Major standard related to safety and export requirements for agricultural products

Product group	*Standards/ regulations requirements on*
Fresh and processed fruit and vegetables	Pesticide residue limits, microbiological standards, traceability requirements, hygiene requirements and control on additives
Fish and fish products	Microbiological and foreign matter standards and factory hygiene standards
Live animal and meat products	Veterinary drug, residue limits, microbial standards, contagious and economically significant diseases
Cashews/ groundnuts	Mycotoxin limits, microbiological standards, pesticide residue limits
Cereals, oilseeds and animal feed	Microbiological standards, pesticide residue limits and mycotoxin limits
Coffee and tea	Pesticide residue limits and ochratoxins

Policy - Should India Produce GM Food - Crops/ Animals/ Fisheries

In February 2008, the European Union has decided to stop all imports of rice from China unless certified free from contamination with Bt63 rice. Apprehending transgenic contamination, Russia had insisted on a written confirmation from Government of India that no GM crops in rice, groundnut and sesame seeds exist in India. This has put GEAC in a fix and could ultimately certify that "no GM of these three food items exist in commercial production" in India.

Constraints in meeting Export Standards of Food

There are number of weakness in the fresh horticulture produce sector which are hampering our produce to meet the international standards. Growers still over rely on pesticides to treat pests and diseases. Government's extension expertise in production of export quality produce by extending pest and disease monitoring, rational use of only recommended pesticides, time interval between harvest and pesticide application is lacking. Most of the produce is placed at the lower end of price range on the basis of quality and shelf life. The mindset of many exporters is to buy cheap and sell cheap. The Gulf market is considered a market for a competitive low priced product.

The supply chain is weak and fragmented leading to poor product traceability. Most often Indian exporters are not able to provide the records to trace the product back to the farm and are not monitoring their supplier food safety risks and therefore are unable to satisfy. The survey and surveillance data, very essential for pest risk analysis and declaring pest free areas are lacking, thus allowing importer countries

to lay down conditions that dictate treatments for pest and pathogens that may not be present or prevalent in the areas of export.

For exports from our country, most of food items rejected in the past are due to adulteration of Sudan colorants or due to unsatisfactory post harvest storage or processing techniques which provide the build up of aflatoxin or erucic acid or the development of Ochratoxin A or pesticidal residues in table grapes. Now meeting the import conditions of European Union are becoming still more difficult, like labeling for allergens for walnuts or other nuts, as canned foods and confections. Some of the markets are beginning to insist on specific fresh produce harvest treatment, in conjuction with the inspection of both the horticultural production units and the packhouses as well as pest risk assessments. Most of the countries are now insisting on testing and marking maximum residue level (MRL).

Food and water diseases remain the most important category of concern for export and domestic health of number of fish/ meat or crop products. A number of European countries are asking for EUREPGAP certificate for the farm production units. Few farms are in a position to gain certification; in fact many farms do not produce fruit and vegetables under a GAP regime, where ICM and IPM practices have to be observed. The certificate requires data on workers health, safety and welfare and environment issues.

Post harvest treatments required by Japan, China and Australia for mangoes and 'kinnow' insist that fruit needs to be treated in order to ensure fruitfly (*Bacterocera dorsalis* and *B. zonata*) among other pathogens and pests, are controlled. The vapour heat treatment (VHT) methods are at their maximum limits of fruit's tolerance and affect quality and shelf life. Citrus is sensitive to chilling at the temperature specified for the length of time, by imports from China.

India's trade in beef and poultry, especially to the Middle East has been affected by foot and mouth disease (FMD) and avian influenza. The Rinderpest disease is known to be there in cattle and buffalos in the country. Over the years there have been periodic problems with fish production industry due to non compliance to safety and sanitary conditions of the destination market. It requires that fish processing facilities should undertake "own checks" with reference to all actions aimed at ensuring and demonstrating compliance to standards laid down by EU legislation.

Unfortunately many low income countries have been hindered in their efforts to integrate into the global economy by inadequate policies, institutions and infrastructure on one hand and by a variety of protectionist measures and other policies that restrict low income countries exports, on the other. It is time for all agribusiness sectors to work together for the common aim of achieving a robust SPS management system, An institutionalized grading and tracking system is required for all exportable items viz. fruit, meat, livestock production, fish, shrimp production and processing.

Recent Developments in India in the Food Front

1. Draft protocol for assessment of toxicity and allergenicity in transgenic crops has been recommended by the Review Committee on Genetic Manipulation (RCGM), Department of Biotechnology to review the existing protocols on toxicity and allergenicity testing of transgenic crops under the chairman of Director, National Institute of Nutrition, Hyderabad

2. Indian Council of Medical Research (ICMR) Guidelines for the Safety Assessment of Foods Derived from Genetically Engineered Plants are being revised.

3. **Draft guidelines for safety assessment for the safety assessment of foods derived from genetically engineered plants available for public comment. The guidelines can be viewed at** http://icmr.nic.in

4. The South Asian Biosafety Program (SABP) is asking for information on information on technical training needs for food, feed safety; policy issues on international trade, environmental safety and sustainability.

5. Comments by the Ministry of commerce are being sought on " Genetically modified food crops have the potential to raise agricultural productivity in India but they are also associated with the risk of market access losses in sensitive importing countries". At http:// ifpri.org

6. Discussions at national and international level are also being made whether four rice growing and exporting countries (India, Bangladesh, Indonesia and the Philippines) should start cultivating GM rice; there is a fear of losing sensitive markets

7. A biotech declaration has been made mandatory for imported food, feed, bioengineered organisms or LMOs by a notification issued by 'Foreign Trade, Ministry of commerce and Industry. http: 164.100.9.245/exim/2000/exim/2000/not/not06/not0206.htm.

8. On an interim basis, recently the GEAC approved the import of refined soybean oil subject to certification from the country of export that it has been derived from Roundup Ready soybean.

FUTURE STRATEGIES TO MEET THE CHALLENGES

Food Safety Plans for the Country

There is need to have food safety laboratories under the technical guidance from National Institute of Nutrition, Hyderabad; having chemical and microbiological analysis facilities. The tasks to be assigned to laboratories are (i) analyse food and water samples for contamination levels (ii) provide supervision on food hygiene and safety issues at food malls (iii) screen and identify sources/ causes of food borne diseases (iv) collect and store samples for solving food borne disease outbreaks. Development of database on pesticide use, violations and so on using testing technology in the production areas backed up by appropriate extension activities for pest surveillance and control strategies. Strengthening enforcement of maximum residue levels in partnership with private wholesale buyers and food chains now coming up in the country. All materials and chemicals used in processing of foodstuffs must be available in packaged form and pass through inspection laboratories.

Unprocessed foodstuffs derived from plants, animals and fish must need a certificate of domestic quarantine by competent state agencies.

Agri-food Export Plans for the Country

Compliance with the SPS Agreement required remains conducting a review of existing phytosanitary legislations to ensure legislative compliance with the national regulations of the importing country and international agreements. Following aspects need enhanced emphasis to improve prospects of our export markets

1. Survey and surveillance to look for pest free places of production in the country for the pests of quarantine importance

2. Development of standards for post harvest disinfestation treatments for the commodities of export interest

3. Registration of export orchards and packing houses

4. Pest and pesticide use – control program

5. Pre- export inspection by NPPO

6. Packaging and labeling compliance
7. Phytosanitary certificate by the NPPO
8. Approved phytosanitary treatment plans and registered facilities
9. Specific conditions for storage and movement

Trained Manpower on Biotesting for Safety and Export Requirements

Safety studies on agricultural products involve study of the commodity from the angle of number of disciplines which are not much related with each other and it is generally very difficult to get comprehensive scenario of the problem and solutions there of. Factors which contribute to man/ animal or plant diseases due to poor hygiene at all stages of the food chain, lack of preventive controls in food processing, misuse of chemicals, contaminated raw materials, ingredients and water, inadequate or improper storage. So to develop a man force to look into all aspects of safety for consumption and exports of agricultural commodities we should have team of persons trained in (1) microbiological hazards (2) pesticide residue analysis (3) misuse of food additives (4) study on pest and pathogens which may spread through the commodity as a pathway (5) chemical contaminants, including biological toxins (6) adulterants and the list has been further extended to cover (7) genetically modified products, allergens (7) veterinary drugs and growth promoting hormones used in the production of animal products.

Importer or consumer expects that produce be protected from all hazards so there is lot more expectations from universities to produce trained manpower in relevant subjects to meet the need based targets.

Summary and Conclusions

Food safety and agricultural health concern fall in three different but related categories, namely risks to consumers from potential illness from consuming contaminated/ unhygienic goods and introduction of diseases in the country of import or loss of export market due to sanitary reasons or in worst situation all of these. At the same time, international trade of 'safe products' has expanded enormously over the last few decades because of changing consumer tastes and advances in production, transport and other supply-chain technologies. Fresh and processed fruits and vegetables, fish, meat, nuts and spices now collectively account for more than 50 percent of the total agri-food exports. One important development that seriously affects the export market of a country is the proliferation and strengthening of product safety and agricultural health standards, a significant advancement occurring at the national and international levels. Although food safety and agricultural health standards are designed to manage risks associated with the spread of plant and animal pests, incidence of microbial pathogens or contaminants in food and recently added parameter if the product is from a genetically modified source or not, also can be used as a trade barrier. Some of the real trade concerns to certain countries are certain plant pests and animal diseases that spread through produce, especially those which spread easily and require stringent controls or eradication measures. Countries are increasingly shifting to production to consumption perspective, requiring traceability of animals, products and raw materials, while national systems for border inspections/ quarantine measures of food and plants have been improved.

Among the horticultural industries common constrains are related to excess use of pesticides, capacities to implement phytosanitary measures and undertake pest risk analysis. Among the fish product industry common problems include lack of clarity about administrative responsibilities for inspection and certification of facilities and products and the persistence of unhygienic conditions at fish landing/ processing sites. In meat sector weak surveillance system for animal health, unhygienic and outdated slaughter houses are most common weaknesses. The cost of complying with food safety and agricultural health standards has been a major constraint in developing countries. Still well planned strengthening of SPS management

capacities can contribute to growth, poverty reduction and improve upon national and international public products. If constrains are removed through adoption of suitable safety and export standards, there could be a spectacular export driven growth in the fruit, coffee, cashew, spices, fish and meat sectors. With regard to pest control and eradication, the establishment of pest free zones for fresh fruits does not appear to be economically or operationally feasible, especially when post harvest treatments are available to meet international standards. Huge polyhouses/ glasshouses, as pest free sites for high value crops (kiwi/ strawberries/ grapes/ tomato/ roses etc.) are feasible methods.

By including the safety first principle in the Cartagena Protocol on Biosafety, the European Union has blocked importation GM food on the grounds of doubts or lack of sufficient information. The US, a non-member of Convention on Biodiversity (CBD) but an active member of WTO, has put very strongly that only transgenic foods which are substantially different from traditional ones warrant labeling regulation. US expects that WTO should prevail over Protocol and huge quantity of transgenic crop and animal products find lucarative Europeon Union markets, thus leading to transatlantic food war.

Domestic food, agricultural food products, situation needs improvement because enforcement of national safety standards and law 'Prevention of food adulteration rules 1955, recently amended in 2006' agencies are not fully functional for which main reason is lack of awareness among consumers. The access to export market to Indian products can only be achieved through improvements in the quality and meeting SPS and Protocol.

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Policy on Biotesting for Safety and Export of Agricultural / Livestock Products

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Agriculture in India has undergone a sea change during the last 15 years. Despite slowdown in agricultural output, terms of trade for agriculture have moved on a downward trend during 1996-97 to 2004-05. The main focus of India's trade policy on agriculture has been to protect domestic agriculture against adverse impact of import and to promote export to fetch better prices for the farm produce. Around 2000-02, India was accumulating huge stock of food grain and it was looking for opportunity for exports. International prices of most of the commodities were low and exports were very difficult. It was appropriate for the country in that context to seek changes in domestic support, market access and export subsidy which would lead to higher international prices and pave the way for more export. The export of agricultural products for the year 2005-06 is presented in table 1.

Market Access

Under this, the agreement primarily envisages tariffication of all non-tariff barriers. This includes tariffication, tariff reduction and access opportunities. Non-tariff barriers such as quantitative restrictions (quota import restriction through permits, import licensing etc.) are to be replaced by an equivalent tariff.

Market access also includes Special Safeguard Provision which allows the imposition of additional duties when there are either import surges above a particular level or low import prices as compared to 1986-88 level.

Domestic Support

This envisages the reduction commitments of subsidies provided to domestic producers. It stipulates that the total support given in 1986-88 measured by the Total Aggregate Measure of Support (TAMS) should be reduced by 20 per cent in developed countries and 13.3 per cent in developing countries.

Policies which have no or at most minimal trade distorting effects on production are excluded from any reduction commitments and called Green Box policies.

Green Box policies include policies which provide services or benefits to agriculture or the rural community, public stockholding for food security purposes, domestic food and security purposes, domestic food aid and certain de-coupled payments to producers including direct payments to production limiting programmes, provided certain conditions are satisfied. Besides it also envisages Special and Differential Treatment provisions for developing countries permitting them to undertake untargeted subsidized food distribution to meet the urban and rural poor and investment subsidies available to agriculture and input subsidies available to low income and resource poor farmers in these countries. The expenditure made on the above items are excluded for calculation of AMS.

Export Subsidies

The agreement contains provisions regarding members' commitment to reduce export subsidies. Developed countries are require to reduce their export subsidy expenditure by 36 per cent and volume by 21 per cent in six years. In equal installments (from 1986-1990 levels) The percentage reduction are 24 and 14 per cent respectively in equal annual installments over 10 years for developing countries. Besides , the

Agreement specifies that for products not subject to export subsidy reduction commitments, no such subsidy can be granted in the future. In India, exporters of agricultural commodities do not get any direct subsidy. Only subsidies on cost of freights on export shipments of certain products like fruits and floricultural products are being given.

The export subsidies, which require reduction commitments are non-existent in India. Exemption of export profits provided in India from income tax under Section 80-HHC of Indian Income Tax Act is not among the listed subsidies. Further, developing countries are free to provide certain subsidies, such as reduction of export marketing costs, internal and international transport and freight charges. India is making use of these subsidies in certain schemes of Agricultural and Processed Food Products Export Development Authority (APEDA), especially for facilitating export of horticulture products.

Trade Issues

The effects of components of agreement on agriculture (AoA) such as improving the market access (tariffication), reduction in domestic support given to agriculture (AMS) , reduction in export subsidies provided for agricultural commodities and trade related intellectual property rights (TRIPS) for agricultural inventions are to be analyzed in proper dimensions since such obligations have an impact on agricultural output and employment.

Sanitary and Phytosanitary Measures

Another important issue in market access is the technical barriers. Importing countries particularly developed countries tend to intensify the use of technical barriers namely sanitary and phytosanitary standards to protect the domestic producers' interests in developed countries. Meeting sanitary and phytosanitary standards are far more complicated and costly in the case of processed food than in primary agricultural products. Thus these standards can retard trade even when they are imposed on genuine health and safety considerations because of non-availability of compliance resources and expertise to government and food supply chain in developing countries.

Table 1: Export of Agricultural Products for the year 2005-06

Sr.No.	Commodities	(Quantity : '000 tonnes) (Value : Rs.Crore) April 2005-March -06	
		Quantity	Value
1.	Pulses	444.61	1102.62
2.	Rice Basmati	1161.44	3030.32
3.	Rice (Other than Basmati)	3905.41	4144.03
4.	Wheat	745.56	557.12
5.	Other Cereals	658.69	512.88
6.	Tea	157.91	1632.09
7.	Coffee	177.89	1577.07
8.	Tobacco Unmanufactured	144.06	1027.7
9.	Tobacco manufactured	-	302.41
10.	Poultry and Dairy Products	-	785.7
11.	Floriculture Products	-	304.69
12.	Spices	402.94	2218.09
13.	Cashewnut Shell Liquid	4.41	6.98
14.	Cashew	124.1	2562.77
15.	Sesamum Seed	196.16	735.29
16.	Nigerseed	27.72	58.8
17.	Groundnut	185.11	500.53
18.	Guargum Meal	186.53	1042.19
19.	Oil Meals	6969.51	4826.07
20.	Caster Oil	253.4	934.41
21.	Shellac	9.67	161.18
22.	Sugar	316.85	557.1
23.	Molasses	72.46	27.29
24.	Fruits/Vegetable Seeds	10.04	89.97
25.	Fresh Fruits	-	1101.22
26.	Fresh Vegetables	-	910.94
27.	Processed Vegetables	-	472.94
28.	Processed Fruit Juices	-	600.18
29.	Miscellaneous Processed Items	-	978.98
30.	Meat and Preparations	-	2647.5
31.	Marine Products	461.06	6355.84
32.	Cotton Raw including Waste	595.88	2791.87
33.	Jute Hessian	-	488.8
34.	Poultry Products	-	326.36
35	Paper/Wood products	-	4431.09
36.	Total Agricultural Exports	-	49802.92
37.	Total National Exports	-	454799.97
38.	% Share of Agricultural Exports National Exports		- 10.95

Source :- Director General of Commercial Intelligence & Statistics, Ministry of Commerce, Kolkata

Policy on the Role of Basic Sciences (Livestock) in Agricultural Education

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Even after 60 years of independence of India more than 60per cent of population are directly or indirectly associated with agriculture. During our independence the total population was 55 crores and now it is about 110 crores. Sixty per cent of 55 crores are much less than 60 per cent of 110 crores. This makes a tremendous pressure on the total areas available for cultivation. However, by employing various scientific methods our agricultural produce were increased many folds. Green revolution has created some success stories. This was followed by white revolution pink revolution, etc. However, recently the agricultural production has gone down to an alarming level. Therefore, development of livestock sector is the need of the hour to provide some financial support to the poor, marginal and landless farmers. Maintenance of livestock is an age old practice in India. But the development and improvement of livestock by scientific management system is almost absent in the backyard animal husbandry sector. Role of the veterinary graduates are of immense importance for this purpose.

Our veterinary curriculum to be framed in such a way that veterinary graduates can accept this profession with dignity and serve the nation as friends of animals.

The livestock sector has provided a consistent sustainability and stability for the national economy. This is evident by the fact that the contribution of this sector to the GDP has risen from 14 to 23 per cent, on the contrary agricultural sector has undergone a decline from 35 to 26 per cent during 1980-81 to 1989-98. With the changing scenario of food habits the animal based foods like milk, meat and eggs have gained lot of popularity.

Veterinary Council of India has given a guideline for minimum standard of education. But, this requires to be restructured depending on the present scenario. Our present system is teacher directed rather than student directed. In formal lecture, the transfer of information involves the student making notes from teacher's oral presentation. The efficiency of knowledge transfer is largely determined by the abilities of student to use memorized information in written examination. We shall have to think that teaching is for limited period but learning is life-long process and continuous. We would teach the student in a manner so that we can focus on the ability of the students to organize, manipulate and retrieve information as to use that information to solve the problem.

Teaching now must be considered on creating an environment for student growth. The student is now to be trained for active research, discuss and apply new knowledge in the context of problem situation and should not be considered as passive recipient of information. Students must be evaluated on their ability to find information and apply those information to real or simulated problem. The teaching should be aimed to promote and enhance student's analytical skills, self-education skills, inter-personal and communication skill and professional behaviours and attributes. Our role should be oriented for encouraging students for leanings once the basic problems/terminologies are explained rather than teaching.

In the days of financial crunch and astuteness in the country, running any educational institute is being seen in the attitude of non-productive business. But, the quality of education is often questioned. The student in a college dealing with livestock educational system is considered to be a valuable product provided he is educated in a more practical oriented education system.

Rather than, giving more emphasis on class-room (theory) teaching, some techniques are required to be enforced, viz. (a) Group discussion, (b) Seminars, (c) Workshops, (d) Simulation, (e) Case study method, (f) Role-Playing (socio-drama), (g) Brain storming, (h) Buzz session, (i) Electronic based education through internet.

In the changing scenario of education, especially in livestock sector, the veterinary graduates may be encouraged to have Managerial, Entrepreneurship and Service (MES) orientation through their curriculum.

Policy makers may think to (a) introduce the functional management discipline in the U.G. curriculum (b) integrate the entrepreneurial, public and private service philosophy into each of the production, paraclinical and clinical disciplines with curriculum for public and private service as electives. This integrative approach may result in graduates as job givers and not as job seekers by mastering both science (Veterinary and Animal Husbandry) and art of management and entrepreneurship. At present the services to the livestock sector is provided by the State Animal Husbandry Department (SARD). The veterinary education is designed to meet the needs of the gradates in public sector. Since SARD can no longer provide employment, strong curriculum initiatives are needed to be link state responsibility to provide employment to all by the introduction of MES orientation in veterinary U.G. education.

In the developed countries 50-75 per cent jobs for vets are in private sector companies to developing countries where 10-20% go for private sector jobs. National Commission on Agriculture way back in 1976 recommended one graduate vet. for 5000 livestock units. The annual out-turn of Vet. Graduate is around 2000, which may be little high (2.5%) (based on trend will be 2280). However, livestock sector is growing at the rate of 6%, poultry 10-15%, so the desired turn of graduates would be 3000 per year.

In the changing nature of livestock outreach service delivery leading to decreased employment opportunities in the public sector, requirement of vety. manpower on par with livestock economy growth rate and potential of livestock and livestock products trade in international market there is a need to re-look on policy with MES orientation.

However, there must be flexibility in the syllabus. Because the expansion of AH at the grass root level depends upon the socio-economic conditions and the food habit of the people. Selection of animal breeds for AH and the health bazard of the animals, varies with the geo-climatic condition of the farming areas. Emphasizing on these, every University should have some flexibility to frame their own syllabi.

Hands on training should be a compulsory part of the curriculum. Students should select some villages for practical studies and demonstration during their course of studies. This is needed for their exposure to the real conditions of the peoples involved in animal husbandry in the villages. This would help students to develop their skill for the management of animal husbandry and to do practical works as a veterinarian. Considering all these aspects the animal husbandry curriculum should be framed.

Moreover, for organized animal farms also well trained veterinarian with practical knowledge in AH is essential.

Agricultural Education Policy for Fisheries and Sea Foods

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India is bestowed with unique, rich and diverse bio-resources, which contribute significantly to the gross national product of the country. These bio-resources are an integral component of the rural economy and to a greater extent essential for human survival and sustainable development. Indian Fisheries Sector has shown tremendous progress in last 50 years. There is an increase in fish production of the country from 752 thousand tonnes (1950-51) to 6572 thousand tonnes (2005-06). The fish seed production, which was 409 million fry at the end of IV five-year plan, has gone up to 22,615 million fry during the year 2005-06 during the X five-year plan. Present fish production in the country is more than 6.4 million tonnes out of which Inland Fisheries Sector contributes more than 50 percent. The fishery sector also helped in generation of employment opportunities especially in the coastal rural area. The country has continental shelf of 530 thousand Sq. km area and 8118 km coastal line for marine fisheries with 1376 landing centres; 1240 thousand Ha. brackish water area with productivity of 10189 kg/ha/annum; and 195 km rivers & canals and 73.59 lakh Ha. total water bodies for inland fisheries. This huge natural resource is still under-utilized. Non-availability of technical expertise and poor infrastructure are the main constraints in exploring these resources to their fullest extent.

Inspite of such growth, the fisheries sector is not explored to its fullest extent due to several constraints viz. availability of skilled human resource, development and dissemination of new technologies, high receptivity of fishermen and women and increased investment by the government. Although, the technology development has been the result of sustained research efforts of the central and state fisheries institutions and traditional universities, the efforts are inadequate. The future of Indian fisheries will be in the hands of these currently passing out graduates and postgraduates from fisheries colleges as well as from traditional university system. Thus, there is an urgent need to streamline fisheries education.

Priorities and Opportunities

In order to meet the obligations of the current millennium, the time is apt for reorientation and prioritization of activities in education, research and extension. The policy programme should be designed to ensure multidisciplinary approach cutting across disciplines and faculties. To mention a few:

(a) Development of knowledgeable and intensively skilled human resource in fishery sector by undertaking programs to improve faculty competence and capacity building in the Universities and the institutes. Emphasis should be given on skill and entrepreneurship development amongst the graduates of the Universities in view of the current global trend of liberalization and privatization. To produce graduate professionals who shall be; self confident, self reliant, Self-competing individuals, fully committed to contribute to science and technology and help in sustaining productivity alleviating poverty and unemployment, preserving integrity of environment, respond to market forces and clients' concerns and employers rather than job seekers.

(b) Development of improved fish disease diagnostics for diagnosis of diseases and immunosensors, by using molecular virology and other biotechnological tools.

(c) Strengthening Research extension linkages through trainers training, distance and virtual education and meeting farmers/fishermen at their doorsteps and Integrated approach for transfer of technology and monitoring technology dissemination by creation of technology feed back bank.

The education policy document should provide a definite direction to the growth of universities imparting education and research in fishery science keeping in view the current needs and aspirations of the fishermen/farmers in consonance with the newer advances in science and technology and emerging challenges, so that education imparted by the University remains locally relevant and globally competitive. Besides, this would also provide the required R & D backup to the policies and programs of the state development departments for creation of skilled and enterprising human resource.

Educational Impact Assessment and Shortcomings

In an educational system, it is very difficult to assess the outcome impact. There are several outputs that cannot be measured in economic units. For example, it is difficult to assign an output value to graduate trained by the University. Every year, total 15 colleges in India produce around 500 graduates and 200 post-graduates (150 masters and 50 Ph.D.) in fishery faculty. A large number of graduates have been employed in various state/central government services and private industries. These graduates are shouldering the responsibilities of the state departments, in the area of fisheries husbandry. They have lent their intelligence and knowledge in development of the fishery sector. Most of the fishery colleges have been established in areas that are well known for fishery activity.

Perspective New Educational Methods and Curriculum Development

The educational system must be able to meet the challenges by accepting newer developments, molding them into learning forms and devising optimal methods of presentation. There is ample scope for integration of disciplines and multidisciplinary teaching with inter departmental co-operation, facilitating interest in students towards learning with better understanding of the subject. A basic assembly of facts can be further brought to life by adding problem-solving assignments to prepare the students to face real life situation. It is proposed to assign the education material development to the senior faculty of the University who would coordinate and collaborate with the students in this task.

To propel the Indian fisheries into the 21sth century, the quality, technical skill and management of fisheries manpower must improve in consonance with the rapidly changing needs of the fisheries sector both nationally and internationally. Human Resource Development for raising a cadre of experts at various levels to support research and vindicate a sustained development in fisheries sector is critically important to India. It is in this context the role of Fisheries Colleges attain paramount importance.

Overall, the status of fisheries education in the country leaves much to be desired. Most of them suffer from the following common lacunae:

- Lack of basic infrastructure, farm and processing laboratories
- Inadequate staff and funding support
- Insufficient government support in ensuring employment opportunities.
- Lack of training facilities
- Lack of linkages among Industry and Institute.

Formulation of uniform fisheries education, in terms of course pattern and content, throughout the country would ensure standard in the education. The ICAR could come in a big way to develop basic infrastructure in the fisheries colleges. Important infrastructure/equipments required for the development of college will be provided by ICAR under the scheme ICAR scheme on development and strengthening of SAU.

Qualified and trained manpower is a critical input for sustainable fisheries development. Fisheries education had a late start in India. Till the sixties 'fisheries' education was confined only to a special paper in

postgraduate programmes, in disciplines like zoology in some universities. Under the State Agricultural University (SAU) system fisheries education the first College of Fisheries was established at Mangalore under the auspices of the University of Agricultural Sciences, Bangalore, in 1969.

Traditionally, the curriculum of most of the fishery colleges world over, seek to prepare the individual as a "generalist", who can meet all the needs of fishery sectors i.e. marine, brackish water and the inland. This put pressure on the syllabus in that the students get patches of knowledge in different disciplines. The curriculum framing is in the domain of ICAR, who has mandate to frame uniform syllabus for maintaining standard throughout the country. This leaves little space to excel in local areas of expertise.

The Fourth Deans Committee has given flexibility of deviating for about 25-30 percent as per the local need. This is a good move for accommodating the regional requirement for marine, brackish and inland fishery technologists. The new syllabus is blend of skill development and theoretical understanding, but with the available human and infrastructure recourse, it is difficult to achieve these goals. There is acute shortage of good textbooks and teaching materials that are in tune with our fishery husbandry practices and culture. The current policy of selection of students in the fishery streams, rely more on marks obtained in examination rather than interest and aptitude for the chosen profession. The focus in teaching methodology is more on delivering structured lecture, rather than self-exploring and problem solving method of knowledge empowerments. Thus the graduates although well prepared theoretically are not confident enough to solve the actual problems. The training is more in tune with producing officers for government or private employment, and there is also little institutional support for preparing the students for entrepreneurship.

Experiential Learning : Under Hands-on Training", a minimum of two areas should be decided by each University as detailed below depending upon local needs and industrial demand. It is expected that the students will prepare a business / work plan for the relevant area of specialization. An end-to-end approach is to be followed in implementing the program. (For example, in processing: the program may start with raw material procurement, and include processing, packaging and storage, organize resources and utilities, sell the product, maintain accounts and documents, wind-up production and submit a report of performance). While identifying the area of specialization, the college shall take into account the faculty and infrastructure facilities available and their regional significance. The areas of specialization for "Hands-on Training", Ornamental Fish Culture, Seed Production, Trade and Export Management, Aqua-Clinic, Post Harvest Technology, Aqua Farming

In-plant Training

"In-plant training" program for each student or a batch of students shall be sent to the aqua farm, hatchery, ornamental fish culture unit, processing plant, product development unit or export agency - whichever is accessible to the college.

Non- formal and Distance Education

Colleges are encouraged to offer non-formal training program that are need-based, customized and self-financed. They may be either certificate courses of 6-12 months duration or diploma courses of 2-3 years duration. The eligibility would be 10+2. However, they shall not become permanent programs and shall be co-terminus with the market needs. There is a good scope for distance education and virtual programs for important areas of fisheries sector viz. aquaculture, ornamental fish culture and breeding etc. taking advantage of IT tools available now. For content development each college need to be provided Rs. 5 lakh.

A task force of senior fisheries professionals and industry representative should be constituted to decide what is best for the country. There is an urgent need for having specialized courses viz, fish disease, fish nutrition, fish genetics and biotechnology, fisheries economics, fisheries extension, where students with

B.F.Sc. degree can pursue masters and doctoral programmes in the above-mentioned specialized areas. For an all round growth of fisheries sector, it would be appropriate if 80% of personnel have fisheries background and 20% with basic and social sciences. The Fisheries Development Officers should essentially have B.F.Sc./M.F.Sc. degrees.

Imbalance in fisheries education is also visible in states like Madhya Pradesh, Rajasthan, Punjab, Haryana, Himachal Pradesh and Jammu& Kashmir, which yet do not have a fisheries college. Depending on the available resources and their potential , M. P. and Rajasthan can support a full fledged fisheries college each under their SAU's , while Punjab, H.P., J&K and Haryana can have one regional fisheries college collectively.

Students Amenities and Development of Communication Skills

It is generally a neglected area and needs urgent attention. The hostel space, the classroom space needs to be standardized to the level of International Institutes. New facilities, such as, computers, photocopying, e-mail, internet surfing and telecommunication should be provided in the hostels. For education to be a continuous process, computer facilities should also be provided in the hostel premises equipped with learning programs, video interactive modular programs. In order to reap benefit of the expertise available in outstations, facility for real time video interactive classes need to be developed.

Graduate Teaching Assistant Programs

In order to elevate the standard of post-graduate education, attempts should be made to introduce graduate assistantship to post-graduate students, with the help of either the state or central government. This will make available teachers to fill the deficit on affordable basis. Additionally, these post-graduate will develop communication skill, and their knowledge level will also increase.

Establishment of The "National Fisheries Council"

Establishment of the Fisheries Council is necessary to ensure quality in fisheries education and for the development of the fisheries profession along the lines of the Medical Council and the Veterinary Council. Again, the ICAR could play a catalytic role in the establishment of the Fisheries Council of India. The council could oversee availability of infrastructure facilities, recruitment and selection, staffing pattern and requirements of curricula and standards.

Provision of the following facilities to the colleges would also help them:

1. Linkages between the colleges and ICAR fisheries research institutions to make use of the facilities of the later by the former.
2. Research and Training support by the Industry to the colleges.
3. Teacher competence and evaluation.
4. Internship for the fisheries graduates, as is the case with medical and veterinary education.
5. Fisheries Law needs to be incorporated in the syllabi.
6. Funding support for publication of text Books, Training manuals, pamphlets, etc. in regional languages by the faculty of the colleges for proper popularization.
7. Interaction among the fisheries colleges
8. Fisheries education could be introduced in school itself under an appropriate system like vocational stream.
9. Separate fisheries schools may also be considered.

Research Systems: Research and investigations are supplementary responsibilities of the University, but there are inherent constraints in fishery research. Recently the demarcation between disciplines and faculties has blurred and therefore on innovative science efforts demand a design-board multidisciplinary approach. The fishery science research, however, is still restrictive to the faculty and there are inherent institution-created barriers for scientists from other faculties to become part of the team. Establishment of separate universities for each faculty, if not tackled in right spirit, also inherently negates the concept of multidisciplinary approach to education and research, which would cause more damage to science, if enough windows for collaboration are not kept open.

The research carried out in most of the disciplines are primarily the 'student research' which has a definite objective of training the students in research methodology and ends with graduation of the students. These research programs, unless made part of larger research initiative, would not inherently be directed towards technology development. Thus, the research programs are focused on process or product development. There is no administrative support to facilitate research program implementation. The administrative staff is not yet recognized as one of the stakeholders in research accountability and hence they get away even after creating willful obstacles.

The extension education program also lacks vision and although the universities are mandated to carry out extension, no staff or infrastructure support from the Government has been given in the past. This is therefore being run as an 'outreach program'. There is lack of coordination between the state government, which is de facto the 'ground-level extension agency' and the university, which is at best the technology developer or 'trainers training agency'. The continuing education program is yet to take off the ground. There has been no effort so far to harness the benefits of information technology into fishery continuing education programs.

AUGMENTATION OF RESEARCH AND DEVELOPMENT AND RESOURCE MOBILIZATION THROUGH INSTITUTES-INDUSTRY LINKAGE

Anticipated growth in all spheres of fish farming would be achieved only through infusion of latest technical know-how derived from organized research and development programs in fishery science sector. To evolve more economically viable and vibrant R&D, integration of institutes with various facets of Agro business industry is essential. Importance may be given to applied and industrial research for generating significant proportion of funds from potential consumers of our industrial technologies. This in turn will expand the base for R & D instead of depending exclusively on state funding. Institutional boundaries must be erased to pave way for collaborative approach in a particular field, cutting across individual laboratories to develop more cutting edge technologies in a shorter span. Modalities must be worked out to develop globally competitive technologies and patents with emphasis on intellectual property licensing to benefit the elite scientific community.

Although, fisheries scientists have accomplished a commendable task of increasing fish production in the country, both the number and quality of their publications suffer at the international level due to poor visibility. An important reason for this is that our fisheries scientists publish mostly in non-indexed journals. An all-out effort must be undertaken to improve the image of the premier fisheries research journal of the ICAR, namely, *Indian Journal of Fisheries*.

Considering the above, one would be tempted to suggest that the issue of fisheries education and development is not simple. It needs to be addressed holistically keeping in mind the salient features of the regions. Where the colleges are functioning and the need for having uniformity in development. A policy paper on Fisheries Education at the National Level could be prepared after detailed deliberations with all concerned including the fisher folk, fisheries entrepreneurs and the NGO's. Including the National Commission on farmers. The role of ICAR regarding fisheries education revamping, employment generation and an able leadership to put fisheries among the top rung of the ladder should be the goal for future.

Education Policy on Fisheries and Sea Foods

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The country is endowed with abundant water resources for development of fresh and brackish water aquaculture. This sector has enough scope to generate employment and earn foreign exchange. Therefore, there is a need to develop technically trained quality manpower to manage our fishery sector effectively. To cater to this need the first College of Fisheries was established at Mangalore in 1969 under the University of Agricultural Sciences, Bangalore. At present 12 SAUs, one Central Agricultural University (CAU) and one Deemed University offer Fisheries Education in the country. In the post WTO regime there is a need of developing competent technically trained professionals for which the IVth Deans' Committee had restructured the under-graduate fisheries science courses as to create a cadre of fisheries professionals who are well qualified to meet demands of fisheries sector and the students have desired entrepreneurial skills and knowledge on national and international issues related to fisheries. The following policy initiatives need to be considered.

- Uniformity with respect to admission formalities, course curricula and faculty strength are required besides adequate infrastructure for providing quality education.
- Emphasis is to be given on practical training through Hands on training/ In-Plant training for capacity and confidence building of students to venture into self employment on Ornamental fish culture, Fish seed production, Processing and value addition, Fish trade and export management, Aqua clinic, Aqua farming and Post harvest technology.
- Regular monitoring (once in five years) of the function/performance of the colleges through Monitoring Team/Accreditation Team. Besides, course curricula need regular upgradation.
- Collaboration between the Cental Institutes and Fishery Colleges of SAUs should be strengthened for imparting quality fishery education and conducting purposeful research.
- Identifying overseas partners and collaborating institutions for student and faculty exchange programme. Sand-witched programmes need be developed in frontier areas of research.
- Newly recruited faculty members have to undergo induction training for maintaining uniformity in teaching standard.
- More specialized market driven courses need be developed.
- Need based location specific vocational courses are to be identified in fisheries to increase the acceptability of courses. Besides, courses need be taken up in distance education mode so as to reach the unreached.

Essential Elements for Fisheries Education Policy

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In the contemporary academic and developmental discourse and usage, the word 'fisheries' connotes the science and practice of fisheries and aquaculture *as well as* the fish and fish products *including* seafood. The given title 'Agricultural Education Policy for *Fisheries and Seafood'* inadvertently mentions seafood in addition to fisheries which itself sufficiently descriptive term. However, to recognise the new reality of increasing contribution / share of aquaculture and the declining share of capture fisheries in total fish production, sometimes 'fisheries and aquaculture' instead of only fisheries is used.

Why Fisheries Education Policy?

Fisheries and aquaculture are vibrant economic activities, and have been the fastest growing food production systems during the last three decades. Their significance and contribution towards agricultural and national economies, livelihood and nutritional security, employment generation and foreign exchange earnings have been enormous, though understated so far. The sector contributes 1.2 % of the total GDP or 5.89 % of GDP from agriculture in a scenario where the share of agricultural GDP itself is declining. Considering that there are still vast underutilised and untapped resources having potential for development, the fisheries sector is recognised as a *sunrise* sector with wider scope to contributing towards poverty alleviation through developing sustainable rural livelihoods and overall food and nutritional security.

In any given scenario, the extent and quality of development is largely conditioned by the given policy, regulatory mechanism and an enabling institutional environment. At present there is no separate comprehensive and an enabling policy framework for fisheries development, leave alone for fisheries education, at the Central and State levels. This, along with non availability of adequate and professionally skilled human resource, ineffective and redundant services delivery systems and poor infrastructure, is limiting the scope of fisheries development in India. Ironically, the importance of policy and HRD aspects has not been given sufficient attention so far.

Also, management of fisheries education in India is plagued with many teething and first generation problems that may, unless addressed through an appropriate regulatory framework, limit the full fledged maturing of the discipline and eventually the development of fisheries sector per se. Among others, the current mismatch between the academic/research *and* development system may be attributed to inadequate attention to skill development in the present curriculum and pedagogy. On the other hand, the forces of globalisation and free market are integrating the world, particularly the academic and research communities, into one 'global village' and has opened the windows of opportunity only for those who are well prepared and able to compete globally.

In such a scenario, only a foresighted educational policy framework may give the much needed overall direction and specific strategies to face the challenges and exploit the opportunities posed by the knowledge led revolution. Hence, a comprehensive fisheries education policy is *sine quo non* for producing competent professionals who could help harness the full potential of the fisheries sector while sustainably managing it. The objectives of such an education policy should be to create centres of academic excellence, to ensure quality education, to set minimum uniform standards (curriculum, faculty, infrastructure, budget, etc) and to promote best academic practices with in the overall goal of sustainable fisheries and livelihood development.

Why a Separate Fisheries Education Policy?

Fisheries sector, as against the crop and livestock sector, is distinguished by certain unique and special resource and resource users' characteristics that demands a more specific education policy to address. They are as follows:

Diversity of Resource Type and Size: There is a vast diversity of fresh, brackish and marine water resources encompassing all climatic and geographic types. It consists of tropical and sub-tropical, coastal, near shore and open sea marine resources, brackishwater resources and coastal wetlands of varying size on the one hand, temperate and tropical freshwater resources of varying size such as rivers, floodplains, ox-bow lakes, ponds and tanks, reservoirs, and other open water resources on the other. The huge track of salt affected areas in northwestern and western India is also a potential resource for aquaculture. There is also great diversity in terms of fish species and other aquatic resources. On the other hand, fisheries and aquaculture consists of not only fish but aquatic plants as well. Compared to many South East and East Asian countries, we are exploiting very limited fin sish, shell fish and aquatic plan species. This poses both challenges and opportunities for fisheries education and human resource development. One of the main challenges is to frame a quality and standard curriculum that also addresses region / resource specific needs and has relevance while maintaining uniformity and competency. The opportunity lies in capitalising on this world scale diversity in an increasingly globalised education market scenario.

Common as well as Individual Property Rights and Management: While capture fisheries resources are predominantly common property resources that are akin to forestry resources in terms of ownership and resources users, culture fisheries resources are mainly private property or individually owned resources similar to crop and livestock sector. That the fisheries sector encompasses both property rights systems that calls for a separate development policy and management framework with attendant approaches, strategies, management regimes and technologies. Only a more specific education policy could do justice to this.

Importance of Regulations: There is a vast and complex network of regulations that govern the use and management of common property fisheries resources. Unlike other sectors, most of these are implemented and supervised by the personnel of State Departments of Fisheries who are also responsible for implementation of welfare programs and provision of technological and other extension support. In addition, provision of welfare measures like distribution of subsidies, facilitating insurance, implementing housing schemes, etc also falls within the purview of Fisheries Departments. This scenario demands generation of human resource who could competently fit into these multiple and often conflicting roles more effectively and be able to plan, develop and execute development an management programs as well more professionally.

Diverse Nature of HR Requirement: The sector demands human resource of varied skill and specialization to be generated for both fisheries and aquaculture. For example deep sea fishing operations and on board handling practices need a specialised skill sets entirely different from managing a corporate aquaculture farm or to design an appropriate gears for small fishing crafts. Also, the knowledge and skill set required by the fish processing industry to maintain quality as per HACCP standards or develop new products is vastly different from skills required to manage fish / shrimp hatcheries or produce and market fish feed or to periodically assess different fish stocks in different aquatic environments and evolve sustainable exploitable level and method or to develop culture technologies for fish species inhabiting a range of different aquatic ecosystem. Besides, specialised HR in areas like fish biotechnology, fish physiology, fish biochemistry, bioinformatics, etc need to be generated to find innovative solutions for quality and quantitative enhancement of fish production are required to be produced. The education policy should be sensitive to this element.

Most Internationally Traded Commodity: Fish is the most and largest internationally traded food commodity with about 40 percent of production entering into export / import markets. The processing and export sector with attendant quality standards, cost competitiveness, trade barriers, disputes and negotiations are very crucial in the sector necessitating availability of specialised skill sets.

Fisher as Both Resource User and Labour: Fishers across the country depend almost exclusively on open water common property resources for their livelihood. His / her position is like farmer and agricultural labourer moulded into single being like a self cultivating farmer or a forest dweller. Thus, the degree of integration of fishers into their community is very high making it community based approaches and management strategies through an appropriate extension system as imperative. The individual farmer centric model of agricultural extension may suffice for TOT in aquaculture, but not the capture fisheries sector. This poses special challenges for the education policy in terms of major changes in the curriculum as well as pedagogy.

Conservation and Sustainability Dimension: Capture fisheries, both marine and riverine, have been exploited to the maximum or over exploited putting future of these resources and those dependent on them under question. This calls for sustainable management approach as against production enhancement approach of aquaculture or crop sector for nearly half of the available fisheries resource. Only an education policy which incorporates this dimension can make the development agencies, industry as well as the community internalise this fact and initiate appropriate corrective measures.

Cost Intensive Nature of Fisheries Education: Agricultural education itself is cost intensive due to its field orientation and other infrastructure requirement. Fisheries education is even more cost intensive as it requires creation / maintenance of certain minimum level of aquatic resources like ponds, tanks, hatcheries with attendant laboratory infrastructure demanding higher capital investment. Accordingly, concomitant budget provisions need to be provided. The present budgetary support for fisheries education is not proportionate to the present contribution and the potential for growth of fisheries sector.

Present Status of Fisheries Education

In the last four and a half decades fisheries education has developed significantly in India. At present, professional fisheries education (BFSc, MFsc) is offered by 15 Fisheries Colleges under State Agricultural / Veterinary Universities and one Fisheries College under Central Agricultural University, besides Central Institute of Fisheries Education (Deemed University) which offers only post graduate programs. The total intake capacity is about 410 for BFSc, 161 for MFSc and 61 for PhD programs. The College of Fisheries under N.D. University of Agriculture and technology, Faizabad, Uttar Pradesh offers the BFSc program under self financing category. In addition, a dozen general Universities offer M.Sc. and Ph.D. programmes in Marine Sciences, Marine Biology, Oceanography, Aquatic Biology and Fisheries, Limnology, Freshwater Biology and Limnology, Aquaculture and Industrial Fisheries. IIT, Kharagpur offers M.Tech. and Ph.D. in Aquaculture Engineering, Barkatullah University, Bhopal offers M.F.Sc. courses in Applied Limnology and Aquaculture while several Colleges offer B.Sc. in Industrial Fisheries (Biradar and Kumar, 2007; Modayal & Ayyappan 2004). Numerous Diploma and Certificate courses and programs in fisheries and aquaculture are offered by various institutions and agencies based on the market demand. While the uniformity of curriculum and quality standards of programs under SAUs/Du/CAU are regulated and monitored by ICAR, there is no regular monitoring and standard setting procedure in existence for vetting the fisheries related programs competently under general universities leading to decline in quality of education.

The report of IV Deans' Committee constituted by ICAR has addressed many issues related to undergraduate agricultural education in general and fisheries education in particular. Especially it has attempted to make the professional programs more practice / skill oriented so as to make them employable as well as entrepreneurs. It has also revised and updated the norms and standards, uniformity of curriculum and

nomenclature, faculty training, and increased performance linked funding support for SAUs. The recommendations need to be incorporated as policy guidelines and implemented immediately.

Inputs for Education Policy

Uniform, Relevant and Updated Curriculum: The policy should provide for or create a *mandatory mechanism* to periodically update as well as bring uniformity in both graduate and post graduate fisheries curriculum. The extensive exercise by the IV Deans Committee constituted by ICAR has helped revise and update the graduate curriculum last year which needs to be followed by all colleges. Similarly, postgraduate curriculum needs to be revised across the colleges along with uniform nomenclature for specialisation at Masters and PhD levels. The curriculum and design shall be reoriented to meet the requirements of not only the growing Indian fisheries sector but also the global fisheries education markets. Though the present Accreditation system of ICAR desires this, there is no guarantee that these exercises are done in the absence of mandatory requirement. All budgetary support also shall be inked with this. In addition, the curriculum of fisheries related disciplines offered by General Universities are hardly standardized and supervised. The policy shall provide for a mechanism to bring all fisheries and related disciplines under single umbrella for the purpose of bringing uniformity and maintain quality.

Effective Pedagogy / Learning Methodology: The knowledge era requires unconventional and unique patterns of learning for a more fulfilling and rewarding life. An ideal learning environment would encourage both students and teachers to learn from each other through mutual appreciation and respect for knowledge. While the utilitarian perspective of learning shall inform the overall policy, it shall not undermine the acquiring knowledge for its intrinsic value. The policy shall encourage participatory and interactive learning approaches in both class room and the field. Various ICT tools would become handy in this endeavour. For example, increasing use of video conferencing would improve students' exposure to wider group of experts from across the globe. The learning process and environment need to be transformed by integrating the contents, training, technologies and services to produce learning outcomes required for the knowledge era. The integrated and networked learning environment shall be created to provide a self-motivated, self-paced learning environment for both the teacher and the taught by enabling skill building in analysis, interpretation, critical thinking and problem solving. Student exchange programs shall be part of policy framework. Also the policy shall encourage preparation of University level text books for many fisheries subjects by the expert faculty as there is dearth of them, although specialised and advanced subject matter books are available.

Competent Faculty: Bringing attitudinal change among the faculty as well as providing opportunities for continuously upgrading of their competency levels would be central elements in creating the most conducive learning environment. The recent Deans Committee has already recommended regular faculty development programs which need to be provided policy and budgetary support. More importantly, the policy shall encourage expertise from the industry, NGO sector and Development Departments to join academic institutions as faculty through lateral entry. Even short term faculty positions would also need to be encouraged. Similarly, the permanent faculty may be encouraged to work on deputation to industry, Development Depts., and NGOs. This would revitalize not only the academic environment but also the research system.

Adequate Infrastructure: The minimum required infrastructure, their paucity in most of the fisheries colleges and the need for budgetary support has adequately been addressed by the IV Deans Committee recommendations. The policy shall provide for necessary budgetary support.

Employability and Recruitment : One of the major departures shall be to orient the educational program to produce *job creators* instead of *job seekers* i.e., producing not just professionals but entrepreneurs who would take up fisheries and aquaculture related business to generate employment and wealth. IV Deans Committee has already suggested some structural changes in the four year BFSc program where the one full final year, instead of the present I semester, will consist of different internships / field trainings as well

as entrepreneurial courses and projects. Colleges shall be encouraged to nurture bright ideas/innovations among the students/faculty, and provide a platform to develop these into commercially viable ventures and launch them in the market. However, the role of larger fisheries development policy to create an enabling environment for entrepreneurial activities in fisheries sector is very vital. Only then more and more student entrepreneurs would become job creators. An environment and culture conducive to this including infrastructure facilities and collaborations with industries shall require suitable policy support. It should also be not forgotten that recruitment policy and education policy are related and influence each other. The recruitment policy of State and Central governments shall encourage recruitment of professional fisheries graduates for developmental work as in agriculture and veterinary sector.

Regulatory Mechanism: However, there is still lot of variations and anomalies in terms of admission policy, curriculum, learning methodology and evaluation, faculty and infrastructure strength across Fisheries Colleges under SAUs leave alone the faculties under general universities. The lack of specialised statutory body like AICTE or Veterinary Council of India has been the main impediment to bring uniformity and maintain standards in fisheries education and generate competent and useful fisheries professionals. The proposed statutory body Higher Agricultural Education Regulatory Authority (HAERA), once established, may be able to address these vexing first generation problems. It is desirable that a statutory Fisheries Council of India with attendant State level bodies is established for the special purpose of bringing in uniformity of standards and curriculum in the context of many sub-standard and inferior quality fisheries related programs being offered across the country. This would go a long way in professionalising not only the fisheries education in the country by transforming the fisheries colleges into centres of academic excellence but also pave way for professional management of the sector as a whole by responding effectively to emerging needs and challenges. Similarly, the overall policy shall provide for professionals to occupy leadership positions in State Fisheries Departments instead of bureaucrats at present in order to facilitate professional management of the sector.

Appropriate Institutional Arrangements: The issue of lack of adequate practical / field level and marketable skills in professional graduates in general and fisheries graduates in particular and the ways and means to address this has often been debated at various levels, but with no satisfactory and effective solution in place yet. A related, but a larger development issue is the wide mismatch between the R&D system and the farm / client system as evidenced by poor adoption and persisting if not widening huge yield gap. This can be attributed to a significant extent to the structural limitations of the present institutional arrangements of agricultural education in the country. While fisheries / agricultural education and research are almost exclusively under SAU-ICAR system which though public funded are autonomous, the development and extension is almost predominantly the role of State Departments of Fisheries / Agriculture. Whatever mechanisms exist for coronation and linkage between the two has been found to be very ineffective and inefficient.

In this context it may be worthwhile to look at some of the alternative institutional arrangements existing in the South East and East Asian countries for their relevance and utility for the challenge at hand. For example in Malaysia and Thailand, even in China to some extent, the yield gap between lab and field is very less. In these countries, the role of education, research, and development / extension are integrated under one umbrella agency at a federal / central level where in the teaching faculties serve a mandatory period practicing developmental / extension role and vice-versa which benefits not both the student as well as the farmer / client as it brings greater degree of synchronization between the field level problems and the relevance of research innovations. This is not a simple solution. It requires radical rethinking, greater study and major political will as it is bound to transform the way agricultural education, research and extension are organised at present. But in order to meaningfully address the various maladies, we need to rethink the present institutional arrangement of provision of agricultural education.

Globalisation of Education: Globalisation is having a profound effect on education. It's transforming the economies into service and innovation economies. Higher education, growing at 20% per annum world-

wide, is counted as one of the most important ingredients in knowledge-based economies. It hardly needs to be emphasized that the rapidly growing fisheries sub-sector requires qualified and trained human resource to plan, execute and manage various research and development programs at different levels. The education policy for fisheries shall be sensitive to this phenomenon of globalisation of education services. Premier institutions has to be encouraged setting up global education centres in collaboration with suitable overseas partners in Asian, African and Latin American countries to capitalise on the opening up of educational markets and the existing demand for quality education. Indian fisheries education has lots of advantages being located in the subtropical region of the Indian subcontinent with access to all types of aqua-climatic resource as well as diverse and specialised faculty. Besides, the international presence would bring synergies in its higher education and research programs as also generation of resources.

National Awareness Program on Fisheries: Fisheries sector in India is metamorphosing from subsistence into a thriving industry, though the vast majority of the fishing communities all along the Indian coast and inland areas still struggle hard to make a decent living. Importantly, there are still vast underutilised and untapped resources having potential for enhanced fisheries and aquaculture with vast scope for private and public participation and investment. Also, fish is a healthy, wholesome food with lot of nutritive value. However, the public in general and policy makers in particular have not internalised and appreciate the potential of fisheries sector for economic development and societal well being. This is one reason why fisheries is given residual priority in planning and development issues at different levels. The lack of awareness is also responsible to a significant extent the stagnant domestic consumption of fish. The education policy should support a major National and State level awareness programs and publicity campaigns to create wider awareness, help policy makers and the public make informed decisions and increase consumption of fish and fish products.

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SPS and Biosecurity Issues in Animal Health Management and Transboundary Animal Diseases

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1. Sanitary and Phytosanitary Measures

In the recent years, there has been a dramatic shift in the focus of trade policy concerns from the barriers that lie "at the border" to the barriers that exist "within the border". Two main reasons can be identified. Among technical regulations and standards, sanitary and phytosanitary (SPS) regulations occupy a particularly relevant place in the regulators' agenda, because of their primary aim of protecting citizens from everyday food hazards. This has become a virtual minefield for trade policy-makers as national differences in risk perceptions and tolerance can be manipulated or exploited to protect domestic industry from international competition (Howse and Trebilcock, 1999). The central role of SPS measures is revealed by the recent growing concerns associated with imported food products. Standards and regulations, in general, and sanitary and phytosanitary measures, in particular, involve a mix of protection and protectionist objectives which is very complex to disentangle. This generates a very demanding challenge for the economist used to trade-off costs and benefits in order to evaluate different policy options.

The main goal of the SPS Agreement is to prevent domestic SPS measures from having unnecessary negative effects on international trade and their being misused for protectionist purposes. However, the Agreement fully recognizes the legitimate interest of countries in setting up rules to protect food safety and animal and plant health. More specifically, the SPS Agreement covers measures adopted by countries to protect human or animal life from food-borne risks; human health from animal or plant-carried diseases; and animal and plants from pests and diseases. The Agreement provides national authorities with a framework to develop their domestic policies. It encourages countries to base their SPS measures on international standards, guidelines or recommendations. The Agreement requires countries to choose those measures which are no more trade restrictive than required to achieve domestic SPS objectives, provided these measures are technically and economically feasible (e.g. to apply a quarantine requirement instead of a ban). The SPS agreement recognizes that, due to differences in geographical, climatic and epidemiological conditions prevailing in different countries or regions, it would often be inappropriate to apply the same rules to products coming from different regions or countries. In carrying out risk assessment, countries are urged to use risk assessment techniques developed by the relevant international organizations like the FAO/WHO Joint Codex Alimentarius Commission, the Secretariat of the International Plant Protection Convention, and the International Office of Epizootics.

2. Emerging Infectious Diseases and Transboundary Animal Diseases

Emerging infectious diseases (EIDs) can be defined as diseases that have recently moved into new host populations, increased in incidence or geographic range, and/or have been discovered or caused by newly-evolved pathogens (Lederberg et al., 1992; Morse, 1993; Daszak et al., 2000a). This broad definition encompasses a range of infectious diseases which form a significant threat to medical & veterinary public health. Many EIDs are "Transboundary Animal Diseases (TADs)". The TADs are defined as those epidemic diseases which are highly contagious or transmissible and have the potential for very rapid spread, irrespective of national borders, causing serious socio-economic and possibly public health consequences.

3. Biosecurity

Biosecurity is defined as "those efforts designed to prevent the introduction and spread of disease in a population, herd, or group of animals (Thomson, 1999). In broader sense, biosecurity is a strategic and integrated approach that encompasses the policy and regulatory framework to analyze and manage risks in the sectors of food safety, animal life and health, plant life and health, including associated environmental risk. It covers: (i) the introduction of plant pests, animal pests and diseases, and zoonoses, (ii) the introduction and management of invasive alien species and genotypes, and (iii) the introduction and release of genetically modified organisms (GMOs) and their products (Khetarpal and Gupta, 2007; http://www.fao.org). Thus, biosecurity is a holistic concept of direct relevance to the sustainability of agriculture, food safety, and the protection of the environment, including biodiversity (Khetarpal and Gupta, 2007).

While discussing biosecurity for a threat from the TAD is of foremost importance, it is also relevant to take stock of changing disease patterns within the country especially diseases which are endemic like peste des petits ruminants (PPR), bluetongue, classical swine fever, infectious bovine rhinotracheitis/infectious pustular vulvo-vaginitis (IBR/IPV), caprine arthritis/encephalitis (CAE), maedi-visna, equine piroplasmosis, equine rhino-pneumonitis, bovine viral diarrhea (BVD), bovine immunodeficiency (BIV), Theileriosis, caprine Mycoplasmosis, enzootic abortion (Chlamydia), babesiosis, Cysticercosis, Anaplasmosis, infectious bursal disease, and infectious hydropericardium syndrome of poultry. These diseases are responsible for enormous economic losses and, therefore, need biosecurity plans to be in place. Thus, biosecurity efforts can be categorized into (a) External measures (external biosecurity) % those directed at prevention of entry of new diseases into a group, and (b) Internal measures (internal biosecurity) % those directed at prevention of spread of disease within a group (Dargatz *et al.*, 2002). Further, although the term "biosecurity" is not specifically defined in the legislation, it has been referred to as "the cost effective protection of any natural resources from organisms capable of causing unwanted harm. In the Act *natural [and physical] resources* means organisms of all kinds; air, soil, water in or on which any organism lives or may live; landscape or landform; geological features; and systems of interacting organisms and their environment".

3.1 Why have Biosecurity?

One may ask a question why to have biosecurity? A number of diseases have emerged in recent times and many of them have zoonotic and bioterror potential which entail establishing biosecurity. Basic reasons to have biosecurity include (i) protecting human health and safety, (ii) protecting production standards, and (iii) protecting access to overseas markets.

3.2 How to Protect Biosecurity?

Possible biosecurity activity areas include: (i) *ex-ante* measures including import health standards, surveillance and pre-border, preventative actions; (ii) border control, such as screening, interceptions and procedures applying to imported goods; and (iii) *ex-post* identification, containment, control and eradication of pests on arrival in the country, and emergency responses. Since any measure to improve biosecurity has resource use implications, it is pertinent to ask whether some other choice of allocation would better achieve the desired aims of biosecurity policy. Such resource allocation decisions are the cornerstone of economic analysis, and raise a series of subsidiary issues like (1) how much is it worth promoting biosecurity, taking account of both the benefits and costs associated with such activities?, (2) what measures are best able to provide biosecurity?, and (3) choices involved in resource allocation include efficiency of delivery and the particular channel of activity which could be pre-border, border, post-border, and internal. As we can not have biosecurity measures in place for all the potentially harmful diseases, prioritization of the disease/pathogen becomes necessary which can be achieved as described above. The concept of biosecurity is not new. There had been a renewed global interest in biosecurity which has been driven by many factors like recent international disease outbreaks, potential risk of agri-terrorism, and increasing commercialization of livestock production–primarily driven by breeders and veterinarians. Now the "Mini-

mum Biosecurity Plan" has been defined and it should address the issues viz., the means of isolating new animals introduced into an existing herd or group of animals, the regulation of animal, worker and equipment trafficking (movement), and design and implementation of cleaning and disinfection procedures directed at reduction of pathogen load within herd or group of animals.

4. Ensuring Biosecurity during Trade and Exchange: National Scenario

4.1 Critical Issues in Biosecurity

Critical issues in biosecurity include research needs to fill knowledge gaps, enhanced laboratory capabilities, expanded surveillance systems, improved diagnostics, improved/new vaccines and therapeutics, collaboration and cooperation between government, scientists, diagnosticians, and industry, education and leadership, and planned response and national preparation.

4.2 Legislation

The import of plants and plant materials are regulated on the basis of a scientific Pest Risk Analysis to safeguard the native plants species from exotic pests. For Animal Quarantine there is a central legislation entitled, "Live-stock Importation Act, 1898" amended many times and the latest being "The Livestock Importation (Amendment) Act, 2001". This Act has been amended through various notifications issued from time to time. This Act also has regulation for inter-state movement of livestock. Issues related to GMOs are covered under the Environment Protection Act (EPA) 1986 but it does not state in clear terms the modality for restriction and prohibition of their potential threats to the environment. The new Plant Quarantine (PQ) Order is as an attempt to comply with the various provisions of the agreement on Application of Sanitary and Phytosanitary (SPS) Measures of the WTO (of which India is a signatory member) and to promote trade and not to use plant quarantine measures as a technical barrier to trade. In order to prevent the ingress of exotic diseases and ensure an effective check against the spread of infection/ diseases in animals, the amendment of existing Livestock Importation Act needs to be undertaken as a priority. This may be modified as per the regulations of the OIE following the standards laid down for Australia and New Zealand which pay more attention to animal husbandry and safe export of livestock and livestock products (Khetarpal and Gupta, 2007).

4.3 Infrastructure, Manpower and Capabilities

The Directorate of Plant Protection Quarantine and Storage (DPPQS) % with a national network of 29 plant quarantine stations at different sites % of the Ministry of Agriculture is the apex body for implementation of plant quarantine regulations. The regulation of import and export of livestock and livestock products, control of exotic disease and certification as per Office International des Epizooties (OIE % The World Organization for Animal Health) is done through the Animal Quarantine and Certification Services (AQCS) under the control of the Department of Animal Husbandry, Dairying and Fisheries (DADF), Ministry of Agriculture with animal quarantine stations at Delhi, Kolkata, Chennai and Mumbai. The five major Plant Quarantine Stations have been modernized recently under an FAO-UNDO funded project. The facilities at Animal Quarantine Stations in four major cities are being strengthened. However, more attempts are required to expand and modernize these stations. A central facility is also required for testing the import consignments consisting of livestock/livestock products before releasing. Such a facility with modern state-of-the-art diagnostic capability will go a long way in facilitation of exports and imports. Such a facility for plant quarantine % NBAGR Quarantine Station at Hyderabad % already exists which exclusively deals with export samples of the International Crop Research Institute for Semi-Arid Tropics. Such a facility for testing livestock/livestock products for export/import does not exist in the country.

The human resource in animal quarantine organization is also not up to the mark. Thus, the animal quarantine set up in the country needs upgradation in terms of manpower, infrastructure and capabilities to

raise it to international standards as the increase in imports and the stipulation of WTO has brought about additional challenges to be faced by the animal quarantine personnel. Strengthening should not only ensure prevention of exotic pests but would also check the interstate spread of indigenous pests and diseases of both plants and animals by effective implementation of domestic quarantine regulations/ certification services against certain important pests and diseases which have been introduced/ detected in the country in the recent years and which are likely to spread fast (from Khetarpal and Gupta, 2007).

4.4 Interceptions at Quarantine

The National Bureau of Plant genetic Resources (NBPGR) undertakes the quarantine processing of all plant germplasm and transgenic planting material under exchange for which it has well-equipped laboratories for detection of pests and transgenes and green house complexes, and a containment facility for processing transgenics. A large number of plant pests have been intercepted during quarantine (Khetarpal and Gupta, 2007). The High Security Animal Disease Laboratory of Indian Veterinary Research Institute at Bhopal takes care of the quarantine processing of import materials pertaining to livestock/livestock products. Many diseases like BVD, Malignant Catarrh Fever (MCF), rabbit haemorrhagic Disease (RHD), Highly Pathogenic Newcastle Disease through the imported consignments (livestock/birds and products) have been prevented at the entry point of quarantine. If not intercepted, these diseases would have played havoc with our livestock and poultry.

4.5 Major Issues in Import of Livestock/Livestock Products

Import of many livestock, livestock products, and biologicals (including vaccines (killed and live attenuated), semen, pig bristles, and serum etc) for personal consumption or for trading and marketing is a regular activity. Country has legislation viz. "The Livestock Importation Act, 1898" and the last amended version viz. "The Livestock Importation (Amendment) Act, 2001" for such imports. No livestock product shall be imported into India without a valid sanitary import permit issued under clause.

At times, DADF may have to take a decision to not permit the import if there is perceived biosecurity risk element after scientific and valid risk analysis. Such decisions, at times, may delay of even hamper the import. To facilitate the import process, it is advisable to have a central laboratory for testing of regular consignments at random as well for the consignments with suspected biosecurity risk. This will greatly facilitate both the import as well as export.

4.6 Major Issues in Import of Transgenics

The major biosecurity issues in import of transgenics plant, GMOs and recombinant DNA products have been described in detail by Khetarpal and Gupta (2007). While Department of Biotechnology (DBT) of Ministry of Science & Technology reviews, permits and monitors the experiments utilizing GMOs and recombinant DNA products, the Ministry of Environment and Forest (MoEF) implements their large scale commercial use through its Genetic Engineering Approval Committee (GEAC). The Institutional Biosafety Committee (IBSC) and the Review Committee for Genetic Manipulation (RCGM) take care of biosafety and biosecurity issues for GMOs and recombinant products.

4.7 Pest Risk Analysis

The Pest risk analysis (PRA) is a procedure by which quarantine services can technically justify new regulations, phytosanitary guidelines or safeguards, operational procedures, entry status of imported articles and resource allocations.14 The DPPQS has taken an initiative in undertaking PRA as per the WTO/ SPS requirements and norms but needs to be technically supported on the matter as far as expertise is concerned, as this would be the most ideal way of warding off exotic diseases by rejecting certain imports with prior knowledge and/ or permitting the imports with proper prophylactic treatments. The DAHDF %

through its Technical Committee on Animal Health % is responsible for making the risk analysis and for preparing the health protocols required as per OIE norms for the import of livestock and livestock products. It should also recognize that risk analysis procedures should provide a basis for biosecurity and not create barriers to trade (from Khetarpal and Gupta, 2007).

4.8 Information, Data Sharing, and Communication

Collating information, data sharing, and communication are very important steps for effective implementation of biosecurity. Thus, there is also a dire need to develop an accessible platform for getting information on biosecurity for the policy makers, administrators and the industry groups. A website http://www.plantquarantineindia.org consisting of a national database on legislation, quarantine procedures, methodologies, etc. designed by DPPQS is available. Such a dedicated website is not available for animal quarantine legislation, procedures and methodologies. There is a need to create a website http://www.animalquarantineindia.org% on the lines of http://www.plantquarantineindia.org. However, an internet-based portal mechanism for exchange of official information on food safety, and animal and plant health and the environment (like the International Portal for Food Safety and Animal and Plant Health), to facilitate communication among countries in these sectors needs to be developed for easy accessibility of information. To address the issue of emerging pests in a proper perspective recently, there was an endeavour by the government to establish a National Institute for Emerging and Exotic Plant Pests with a focused mandate for the development of an early warning system for pest outbreaks, and models for pest/disease forecasting and risk analysis; development of novel diagnostic approaches for detecting pests, imparting multiple resistance to enhance the durability of resistance by pyramiding genes or developing management strategies by developing transgenics resistant to diseases. This institute could possibly work in a network mode to facilitate research by those laboratories that are not well equipped and may boost research in the case of many regional and chronic plant diseases (Khetarpal and Gupta, 2007). Such an institute for animal pathogens is also required.

4.9 Public Awareness about Biosecurity

Biosecurity implementation is a public endeavor and, therefore, public awareness about biosecurity among the scientific fraternity as well as general public is important. Campaigns for public awareness through mass media like TV, Radio and news papers are now common. The still more effective campaign can be through education department wherein teachers can also educate children. A small chapter on infectious diseases especially on TADs, if included, will go a long way in educating students and also general public through them. This, in turn, will help in generating respect in general public for the regulations in the interest of national security and, therefore, implementation of biosecurity plans and programmes would be much easy. Recently, a one-day workshop on Biosecurity was organized at NBPGR on March 25, 2008 wherein one of the recommendation emerged was to introduce biosafety and biosecurity courses at undergraduate and postgraduate level. Further, the scientific personnel engaged in biosecurity should also be instrumental in making the general public aware through mass media or else by lecturing in schools, colleges, social meetings, seminar and symposia. Electronic media could play significant role in mass awareness provided multi-media based teaching aids are developed.

4.10 Future Research Thrusts

Future thrusts will include basic and molecular virology researches to develop immunodiagnostics and prophylactics, infrastructure development including information database, preparedness for diagnosis and control of exotic diseases, emerging and re-emerging diseases etc. various points which warrant immediate attention are (i) researches on molecular biology of pathogenic microbes to develop highly sensitive and cost-effective immunodiagnostics, improved prophylactics and safe and effective therapeutic regimens, (ii) identify strain variations of viruses isolated from vaccine outbreaks through nucleotide sequenc-

ing, (iii) identify sequences responsible for virus persistence and virulence, (iv) molecular basis of disease resistance, (v) improving mechanisms of disease forecasting and monitoring to ensure strategic control and eradication, (vi) creation of Animal Disease Database and Information System (ADDIS) infrastructure and interfacing with human disease databases, (vii) the Emergency Preparedness and Emergency Control Measures for emerging and re-emerging diseases, (viii) create data bank for exotic disease situations in India and its neighboring countries and network for dissemination of the information, (ix) develop diagnostic test capabilities for exotic diseases and be in readiness for providing diagnosis of exotic viral diseases at a short notice, (x) development of recombinant antigens (diagnostic reagents) for disease pathogens which have either been eradicated like Rinderpest or for exotic disease like avian influenza, SARS corona virus, BIV, BVDV etc. Critical reagents like monoclonal antibodies, if not available, may be procured commercially or from Reference Labs, (xi) provide referral and consultancy services and advise on procedures of diagnosis and containment of exotic disease problems, (xii) train Field Veterinarians, medical staff and other staff who could be of help in diagnosis and control of exotic/emerging diseases, and, (xiii) initiation of disease control and eradication programmes when a new disease emerges so that the disease can not establish itself.

5. Developing a Comprehensive Strategy including Mechanism and Infrastructure

Based on the foregoing discussion, the conclusion is that there is a need to evolve a holistic concept to address the issue of biosecurity. Internationally, the Agreement on the Application of Sanitary and Phytosanitary (SPS) Measures of the WTO governs SPS measures in relation to international trade. The Codex Alimentarius Commission (Codex), the IPPC and the *Office International des Epizooties* (OIE) provide international standards for food safety, plant health, and animal health, respectively. Further, the Cartagena Protocol of the Convention on Biological Diversity (CBD) applies to the transboundary movement, transit, handling and use of Living Modified Organisms (LMOs). Guidelines on the management of invasive alien species have been developed under the SBSTTA (Subsidiary Body on Scientific, Technical and Technological Advice) of CBD. This group of international agreements, organizations and programs are part of a loose international framework for biosecurity, and reflect the sectorial approach to regulate this area (Khetarpal and Gupta, 2007).

It is also clear that under the present international scenario, the plant and animal protection specialists have a major role to play not only in promoting and facilitating export and import in the interest of their respective nations but also in protecting the environment from the onslaughts of invasive alien pests and unforeseen ill-effects of the introduction and trading in GMOs. Besides, the threat to national biosecurity from the use of such instruments as bioweapons to create agro-terrorism is a possibility that requires preparedness. It is because of these reasons that the FAO has recognized the growing importance of biosecurity, and has included it as one of its sixteen Priority Areas for Inter-disciplinary Action. Biosecurity was also included in the Medium Term Plan which aims at "promoting, developing and reinforcing policy and regulatory frameworks for food, agriculture, fisheries and forestry" (http://www.fao.org.COAG/2003/9.htm) (modified from Khetarpal and Gupta, 2007).

At the national level efforts are being made for the development of a coherent biosecurity strategy for the country. A number of meetings have recently been organized to debate the biosecurity issues of national and regional interest. The gist of the proceedings and recommendation is that there is a need for "convergence in the efforts of all departments and ministries" to develop a coherent biosecurity strategy. It was also emphasized that education, regulation and social mobilization were the three pillars necessary to formulate a biosecurity strategy (from Khetarpal and Gupta, 2007).

The holistic approach to ensure biosecurity seeks to use the synergies of various existing sectors at the national level, without necessarily creating new structures. It further recognizes the need for integration of various aspects of biosecurity and the institutions involved. Khetarpal and Gupta (2006c) have empha-

sized the need to set up a National Plant Biosecurity System comprising a National Plant Biosecurity Centre (NPBC) to deal with plants, animals, living aquatic resources, and agriculturally important microorganisms as its four major Divisions with the Ministry of Home Affairs (MoHA) at the helm of affairs. MoHA has the National Disaster Management Authority that can properly monitor and regulate the biosecurity issues. Besides, MoHA is also the nodal point of the National Crisis Management Plan 2003. Therefore, if we have to put in place an effective biosecurity system in future, it has to be under the MoHA so that matters related to both biosecurity and bioterrorism (agroterrorism) can be dealt with more effectively and the funds can be invested in the right perspective. The emergency action plans and the rapid response teams that are critical for managing an epidemic also need to be in place under MoHA. The MoA % in its Indian Council of Agricultural Research (ICAR) % has excellent researchers and laboratories in the field of plant/animal/aquatic protection, which would support and work in a networking mode for diagnostics and control of diseases/ pests in the case of emergent situations. Hence, a network of various ministries, like MoA, MoEF, Ministry of Health and Family Welfare (MoHFW), Ministry of Defence (MoD), Ministry of Food (MoF) and Ministry of Science and Technology (MoST) could work in close collaboration with the MoHA. While this set up would be an ideal one, it is proposed to have a common set for plant and animal biosecurity. As such, setting up a National Biosecurity System comprising a National Plant Biosecurity Centre (NPBC), a National Animal Biosecurity Centre (NABC), a National Medical Biosecurity Centre (NMBC), and a National Aquatic Biosecurity Centre (NAqBC) would be ideal to deal with plants, animals, humans, living aquatic resources, and agriculturally important microorganisms. A National Biosecurity Authority (NBA) or the National Biosecurity Council (NBC) can be created for administering the National Biosecurity System. A biosecurity mechanism is proposed as Figure 1 (Khetarpal and Gupta, 2006c). The National Disaster Management Authority has orientation towards crisis management and would be effective in tackling the agroterrorism issues only. The biosecurity issues pertaining to TADs and endemic diseases envisage attention on day-to-day basis and require due time and considerations and hence a dedicated infrastructure and mechanism exclusively for implementing biosecurity would be ideal. The National Animal Biosecurity Centre will be aided by animal science institutes and their regional centres which can be reoriented to additionally shoulder the biosecurity responsibility in the areas of their specialization. The animal science institutes % through their campuses/regional centres % almost cover entire geography of the country and strengthening of these campuses/regional centres rather than creating new ones would be practical and cost-effective. Additional containment facilities/labs can be created in isolated islands like in Lakshadweep for research on exotic animal or aquatic pathogens including disease resistance studies as has been proposed by National Farmers Commission. It would be apt to consider a common National Biosecurity System for the country and as such the Fig.1 might need slight modification.

6. Multi-disciplinary and International Cooperation

Multi-disciplinary Collaboration is Essential in research, disease diagnosis, implementation of biosecurity measures from farm till enforcement of legislation, maintaining vigil after effectively controlling the disease, and rapid and effective control of outbreaks of TADs. Benefits of multi-disciplinary approach in controlling diseases like West Nile, Hendra, Nipah, Influenza, BSE and FMD has already been demonstrated. Multi-disciplinary collaboration should involve (i) inter-departmental cooperation between Medical Public Health, Veterinary Public Health, Forest and Environment, wild-life; (ii) Integration of research activities between various labs as "Network mode" of research delivers fastest as has been demonstrated by SARS Coronavirus episode % sequencing of the complete virus genome in least possible time with involvement of 16 labs world over. Another example of "Network Mode" is "European Med-Vet-Net" which is made up of 16 European partners. The aim is to provide a 'network of excellence' for integrated research on the prevention and control of zoonoses. Similar networks are required world over for tackling TADs.

Collaboration between South Asian Nations (SANs) for creating a biosecure SAARC/Asian region is must.

The issues include: (i) strict implementation of quarantine at national boundaries of SANs, (ii) compatible import-export policy for SAARC nations, (iii) establishing Biosecurity Board for each nation and each SAARC country, (iv) HSADL of IVRI Bhopal in India has paid dividends and more such labs needed in the country, (v) each SAN to have high-security labs on the lines of HSADL, (vi) training of staff from SANs on management of high-risk diseases including diagnostic methodologies & epidemiology, (vii) establishing a disease database and sharing of information between these nations and also with other nations, (viii) direct contact with Governments of SANs for effective implementation of the disease control strategies, and (ix) adapt policies which have proven effective like for bird flu. Establishing a "SAARC-Med-Vet-Net" % on the lines of "European Med-Vet-Net" (Gibbs *et al.*, 2005) % would go a long way in controlling zoonoses (figure 2).

7. India's Preparedness for Bird Flu

India had been able to control avian flu in the past. However, certain points still need consideration which include: (i) identifying and forming a Core Group of scientists for strategic planning and implementation at the face of an incursion, (ii) immediate mobilization of teams (regional and national) without loosing any time, (iii) on-field supervision of activities by an expert group, (iv) more closer and cohesive interaction with central and state machinery, (v) allocate sufficient funds for such exigencies, (vi) on-spot payment of compensation to farmers, and (vii) mass awareness program for general public through newspapers and Television. Other points to consider include: (i) establish more research/diagnostic labs across the country, (ii) follow the OIE/WHO SOPs and plan/policies with country-specific changes, (iii) establish a repository (regional & central) of AIVs/other disease agents for posterity, (iv) keep adequate stockpile of antivirals as a precautionary measure, (v) stock adequate vaccine doses in Vaccine Bank for emergency, (vi) develop more human resource for emergency operations, (vii) strengthen on-border quarantine and testing facilities, (viii) expand and strengthen quarantine facilities at ports/land sections, (ix) develop mechanisms to ensure negative certification of livestock and livestock products before permitting import, (x) develop mechanisms and infrastructure (a central testing laboratory for imports/exports) for testing of random consignments after import and/or for export, and (xi) ensuring continuous surveillance even after disappearance of the disease will pave the way for eradication of the disease.

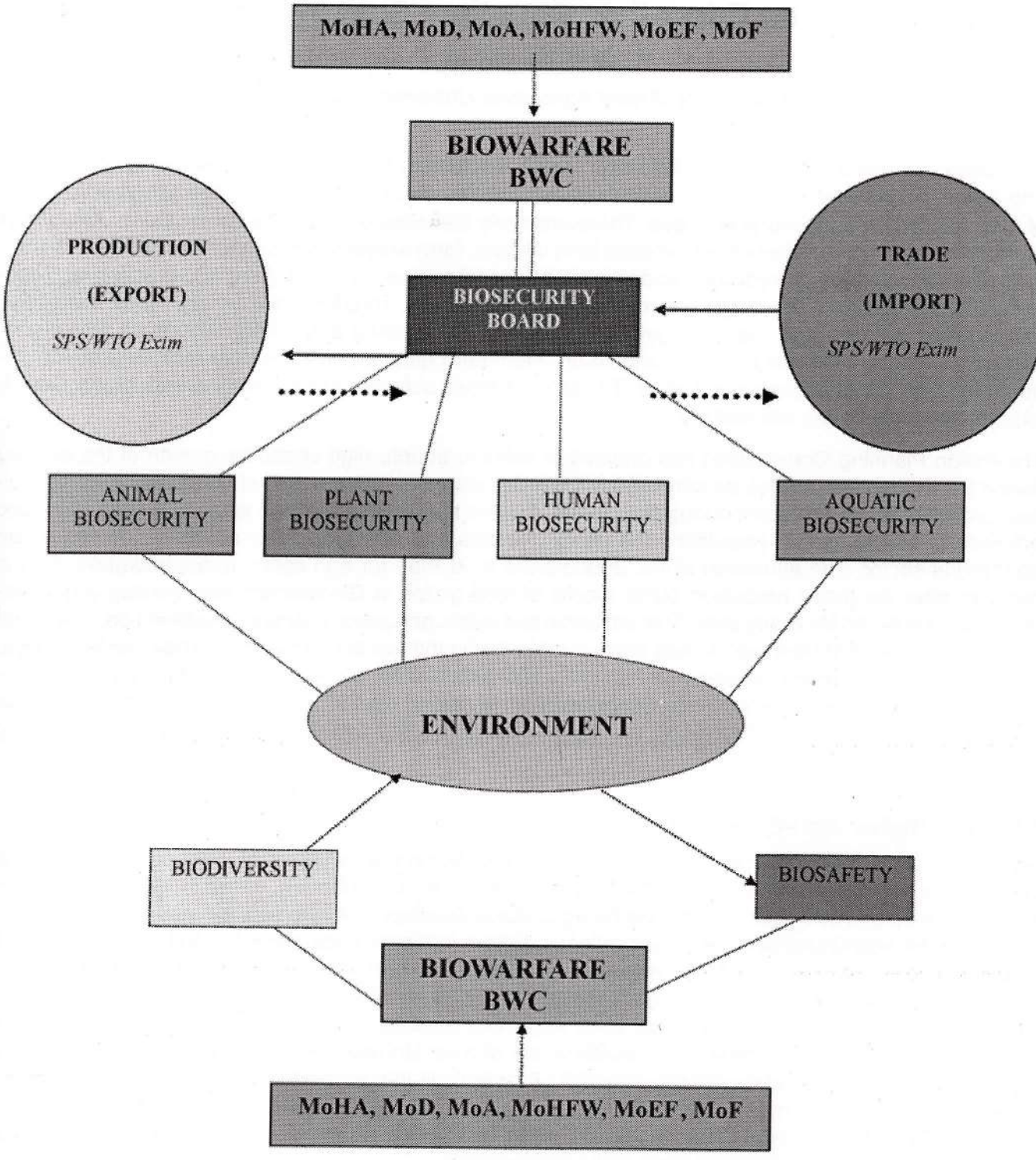
MoHA, MoD, MoA, MoHFW, MoEF, MoF
BIOWARFARE BWC
PRODUCTION (EXPORT) SPS WTO Exim
BIOSECURITY BOARD
TRADE (IMPORT) SPS WTO Exim
ANIMAL BIOSECURITY
PLANT BIOSECURITY
HUMAN BIOSECURITY
AQUATIC BIOSECURITY
ENVIRONMENT
BIODIVERSITY
BIOSAFETY
BIOWARFARE BWC
MoHA, MoD, MoA, MoHFW, MoEF, MoF

Figure 1

Towards Green Education: Paradigm Shift in Agri-Education

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Agriculture is more an economic activity than merely livelihood of farmers. About 68 per cent of Indian population is employed in agriculture and its related activities. Nearly 43 per cent of the geographical area of India is used for agricultural activities. There are many stakeholders than the farmer alone. Along with farmers the agriculture activities encompass farm labours, farm artisans, seed growers, fertilizer industry, farm machinery manufacturers, technicians involved in pest control, value addition, food processing, packaging industries, marketing, crop insurance, crop disease clinics, irrigation engineering, roads, transports and logistics, cold storage, agri-entrepreneurs, soil and food testing and quality assurance labs,phytosanitary, livestock, veterinary pharma and so on. From farm gate to consumers agricultural produce undergo through lots of economic activities. To carry out those activities skilled, semi skilled, highly skilled, experts and technocrats are needed.

The Indian Planning Commission has decided to achieve double digit economic growth of the country during the XI Plan period. But, as admitted by the policy planners, this can be achieved only if the agricultural growth reaches 4 per cent during plan period. Despite the fact that the farm sector provides economic activities to 68 per cent of population the policy planners had not adequately addressed needs of the agricultural sector. The allocation of Rs. 25000 crore in XI Plan for agri-sector is not adequate. This is because after the green revolution buffer stocks of food grains in Government warehouses was maintained around 40-48 Mt. every year. The allocation and public and private capital investment on agriculture infrastructure development was scaled down sizably during the last two decades. No new dams or irrigation facilities were created; no new agri-industries was established; no new agriculture college or agricultural engineering or veterinary college were opened in the public sector. The negligence of the agri sector resulted in tragic suicides of farmers. The figures between 2001 and 2006 are astoundingly crossing 23000.

Status of Higher Agri-Education

Agriculture plays a greater role in the Indian Economy. Setting up of adequate number of Agricultural Universities was considered very important in India. The Royal Commission, set up in 1926, emphasized the importance of a strong research base for agricultural development in India which led to the establishment of some agricultural and veterinary colleges. Before independence, there existed only 17 such colleges. These colleges were undertaking teaching programmes only. Therefore, a need was felt to reorganize the agricultural education to increase food productivity and to broaden research base. After the Independence, the Government of India in 1948 appointed an Education Commission headed by Dr. S. Radhakrishnan, which recommended establishment of rural Universities in the country. But no rural or agricultural university could be established till 1960. First Agricultural University was established at Pantnagar in 1960 on land grant pattern of US. The second National Education Commission headed by the then University Grant Commission Chairman Dr. D.S Kothari (1964-66) recommended the establishment of at least one Agricultural University in each of the Indian states.

At present there are 38 Agricultural universities, 5 deemed universities, 3 Central universities and one Central agricultural university, as against 300 traditional universities in India, while there are merely 260 agricultural colleges as against to 15,000 or even more traditional colleges. 21,000 agricultural graduates and post-graduates are passing out of agricultural institutions annually, while the actual requirement of agricultural graduates to be absorbed into various organizations is approximately 35,000 per annum.

Scanty Fiscal Support to HAE

In a contemporary context, almost all agricultural institutions are confronted with the financial crunch and increasingly tight budgets. Higher Agricultural Education (HAE), as such, is receiving less attention despite the enormous contribution it is making for the agricultural prosperity of the country. The pathetic allotment of meagre grants for agricultural higher education is evident in the allocation of Rs.1210 crore in 1998-99, while during 2002-03, the figure went up only to Rs.1454 crore, indicating almost an ignorable rise. Even in this distribution, more than 3/4th of the burden is being borne by the state government, while ICAR contributes only 17% of the total expenditure.

As if this is not enough agricultural education and agri-skilled development are almost ignored, and often agri-graduates are waived off or by-passed for graduates in other disciplines where employment preferences are concerned. Mr. W.I. Lindley, Senior Officer, Agricultural Education, SDR Division, FAO, noted at World Conference on Higher Education organised by the UNESCO in Paris in 1998 that, "... In the past, the public sector absorbed nearly all of the students who studied agriculture. This is no longer the case now. Agriculture graduates and diploma holders are finding it more difficult to get gainfully employed. Governments can no longer afford to hire every graduate, and education in agriculture has not kept pace with the increasingly sophisticated labour demands of the private sector. These and other factors such as environmental degradation, rapid changes in technical knowledge and the marginalization of rural areas, all call for changes in the current systems of education in agriculture in many countries."

The situation is now somewhat improved (after the WTO regime) and agri-graduates are in high demand with comparable pay package with their counterparts. But, it cannot be exploited fully. Because of poor investments by public and private sectors in opening new agricultural colleges, the demand and supply ratio of trained manpower in agriculture is widening.

It is imperative that the upcoming education policy should address the wide array of needs of society and industries resulted from the WTO regime. The policy planners should address the needs of food and agriculture sector, rural employment, infrastructure, skill development and market requirements. Emphasis must be laid on entrepreneurship development and market intelligence and management. Public-Private Partnership is also vital for agricultural success. In this regard, there are several areas of collaboration ranging from agri-fishery sector, production of high-value crops, to productive technology and extension, just to name only a few out of the myriads of possibilities.

It is an established fact that in an era emphasizing experience- based learning activities, traditional streams as Arts, Commerce and Law cannot fulfil contemporary socio-economic requirements. These branches of learning cannot feed one billion people. Hence, in the context of ever-rising global population, acceleration and aggrandizement of Green Education is imminent. Change in the mindset and shifting the focus to enhance the infrastructure from traditional education to agro-based education or "Green Education" is the need of the hour. Therefore, paradigm shift in entire education system must be made and instead of babus, farmers and those who can assist him in augmenting the rural economy must be raised.

- Specific emphasis to be laid on and attention be paid to, green/agricultural education, rather than traditional education and other professional/vocational courses.
- The UNO census projects a world population of about 8.5 billion by the year 2025 with particular reference to urban population attaining 5.1 billion from the previous 2.5 billion in 1994, resulting in consumers getting separated from producers. Under the circumstances, qualified personnel are needed for food production, efficient transportation, environmental protection, management of food quality, efficiency in negotiating agreements, entrepreneurship in agriculture, and other multifarious agri-related tasks.
- Essential to create more "green collar" and "blue collar" jobs, as compared to the prevalent "white collar" ones.

Policy to Ponder

While expostulating "Strengthening Institutional Capacity", Lavinia Gasperini, FAO, SDRE at Inaugural Conference of the Global Consortium of Higher Education and Research for Agriculture, July 22-24, 1999, Amsterdam, The Netherlands stated that, "Efforts to ensure Food for All need to be closely coordinated with those aiming to reach Education for All, since the results of both programmes are interdependent. We intend to contribute to:

- The definition of a systematic approach to education for rural development and food security, addressing all levels of education, with priority on basic education (primary formal and non formal education, adult literacy and adult education and basic skills for life).
- Research and dissemination of best practices and case studies which illustrate the contribution of education to sustainable agriculture and rural development and food security.
- Training of policy makers and managers on education for rural development and food security

The existing educational policy, therefore, needs drastic changes to achieve the optimum, set as target for ourselves. Adhering to these set norms, the Agricultural Universities should define and formulate their own vision and mission.

As a new paradigm shift in present agri-education policy, a four-tier agri-education system needs to be introduced in the country with following pattern and a la motif:

- ***First Tier***: From Kindergarten to seventh (prepare farm lovers and environment conscious citizens)
- ***Second Tier***: From eighth to 12th (prepare farm technicians and small scale entrepreneurs).
- ***Third Tier:*** 12th to graduation (prepare students for green collar jobs- Agri-marketing, Banking, Insurance, Poly-clinic, Value addition entrepreneurs)
- ***Fourth Tier***: University Departments (Prepare Agricultural Scientists for cutting-edge research to enhance productivity)
- ***Incentive*** : One time grant up to 50 % to schools which switch over to total green education should be given with yearly maintenance grant
- Each district must have one Agriculture College
- ***Navodaya Krishi Vidyalaya***: Establishment of specialized model of agriculture high school similar to Navodaya Vidyalayas to prepare future farmers
- Agricultural Education Board similar to Technical and Higher Education Board at state level should be constituted
- Pragmatic budgetary policy changes are required
- At least 10 % or more of agricultural GDP should be allocated for agricultural literacy and green education.
- % of total out lay for agriculture should be allocated for Higher Agriculture Education (Universities)
- Pedagogical training of teachers in green education in School and Colleges
- Priority in rural jobs for agricultural graduates

In addition, holistic approach is required in compounding the syllabus to make the transition in the system more wholesome.

It is time to make decision for priorities to change. There is much to be done, and we need to run against time to go beyond the set goals. These are not maximum goals, but minimum goals. New conventions and new innovations mean the innovators and the policy-makers going hand-in-hand and working together: if we are working together, breaking ancient walls and bridging our efforts, we can make it. Together, we can build a better, greener world for all. In a fervent appeal to all planners let it be noted the famous words of Late Prime Minister *Pandit* Jawaharlal Nehru: "If agriculture fails, everything fails".

Let us hope for better future of India and the world.

Policy on the Role of Basic Sciences in Agriculture Education- Veterinary and Animal Sciences

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Policy endowment and application of any science in education is directly dependent upon and related to the contributions and expectations from the sector. This application is further affected by dynamics of future prospects and trends in the subject matter. The essentiality and desirability of the role of basic sciences has never been in doubt in any education curriculum, but recent developments and advances in the area of understanding the basic functions of the units of life process within a cell, has greatly altered the emphasis which needs to be laid in preparing a graduate for professional life.

Agriculture professional education in the recent years has not undergone any dynamic directional changes in conformity to the changing demands of the farming community nor has the advances in basic sciences touched the contents of the subject matter. In fact, over years agriculture education has tended to be elitest and slowly got weaned away from the core constituent and stakeholder, the "Farmer" itself. The essential policy demand on agriculture education should be to optimize the resource management in different agro-ecologies so that the soil, plant and animals function in an integrated system with farmer as the central hub of the system.

Agriculture Education Policy Scenario- Green Education

Students in professional education come through a feeder system of education consisting of a primary, middle, high and higher secondary levels. In these twelve years of education, the primacy of agriculture is not recognized and unfortunately education is known to breed a sense of rural discomfort. In this educational ethos, agriculture is not reckoned as a job or vocation and education is not married to any social responsibility and school or college education is neither local rural eco-oriented nor environmentally based. In fact, the educational content draws students out of the locale. The Natural resource base available locally is never made aware of or a focus for its management through education. Deliverables are missing from teaching contents and no orientation is there for rural on-form and or off-farm jobs.

Thus basic science content needs to be re-examined with respect to stage, type level and duration. The content needs evaluation to bring forth as to how much is essential, particularly considering that not all the school going students will be ending up as professional graduates. Social Sciences, Environmental Sciences or Application sciences may have more relevance to students who opt out of professional race to engineering, medicine and allied subjects. Once the learning principles at high and higher secondary levels are not married to jobs-empowerment, the content and emphasis towards basic sciences will be utopian. All the students, therefore, must be oriented to "green education" a means to relate the life to the environment they live or intend to work with.

Livestock in Agriculture Education- Science basic in high and higher secondary Education:

Having accepted the primacy of agriculture in socio-economy, agriculture as a subject of study should be regular and compulsory for three years in 6-8 standards, The subjects of Production system orientation, rural ecology, economics of different production systems, biodiversity appreciation, the art and science of livestock, livestock as an integrator of rural economy, economic identification of livestock base and information technology to address productivity and produce should be essential parts of the school/college curriculum for giving a strong basic sciences background to a student. Animal Husbandry (dairy, poultry, piggery, goatery, fisheries) should be introduced as a regular vocational subject at +2 stage of education.

Policy imperatives for such change will involve creating content, identification of learning activities, and identification of on and off farm jobs to tailor an educational programme specific to such jobs and identification of delivery systems for goods and services. Virtual education and information technology tools can very effectively be used for such identification and trainings.

Evolving Concerns in Agriculture

Agriculture education has to take into consideration, the recent concerns which have evolved the agriculture sector. Production has fatigued and productivity stagnated. Crop growth has retarded and has been negative for some years. There has been acute nutrient mining and considerable soil degradation. In the wake of these developments the sustainability of production strategies has flawed and the result has been poverty and livelihood preposition has remained unsolved.

Indian agriculture has come under this stress due to several factors which include declining farm size and income, insufficient incentive for productivity and quality, growing rural unemployment, uncertain market prospects and trade problems and high indebtedness. Out of all these happening and considering the state of growth, there is a consensus that there should be a paradigm change in agriculture. We need to come forward convincingly with a model that agriculture is a profitable proposition. The existing approach model addressed agriculture through land resource for food security. However, water, soil health, sustainability, social equity and livelihood considerations remained largely unanswered.

Livestock Linkage

Economic linkages are complex in today's agriculture and it is becoming clearer with overwhelming evidence that livestock is basic to profitable agriculture and can substantially offset and even reverse the negative trend in crop productivity. In subsistence agriculture; significant level of economic dependence is on livestock.

Livestock provides half of the value of global agriculture out put and one third in developing countries. The value from livestock in GDP contributions to agriculture comes around 30%, in spite of agriculture contribution to total GDP falling from 52% to 19% in the past decades.

Milk and Meat is the major protein for human diet and an instrument for nutrition security. Livestock embodies saving in rural scenario and integrates with and complements crop production, draught power, organic fertilizer, rural transport etc. The landless and rural women benefit directly from livestock as they provide the sustained source of food. Further, the rapid growth inherent in this sector and the demand for livestock products, particularly in the developing countries is viewed as "Food revolution". In this context, the greatest strength for India, compared to world's developing Nations, is that its food basket replacement is not through imports of animal products but through domestic production. India has a unique production system where rich animal protein is produced form roughages and grasses and not by feeding concentrates and grains as in the Western and other developing world.

Education Component Integration: Effective Basic Sciences Teaching

Effective Basic Sciences teaching in professional courses, particularly in biology and health dominated course programme of B.V.Sc. & A.H., can only be possible if we have teachers, as well as students properly endowed with the knowledge, capacity and skill delivery capability developed over years. Teachers having acquired the ability through an adequate training and students prepared from early/ primary education level to develop a zest and zeal in the subject matter. Above all, the greatest cementing component of education is an enabling environment for communication between a teacher and student which will ensure imbibing information, creating knowledge and inspiring output from the students in their professional pursuits.

Basic Sciences in Animal Science and Veterinary Education

At undergraduate level training in animal science subjects for Agriculture (B.Sc. Agri) Fisheries (B.F.Sc.) Forestry (B.Sc.), Dairying Science (B.Tech) and in Veterinary Science (B.V.Sc. & A.H.), the emphasis of teaching basic science subjects varies considerably depending upon the course programme. Animal Sciences component in the agriculture and allied sciences do need a good basic science background but there are no courses as such for basic science subjects. Applied basic sciences are comprehensive in the entire course programmes. However, during the last few years, the teaching programme at +2 level has undergone considerable revision and considerable amount of basic sciences like Physics, Chemistry, Zoology and Botany are being covered.

It is often observed that in professional colleges under B.Sc. Agriculture or B.V.Sc. & A.H., repetition of the same material often dents the subjects inquisitiveness' to new course programme and even lulls a student to complacence, if the same material is taught in the Ist year or II year degree at B.Sc. Agriculture. At B.V.Sc. & A.H., however, such repetition is minimal and not conflicting with the learning objectives of the course. Repetitions, if any have further been reduced through the revised course programme for B.V.Sc. & A.H. proposed for implementation by the Veterinary Council of India which is the apex regulatory body for undergraduate education in the field of Veterinary Sciences.

New millennium professional has to answer the new concerns and demands of the modern veterinary practice including veterinary disease diagnosis, control and treatment of animals. Recent techniques and technologies have largely arisen out of better understanding of the cell function and the information which is contained in the sub cellular organelles. Biotechnological advances in covering these mechanisms, unknown previously, has considerably changed disease control and management strategies.

Advances in science can come through in depth research for which knowledge and application of basic science is prerequisite. Hence, it is essential that for teaching and research both the emphasis on basic research should be so regulated that the graduate students should be able to use the knowledge as a resource base both as a practicing professional and should also keep an urge in him to discover more. For this, our course teaching programme should develop close linkage with industry so that their strength in basic science could be used for developing better expertise and advances could be ploughed in the training programme of the students.

Modern methods of animal improvement bank heavily on the research advances and discoveries made in the area of basic science understanding the gene expression has been utilized into bringing about synthesis of genetic combination for better body weight gain, disease resistance, higher production, better quality and composition of meat, milk, eggs, wool etc. The art of embryo transfer, *in vitro* fertilization and sperm sexing has come as a technology where the basic mechanisms in egg and sperms interactions were understood. Gene insertion for traits and genetic modification of animals as well as conservation strategies are born out of laboratories where fundamental research was pursued. Gene cloning and drug discovery are essential components of professional advancement.

Concluding, it can be said that agriculture education needs an urgent change both at the level when the students are being prepared in schools for entering in professional life as well as at the professional college level. There is urgent need to "Green" our school education and identify inadequacies in college education. Major structural changes are needed in contents to shift emphasis on skills than knowledge alone and empower our graduates to entrepreneurship with professional competence with adequate background of basic Sciences education. There should also be a policy initiative to encourage greater faculty interaction by involving specialists in basic sciences to professionally teach and guide students in advanced research in Veterinary and Animal Sciences fields.

Agriculture Education Policies for Livestock in Indian Agriculture

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Livestock and Indian Agriculture

As part of the physical world, animals have formed an integral element of the environments in which humans evolved and in which we live today. The earliest relationship between humans and animals was the predator-prey relationship, with certain animal species - those that could be caught and killed using the tech-nology and techniques available at the time - hunted for food and used as a source of other material supplies. Although this relationship was not exclusively unidirectional, the role of animals as a source of food is perhaps a fundamental one in human-animal interactions. Cave paintings from widely dispersed sites in the Old World suggest that by around 40,000 years ago, animals had assumed a much more important position in the human psyche than merely as food. Whether Paleolithic cave paintings involve mere representations of fauna, sympathetic hunting magic, or the development of some aesthetic or spiritual awareness relating to animals, they indicate that animals played an expanding role in the consciousness of humans. This role subsequently grew to encompass a range of animism, totemism and religious symbolism, and became even more complex following the domestication of food animals beginning around 10,000 years ago. The emergence of agriculture, based on specific groupings of domesticated plants and animals, provided the foundations for sedentary societies. Today, animals have acquired social func-tions, e.g. as pets and indicators of social status, and in some areas of the world have even assumed political roles. Clearly, animals play different roles in different societies at different times in history. However, the roles has been very much complex as in South Asia, particularly, multicultural India, precisely due to differences in attitudes, beliefs and practices associated with one species in particular, cattle.

Domesticated Indian zebu cattle were present on the western margins of the South Asian subcontinent as early as 6000 B.C. Cattle were important in the agricultural economy of the Harappan civilization of the Indus Valley, but archaeological evidence suggests the bull was also assuming a symbolic or religious role in this culture during the third millennium B.C. There is, however, little to suggest that the cow was viewed as sacred. Following the decline of the Harappan civilization, northwestern India was settled by Aryan-speaking peoples who laid the foundations of modern Indian society. The Aryans were pastoral by nature and the economic importance of cattle to this society is mirrored in the role of cattle in ritual, in the pastoral symbolism of the Vedic literature (the ancient religious literature of Hinduism), and also in the association of the cow with various Vedic deities. Yet, again there is nothing to suggest the cow was viewed as sacred at this time. It is not until the appearance of the *ahimsa* philosophy at the end of the Vedic period, and the acceptance of this belief in the major religious philosophies of the region (Jainism, Buddhism, and later Hinduism), that the concept of the sanctity and inviolability of the cow began to crystallize. The "sacred-cow concept" appears as established doctrine in Hindu literature by the end of the medieval period (ca. fourth century A.D.), although popular practice appears to be at variance with this doctrine. A variety of historical, political, religious and social factors appear to have contributed to the general acceptance of the sacred cow doctrine by the Hindu popu-lation at large. During the 1960s, the "sacred cow" was at the center of a controversy in the social sciences concerning whether the concept was essentially religious in nature or reflected the ecological realities of the cattle economy of the Indian subcontinent. This debate notwithstanding, cattle remain central to the Indian economy, but also play a significant role in the religion and rituals of modern Hinduism, particularly those related to the worship of Krishna. Cattle have also assumed a political role in contemporary India, with anti-cow-slaughter legislation and the protection of the cow being identified with the emerging Hindutva movement. No understanding of South Asian culture can

be complete without an awareness of the economic, historical, political and religious dimensions of cattle in the Indian subcontinent.

The Indian farmer who depends on his cattle for his livelihood, the village housewife who spreads purifying cow-dung *(gobar)* on her hearth at the time of *Govardhan Puja,* the businessman who performs the cow-worship ceremony *(go-puja)* at *Gopashtami,* the priests who feed milk to the idol of Krishna at certain times of day at Vaishnava temples, the devout Hindu who supports aged, non-productive cows out of respect for "Mother Cow" and as an alternative to slaughter, the politicians who promote cow-protection to demonstrate their "Hinduness" - all act in a cultural context that places great emphasis on and is circumscribed by the concept of the sanctity and inviolability of the cow.

Cattle (and the cow) are of great economic importance to the Indian economy and people, but they are also of considerable symbolic significance in the context of the Hindu religion and society. They thus assume the roles of both sustenance and symbol, though the duality of this heuristic device does not come close to doing justice to the complexity of the roles cattle and the cow play and have played in Indian society.

Veterinary Education: Preamble

The human resource developed by Agricultural Education system has undoubtedly transformed the Indian agriculture. Now the need for new knowledge and skills is more challenging than ever before. The existing education is thus hard pressed to keep pace with the rapid technological, economic and social developments taking place nationally and internationally. Henceforth, Agriculture Education is required (i) to respond to the needs of employment, economic growth & sustenance of the natural resource quality, and (ii) to measure up to handling of internal (poverty) and external pressures like WTA, GATS, GMOs. Reorientation of agricultural education & its linkage with trends of employment & needs of various sectors of economy (public, private, service, import & export) on the one hand and its responsiveness to maintain environmental integration on the other will have to be the front ranking strategy of the National Agricultural Education System (NAES).

Present Status of Agricultural Education

Beginning in 1950, there were 17 Agriculture colleges, three veterinary colleges and one Agricultural Engineering college. The NAES has now developed into one of the most comprehensive systems in the world comprising of 34 State Agriculture Universities (SAUs), one Central Agriculture University (CAU), 05 Deemed-to-be-Universities (DUs), three Central Universities, and one horticultural University. The details of the universities, colleges, and other Private agricultural education institutions are given in Table 1.

The National Agricultural Education System

The Indian NAES comprises of (i) Public organizations which comprise of SAUs and their constituent colleges, and institutions supported by the central government and (ii) Private organizations like agriculture and veterinary colleges affiliated to traditional/ general universities.

State Agricultural Universities

Of the 34 State Agricultural Universities (SAUs), there is one exclusively for Horticulture and forestry Education. Four SAUs and three Deemed-to-be-Universities (DUs) concern primarily with education in veterinary, fishery, dairying and animal sciences. More and more veterinary universities & private colleges are coming up. The agricultural education is patterned in Land Grant model of the USA. Agricultural education establishments embraced education, research and extension as integral to their functioning. There

are now 37 veterinary colleges in the public sector and two private veterinary colleges (Rajasthan) in private sector. There are now a number of veterinary universities (Tables 2, 3). The updated list of SAU, veterinary colleges, and veterinary universities in given in Tables 2 and 3.

Role of ICAR in NAES

The role of ICAR in NAES has been noteworthy. The ICAR & SAUs jointly have been able to streamline the NAES in India and results have been encouraging. However, the futuristic needs warrant reform of the NAES in the country.

Policy for Veterinary Education and Training

The National Policy on Education (1986), focused on the Programme of Vocationalisation of the Education. The primary aim of Vocational Courses was to cut across several occupational fields and prepare students with employable skills in organized sector and for self-employment. To cater to the needs of farmers in veterinary field and to provide basic veterinary services to the society, educating learned youth, veterinary livestock practitioners, and paravets/para-professionals in large number are required with sufficient skills in rural areas. Therefore, the principal objectives will be two-fold, viz. (i) to train the students to scientifically undertake animal husbandry activities and preliminary knowledge about treatment and prevention of livestock diseases, and (ii) to create employment potential and man power for livestock development. However, the objectives in more details include: (i) imparting training in managemental practices of (a) Dairy animals, (b) Sheep and goat production, (c) Swine production, (d) Poultry and other avian production, (e) Pet and zoo animal management; (ii) training the personal in animal improvement using artificial insemination programme; (iii) training the personal in treating common livestock diseases and prevention, (iv) developing abilities for collection of livestock samples for laboratory diagnosis; (v) developing abilities for laboratory techniques to help in diagnosis of diseases, (vi) preparing livestock industry workers as capable organizers/supervisors/ Assistants / Extension workers / hatchery supervisors etc.; (vii) developing abilities for production sale of livestock feeds and livestock products, (viii) developing abilities for quality control of livestock products, (ix) gaining practical knowledge about fodder production and its preservation methods; (x) gaining practical knowledge about of post-surgical treatment and care; (xi) training the individuals in need based livestock operations like surveying, organization of Livestock Shows, Kisan Melas, Exhibition etc.; and (xii) preparing animal husbandry workers as a link between agriculture supporting organizations / Institutions and farming community.

The futuristic View: Veterinary & Animal Science Education

Contribution of livestock sector in national GDP has been continuously rising giving relief to even agriculture as its share in national GDP has been declining over a period of time. The contribution of livestock in

Table 1: Agricultural Education System in India

University	No. of Universities	No. of Colleges
SAUs	34	200*
CAU	01	06
Deemed-to-be Universities	05	10
Central Universities	03	03
Indian Institute of Technology	01	01
State General Univ.	16	41
Total	60	261

* Includes 09 affiliated colleges; Source: Katyal, JC (2004). Status of Agricultural Education in India, Presentation to Governing Body of ICAR in March 2004.

agriculture sector is continuously on increase and has to further increase in future as the demand for livestock products is also on increase. As such, the livestock sector business activities are on increase. However, the human resource is scarce and veterinary infrastructure is quite inadequate. Several factors like changed use and fragmentation of agricultural land, declining grain output and increasing population point towards the increasing role of livestock in meeting the nutritional security throughout the globe and hence signaling the increase in demand for livestock products for human consumption. Livestock constitute the engine for growth and are the developing focus for tackling global food crisis. However, in spite of the realization of importance of animal husbandry all over, this sector did not get the desired thrust. Developing countries are short of resources and, therefore, face competing demands from various sectors leading to neglect of livestock. The lack of importance of livestock sector is reflected by inadequacy of veterinary services infrastructure like veterinary dispensaries, modern equipment, and shortage of trained manpower). The veterinary education infrastructure has grown but not the desired level. The veterinary education needs to be internationally competitive. The role of veterinarians has been changing with time and now veterinarian has to play much more diverse and significant role in today's world especially in ensuring food safety and nutritional security besides augmenting food availability.

Steps to realize importance of Livestock Sector

It is very evident by now that the livestock sector now needs much thrust if the world has to sustain itself in terms of food availability, food safety and nutritional security. Following are some of the steps to realize the importance of livestock sector.

- The economic analysis of the livestock products (internal consumption, tradable and non-tradable) and commodities pinpoints about the role played by the livestock sector in national economy. The output of milk is more than combined output of sugarcane and paddy. Similarly, total economic gain from rice is less than the milk. Demand for milk/meat/egg will rise as living standards rise fuelling demand for nutritionally valuable products. The realization of this direct national economic gain as well as gain in health status of human as well as animals, it should be easier to comprehend the expenditure allocation to the livestock sector.
- The veterinary services are also inadequate which warrant assessing the performance of veterinary services employing Performance of Veterinary Services (PVS) tools of OIE followed by filling these gaps.
- Donors and governments have to come forward to remove inadequacies of infrastructure and trained manpower. For fighting TADs, global community has to come forward as TADS in global village or one world will not spare any place or country i.e. world is not biosecure which entails establishing biosecurity. The animal diseases are emerging as major threat to human health as well and, therefore, need to be addressed at global level. This needs reorientation of veterinary and Animal Science education to meet the future challenges and requirements entailing scope for education reforms in the country.
- Further, as the emerging infectious disease scenario entails international cooperation, the veterinary and animal science education needs to be globalized in terms of contents, subject and syllabi to enhance the professional competence, not only at national/country level, but also at global level.

Areas for Reform

1. Course Curriculum

Course curricula need regular updating with changing times in context of knowledge explosion and technological advancements. The curricula should also include vocational and entrepreneurial courses, courses

on newer and emerging areas like biosecurity, Sanitary and Phytosanitary (SPS) measures, intellectual property rights (IPRs) including patenting, ethno-veterinary medicine, bioinformatics, nanotechnologies, trans-boundary issues (international livestock trade including TRIPs, trans-boundary disease management, biosecurity, bioresource management and conservation), Risk analysis, Risk Management & Risk Communication, integrated information and knowledge management systems in veterinary education, animal welfare, socio-ethical issues, climate change in livestock agriculture, E-learning (resources) and blended delivery models in veterinary sciences, mentoring in a veterinary practice program, group learning to encourage integration and deep learning in veterinary science, clinical teaching using extramural teaching sites in veterinary practices, etc. Curricula should be similar for same degree in all the teaching institutions. ICAR should have a central committee for ensuring the above at regular time intervals.

Currently, biotechnology is taught in the first year of undergraduate course clubbed with molecular biology. It would be more appropriate to teach molecular biology and cell biology in first year while biotechnology in fourth year since the pre-requisite subject knowledge (microbiology, physiology, biochemistry, genetics, animal reproduction, nutrition) is gained in first four years. Therefore, applied subjects like biotechnology need to be taught after gaining these pre-requisite knowledge and skill to make it more effective. Further, the basic computer science should naturally be taught at first-year level while applied computing including bioinformatics should be taught at fourth-year level along with biotechnology. Teaching of such applied subjects in the final years of the degree course will be much more pertinent for effective learning in the wake of the knowledge explosion and technological advancements. Assignment-based component of the theory teaching should be increased from the current level. Practical classes should get more emphasis with real-time experiments/special problems and use of animals. Livestock statistics and economics subject should be upgraded to agri-business management.

Develop Entrepreneurial Skills

While developing course curricula, it is essential to bear in mind that course modules should also have emphasis on entrepreneurship (or entrepreneurial skill) development. Developing entrepreneurial skills will involve giving small projects linked to the interest of the individual students. Training and experiential learning (EL) in similar area in real field situations like livestock farms or meat/dairy plants/factories. Students should be encouraged for additional experience in that area for developing entrepreneurial skills. Organization of institution-industry interface will provide an opportunity to faculty and students for interaction which can further motivate the students. The institutions should provide specific opportunities to students for specific trainings and/or research. Students can be identified in initial stages like in pre-final year or first year of post-graduation & impart industry-specific training. Potential for employment of such students will be high. At BVSc & AH level, the course curricula should have courses on entrepreneurship. The Rural Agricultural Work Experience (RAWE) for six-months, training of veterinary/para-veterinary staff under RAWE will go along way in upliftment of veterinary profession. ICAR funds are available for such training and should best be utilized.

Areas for Reform: 2. Teaching Facilities

The current teaching in veterinary sciences should adopt the "Smart Classroom Approach". As such, the Lecture Halls should be equipped with e-learning with Interactive Internet facilities, Multi-media, and Video-conferencing facilities. Preferably, lap-tops should be made mandatory for students as they are to go for courses like biotechnology, bioinformatics, advanced genetics, livestock economics and statistics, agri-business management, etc. Now-a-days most of the advanced colleges have already made it mandatory for students to have lap-top computers to make the teaching/studies more economical. Buying lap-top computers is now not problems since the prices have come down considerably and is well within reach of the students. Lecture by outside eminent scholars should be a part 'n' parcel of the regular theory classes.

The Practical Labs should be modern equipped with state-of-the-art equipment and animal house facilities. Every institution should have biosafety level-2 facilities so that students have exposure of working such laboratories. Practical classes should be more than two hours as two hrs of time for practicals is not sufficient. Real-life and real-place practical experiments will go a long way in skill development.

Areas for Reform: 3. Experiential Learning

The experiential learning is very crucial for veterinary graduates and, as such, such training programs should be arranged with suitable Models. The experiential learning at plants, farms and factories is essential. Vet-clinics, Pet-clinics, AI clinics, and semen banks with state-of-the-art facilities need to make essential component of veterinary education. Agriculture farms for fodder/forage production, livestock/Dairy/fish/poultry/ bio-organic farms for modern practices; processing plants for, meat, milk, and other livestock product; animal/ poultry farms, fish ponds and hatcheries for demonstration of modern husbandry practices; Harvesting at farms and processing in plants will provide real-life experience. Integrated farming systems should be encouraged as they are eco-sustainable. Regular Ambulatory services for veterinary graduate students & PG students in clinical subjects and state-of-the-art mobile polyclinics are essential components. Encourage teaching in farming of new animal/bird species like Ostrich, Emu, red deer, wildlife, etc). Experiential learning models/plants should be set up in institutions which should have linkage with public/private models/farms as developing human resource by experiential learning provides manpower to farms and/or companies. ICAR/ Pool funds for establishing such facilities have to be shared by others. The Niche Area of Excellence (NAE)/ National Agricultural Innovation Project (NAIP) projects by ICAR have been much helpful in upgrading the infrastructure to international standards. Currently, there are 183 projects running in 43 SAUs.

Experiential learning has now got a boost in many sectors. Establishment of Indian Institute of Crop Processing Technology (IICPT) at Thanjavur by Ministry of Food Processing & Industries on Feb 18, 2008 is a welcome step. The vision of this institute is : (i) to serve as a National institution for research, education, training, and extension in the area of post harvest processing of crop of wetlands, flood, cyclone and storm prone regions, and (ii) to establish linkages with related processing industries & other academic as well as R&D institutions for achieving its goals. Establishing such plants in dairy, meat, leather, and wool sectors should be actively considered.

Areas for Reform: 4. Faculty Strength

Faculty strength in most veterinary colleges/Universities/ SAUs has been depleted beyond one's imagination and comprehension. Less than optimum strength of the faculty in teaching institutions is jeopardizing the quality of education. This is because fewer graduates opt for teaching in veterinary schools. It is essential and urgent that brilliant veterinary graduates are appointed on the lines of Medical Residents; they are given higher scales, and upgraded with PG/PhD degrees. Providing e-learning opportunities for higher education, where practical is not pre-requisite, as has recently been offered for MBA (24x7 e-learning modules) so that they can acquire higher degrees without interrupting work. Further, in consonance with institutes run as per MCI and IIT norms, the veterinary educationists should get one-grade higher salary structure. The NPA should be given to all the teaching faculties in the universities. The non-grant of NPA in the universities has been responsible for depleting strength in the universities.

Areas for Reforms: 5. Faculty from Wider Geography

Another major concern has been the inbreeding of the faculty. There should be provision for at least 25% staff from outside the state (4th Deans' Committee recommendation). The ICAR may appoint this 25%

quota of faculty otherwise states may not agree. Exchange program for faculty between different colleges/ universities in stronger areas of learning or areas of excellence is essential. Cultural exchange of faculty and students, inter-institutional and international collaborations between teaching institutions and with others institutions in public/private sector will also go a long way.

Areas for Reform: 6. Faculty Up-gradation

In view of the knowledge explosion and technological advancements, continuous up-gradation of the teaching faculty in teaching institutions is necessary to maintain the educational standard. There are many facets which help in faculty up-gradation. Faculty exchange between institutions within India and abroad is an important component of faculty up-gradation. The faculty exchange for training in stronger areas of learning within the country, encouraging inter-university collaboration in education under international projects like Indo-US Knowledge Initiative (INDO-US AKI), NATP and NAIP will definitely facilitate faculty up-gradation. Veterinary colleges at Chennai & Pantnagar have already initiated faculty exchange program under INDO-US AKI and faculty exchange has already commenced. Collaborative research projects between the Indian universities through multi-institutional projects between Indian & foreign universities funded by DBT, DST, UGC and other funding agencies will go a long way in integrating research and teaching. Funding options from inter-country science collaboration initiatives (Indo-Japan, Indo-Australian), foreign funding agencies like European Commission, NIH, Welcome Trust, and other foundations/ trusts can be explored for such projects. Sabbatical leave is not very popular among the faculty. They need to be given incentive otherwise they may not be willing to go abroad on sabbatical leave leaving their families back home in the country. Following this approach, multiple short-term faculty exchange programs between Indian and foreign universities will be more feasible.

Areas for Reform: 7. Continuing Veterinary Education

The changing education scenario and changing role being played by the veterinarians today as well as the changing multiple roles to be played by the veterinarians in future envisages "Continuing Veterinary Education (CVE)" to upgrade the veterinary professionals' competence. Regular trainings for faculty is a must, may be, as refresher courses every 5 years. The first course under CVE was recently organized on "brucellosis" by Veterinary Council of India (VCI). Similar courses in all the other areas of veterinary and animal science courses need to be organized regularly. Another issue which is very crucial is "inter-university transfer" of the faculty. While inter-university transfers help in discharging the social and family obligations by the faculty, they also enrich the university faculty with experienced teacher.

Areas for Reform: 8. Integration of Research & Teaching

The SAUs have less component of research but more teaching which is reverse in research institutions. Each faculty should have research projects especially externally-funded multi-institutional projects with faculty visit/exchange component. The German DAAD Fellowship is one such program wherein the DAAD fellowship awardee students working foreign universities, the faculty (the supervisor of the awardee students) also gets opportunity to visit the lab in Germany. The faculty should be encouraged to take advantage of such schemes where students can complete course work in Indian universities and do research in foreign universities; faculty also visits the lab abroad. The faculty should be given equal weightage for teaching and research when they are assessed for their career advancement. This will motivate the faculty to give equal weightage for research as well as teaching activities which will also help in integrating the research and teaching. Students should be encouraged to take small research projects as special assignments wherein provision for incentives (awards/medals) exists making it competitive. Inter-institutional collaborative research projects should be encouraged under internationally-funded projects like AHRD, Indo-US AKI, and NAIP.

Areas for Reform: 9. Integration of Research & Teaching with Business Market

The global trend in commercialization of agriculture and well-informed consumerism needs integration of research and teaching with business. This integration of teaching and research will also help in directing the research and teaching activities in a direction which is suited for the existing market demand and future market trends. This integration entails including components of Agri-business Management courses in BVSc degree course. Even the livestock economics and statistics course may also have component of Agri-business management. Providing training opportunities to graduate/PG students in Agri-business Management and encouraging students for choosing agri-business management for higher degree will expose the students to market/business situations to gain first-hand knowledge and experience which will re-orient their thinking towards practical situations making them more successful in their career.

Areas for Reform: 10. Harmonization of Elements of Veterinary Education

Harmonization of elements of veterinary education is an essential element in maintaining the standards of veterinary education to be globally competitive. Various elements requiring harmonization include the syllabus, course content, academic session, extension services, and examination system. All the institutions in the country engaged in veterinary education should have similar syllabus and course content to have a pool of professionals who are equally competent. The harmonization of academic calendar and examination schedule will help the students in furthering their advanced education as they will get equal opportunity to take admissions in institutions where ever they wish. The harmonization of academic calendar and examination schedule will also help the institutions in admitting the brightest students in their programmes. The examination system should have both external and internal system of evaluation which makes the education evaluation system more rigorous. Distance education modes especially for specialized professional courses will also go a long way in up-grading the faculty in their professional competence.

Areas for Reform: 11. Para-professionals

The human resource in veterinary services has always been very scarce and situation is no more different at present. This entails having sufficient strength of para-professionals. The "Paravets" - with informal education (certificate course) or informal (Para-professional) training - are important human resources who support the veterinary services activities. Other para-professionals can also be developed on similar lines. These para-vets and para-professionals will enhance the output of professionals by discharging low-key duties

Areas for Reform: 12. Motivating Younger Generation

To ensure adequate human resource availability in any field is the greatest challenge today. As such, ensuring this availability of trained/specialized human resource entails motivating younger generation to opt for such an area of study to make it their career. Thus, motivating younger generation through public awareness programs through mass media about opportunities and scope for veterinary & animal science graduates in veterinary and animal science areas including public teaching/research institutions, private teaching/research institutions, State government jobs, private companies engaged in drug and vaccine manufacture, Agri-business Management graduates, and self-employment enterprises. Motivating younger generation in entrepreneurial skill development animal and veterinary science is an important component in augmenting human resource in animal and veterinary sciences. Informing the younger generation about potential for high income generation through self-employment in High-end business opportunities like organized dairy farming, poultry farming, fish/prawn farming, establishing processing plants/units (Dairy, poultry, fish), animal feed plants/factories, organized integrated farming systems, organized composite farming systems, corporate farming, retailing agri-products including livestock/poultry/fish products, and

high-end exotic bird (ostrich & Emu) farming like ostrich and Emu farming. The ostrich farming has, of late, gained importance as a beneficial farming enterprise because ostrich leather and fat oil are very expensive. The educational institutions should have such farms in their premise\ as a teaching facility. The Tamil Nadu University of Veterinary and Animal Sciences already has an ostrich farm in their premises. Similarly, Emu farming has also gained importance as a farming enterprise as Emu meat is also expensive and is supplied in 5-star hotels. Emu fat oil has medicinal value and is also very expensive. Successful Emu farms are now very common in Maharashtra (Pune), Tamil Nadu, and New Delhi. Availability of Toll-free numbers at these farms is an indication for higher income generation thru Emu farming and the willingness of the Emu farmers to expand their business. Private Emu farmers are now ready for joint-ventures with institutions and individual entrepreneurs. They are ready to supply Emu chicks, the technical know-how of Emu farming, and also provide "Buy-back Guarantee". Such high-end enterprises will definitely motivate the younger generation to opt for veterinary and animal sciences.

Areas for Reform: 13. Higher Level of Coordination

Over and above the issues already discussed above, the higher level of coordination is essential between SAUs, SAUs % ICAR Institutions, SAUs %Vet universities % ICAR Institutions, Public and Private Institutions, teaching institutions and practical facility centres, Teaching institutions % Industry % Private plants/ farms, and ICAR % Academies (NAVS) % Councils (VCI). Encouraging the Public-Private Partnership (PPP) by involving private institutions in teaching roles, encouraging Build-Operate-Transfer (BOT) module in developing teaching institutions/infrastructures, encouraging Industry-University partnership, regular Industry-University interface, and organization of campus interviews will go a long way in assuring the quality education in the country which is internationally acceptable and globally competitive.

Areas for Reform: 14. Other Issues of Concern

Some other issues are also mentioned below which need attention.

A placement cell at national level for veterinary graduates will provide better placement helping the prospective job seekers (veterinary graduates) as well as the employers. This placement cell can be headquartered at ICAR or ASRB.

The duration of veterinary degree course is currently 5 years (4 ½ years for course + ½ years for internship). If some new courses are to be incorporated, then this time may go up by 6 years (5 years for course+ ½ years for general internship+ ½ year for specific internship).

Policy Issues

Policy issues related to agriculture education especially veterinary education also need to be addressed. One issue is that the prospective students from rural areas were earlier getting weightage in admissions but that provision was later scrapped off. The fact is that the rural students have fewer opportunities for tutorials for preparing competitive examinations due to poor economic status as well as being away from cities where such tutorials are available. It would be pertinent to give them opportunities for getting admissions in the streams they wish as they have talent which could not be expressed due to non-availability of opportunities. There could be provision for giving admission to prospective students from rural background as is the provision for women as a special quota.

Vocational courses need to be introduced in veterinary education as most of the students from rural background can not afford the admissions to veterinary graduate programmes because of high admission fee. The education pattern at 10+2 level also needs to be re-oriented where students are primed especially in courses relevant to livestock husbandry. As such, students may go for two-years vocational courses in

many streams of livestock husbandry like goat keeping, dairy, poultry farming, emu farming, ostrich farming, animal feed technology, artificial insemination, pharmacy etc.

Continuous veterinary education should be an activity for upgrading the skills of the veterinarians. Distance education may play a crucial role in this as distance learning based educational strategies offer much scope for the continuous professional education of veterinary professionals. Today's veterinary surgeons face ethical dilemmas as well as emerging zoonoses that cross species barriers in their day-to-day work. A veterinary surgeon specialized in companion animal sector must now understand how new livestock diseases affect pets and what control measures are available. Biosecurity and biosafety, sanitary and phytosanitary (SPS) measures, vaccination strategies, effective surveillance, risk analysis and contingency planning may be new skills in which the professional now needs to be proficient. The ability to continue professional duties whilst studying also makes them attractive to the employers. Self-paced independent study, using distance learning tools such as text-based, computer-assisted or in online formats; or, as the field evolves, using m-learning based methods offer much promise. The programme should be designed for trans-national training and should offer postgraduate qualifications or short courses that can be customized for individual or group training purpose. The topics offered should be distinctive, and based on training requirements of veterinary surgeons employed by the public sector and are developed in conjunction with employers. Practical knowledge in veterinary epidemiology combined with animal health economies, global animal disease patterns using spatial analysis of disease data, surveillance training to ensure competence in development of surveillance tools, veterinary ethics and animal welfare, import control of animal products at border inspection posts and up to date techniques in assisted reproduction a re some of the unique topics which should be covered.

Table 2 : Veterinary Colleges

State	Name of University	Name of College
Andhra pradesh	Acharya N.G. Ranga Agricultural University, Hyderabad	1. College of Veterinary Science, Rajendra Nagar, Hyderabad 2. College of Veterinary Science, Tirupati 3. N.T. Rama Rao College of Veterinary Science, Gannavaram
Assam	Assam Agricultural University, Jorhat	1. Faculty of Veterinary Science, Khanapara Campus, Guwahati 2. Lakhimpur College of Veterinary Science, North Lakhimpur
Bihar	Rajendra Agricultural University, Samastipur	1. Bihar Veterinary College, Patna
Chhattisgarh	Indira Gandhi Krishi Vishwavidyalaya, Raipur	1. College of Veterinary Science & Animal Husbandry, Anjora, Durg
Gujarat	Gujarat Agricultural University, Banaskantha	1. College of Veterinary Science and Animal Husbandry, Anand College of Veterinary Science and Animal Husbandry, Sardar Krushi Nagar
Haryana	CCS Haryana Agricultural University, Hisar	1. College of Veterinary Sciences, Hisar
Himachal pradesh	CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur	1. College of Veterinary and Animal Sciences, Palampur
Jammu & kashmir	Sher-e-Kashmir University of Agricultural Science & Technology of Jammu, Jammu	1. Faculty of Veterinary Sciences and Animal Husbandry, R.S. Pura, Jammu
	Sher-e-Kashmir University of Agricultural Science & Technology of Kashmir, Srinagar	1. Faculty of Veterinary Sciences & Animal Husbandry, Shuhama, Srinagar
Jharkhand	Birsa Agricultural University, Ranchi	1. Faculty of Veterinary Science & Animal Husbandry, Kanke, Ranchi

Karnataka	University of Agricultural Sciences, Bangalore	1. College of Veterinary Science, Bangalore
	University of Agricultural Sciences, Dharwad	1. College of Veterinary Science, Bidar
Kerala	Kerala Agricultural University, Thrissur	1. College of Veterinary & Animal Sciences, Mannuthy, Thrissur 2. College of Veterinary and Animal Sciences, Pookot
Madhya pradesh Mhow	Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur	1. College of Veterinary Science & Animal Husbandry, Jabalpur 2. College of Veterinary Science & Animal Husbandry,
Maharashtra	Maharashtra Animal & Fishery Sciences University, Nagpur	1. College of Veterinary and Animal Science, Udgir 2. College of Veterinary and Animal Sciences, Parbhani 3. K.N.P. College of Veterinary Sciences, Shirwal 4. Nagpur Veterinary College, Nagpur 5. Bombay Veterinary College, Mumbai
Mizoram	Central Agricultural University, Imphal	1. College of Veterinary Sciences & Animal Husbandry, Aizawl. Mizoram
Orissa	Orissa University of Agriculture & Technology, Bhubaneshwar	1. College of Veterinary Science and Animal Husbandry, Bhubaneshwar
Pondicherry	Pondicherry University, Pondicherry	1. Rajiv Gandhi College of Veterinary and Animal Sciences, Pondicherry
Punjab	Punjab Agricultural University, Ludhiana	1. College of Veterinary Science, Ludhiana
Rajasthan	Rajasthan Agricultural University, Bikaner	1. College of Veterinary and Animal Science,
Bikaner	Maharana Pratap University of Agriculture & Technology, Udaipur	1. College of Veterinary and Animal Science, Navania (Vallabhnagar), Udaipur
Tamil Nadu	Tamil Nadu Veterinary & Animal Science University, Chennai	1. Madras Veterinary College, Chennai Veterinary College and Research Institute, Namakkal
Uttar Pradesh	Uttar Pradesh Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go Anusandhan Sansthan, Mathura	1. College of Veterinary Science and Animal Husbandry, Mathura
Uttaranchal	Govind Ballabh Pant University of Agriculture & Technology, Pantnagar	1. College of Veterinary and Animal Sciences, Pantnagar
West Bengal	West Bengal University of Animal & Fishery Sciences, Kolkata	1 Faculty of Veterinary Sciences, Kolkata

Current Status of Agricultural Education and its Policy in India

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Agriculture Education in India

The spectacular growth in agriculture has been on account of development of skilled human resource, which played major role in developing technologies, their assessment and dissemination to farming community. This was coupled with higher participation and receptivity of farming community and sound policies of Government of India. The establishment of postgraduate school at IARI was an important milestone, in 1958, heralded growth of Agricultural Universities in the country. Based on Dr. S. Radhakrishnan Commission on university education and subsequent two Joint Indo-American Study Teams (1955, 1959) recommendations, first Agricultural University was set up in Pantnagar in 1960, which paved the way for establishment of agricultural universities in other states.

At present, there are 40 State Agricultural Universities, four of the ICAR Institutes as Deemed Universities (IARI, IVRI, NDRI, and CIFE), Allahabad Agricultural Institute and one Central Agricultural University for northeastern region at Imphal. In addition, four Central Universities, namely Banaras Hindu University, Aligarh Muslim University, Vishwa Bharti and Nagaland University have strong agricultural faculty.

These institutions enroll on annual basis about 15,000 students at UG level in as many as eleven disciplines and over 7,000 students at PG level in Masters and 1700 in Ph.D. programmes. At any point, there are over 75, 000 students studying in SAUs. In addition to this, there are large number of private colleges both affiliated and non-affiliated to SAUs which also annually admit larger number of students. The Human Resource Development by National Agricultural Research and Education System has played a pivotal role in agricultural transformation in the country. Green, blue, yellow and white revolutions have been responsible for bringing in prosperity to the farming community. In order to have quality assurance in agricultural education, Indian Council of Agricultural Research initiated a series of steps. These include setting up of Norms and Accreditation Committee followed by establishment of Accreditation Board in 1996, course curriculum revision through Deans Committee, networking and strengthening of SAUs through development support etc. Courses in the agricultural universities system have been revised based on the recommendations of the Deans Committee. The major exercise was done at the time of Third Deans Committee, which submitted its report in 1995, and this was followed by dialogue with different stakeholders in developing detailed curricula and syllabi for various undergraduate and postgraduate courses by the Education Division of ICAR under Agricultural Human Resource Development Project supported by World Bank. Recognizing the need for quality improvement in agricultural education, World Bank supported ICAR through Agricultural Human Resource Development Programme with an outlay of US $ 74.2 million for bringing in much needed reforms in agricultural education. The major reforms brought in through this project included:

1. **Establishment of Accreditation Board** – The new Accreditation procedure has been institutionalized which involved preparation of Self Study Report by the institutions, validation of Self Study Report by a Peer Team and finally decision by the Accreditation Board on accreditation of the institutions. The Board also approved three sectoral committees on Accreditation Norms and New Institutions/Programmes, Curricula and Equivalence, Governance and Personnel/Financial Policies.

2. **Norms and Standards for Improving Education** – Uniform academic regulations, examination and evaluation system including grading system made in SAUs. Rural Awareness Work Experience included in the programme, courses in new emerging areas such as Computer Applications,

Bio-Statistics, Biodiversity, Biotechnology, Agri-Business Management, Marketing and Environment incorporated in all degree programmes.

3. **Capacity Building for Human Resource Development** – The HRD programme were strengthened by supporting, modernization of class-rooms, library strengthening, establishment of students' laboratories at college level, students counselling and placement cell, supporting construction of International student hostels, girls hostels, education technology cells and providing support for modernization of UG and PG practical and research labs.

4. **Faculty Competence Improvement** – In order to improve the faculty competence, large number of training programmes were organized through Centres of Advance Studies, Summer and Winter Schools in which 9,000 scientists benefited. Besides nearly 1000 scientists were sent for training in best of the institutions overseas. Sabbatical leave rules as well as Visiting Scientists scheme operationalized. To promote excellence in teaching, five Best Teacher Awards were instituted both at university and national level. Faculty made computer literate and support provided for participating in seminars, symposia both nationally and internationally.

5. **Reducing Inbreeding** – Extensive inbreeding is the single factor contributing largely for decrease in quality of education. From 1995-2000 major steps were taken for reducing inbreeding: All India Competitive Examination each year to fill 15% UG and 25% PG seats in all SAUs. Through this examination each year about 1500 students at UG level and 1000 students at PG level are sent from one Institution to other. This has changed the cultural life on campuses, brought healthy competition, promoted national integration, leading to improvement in instruction.

Three hundred National Talent Scholarships at UG level awarded to students who opt to move out of their state of domicile. This is to attract talent to agriculture and promote national integration.

Award of 475 Junior Research Fellowships each year to students on merit for M.Sc. programme only if they join programme in the University other than from which they obtained UG degree. This has been a major step in reducing inbreeding to a large extent.

Recruitment at Assistant Professor Level in all SAUs based on NET conducted centrally by Agricultural Scientists Recruitment Board while all these steps led to some extent improvement in quality of education; still there have been many constraints. These constraints included lack of modernity and state of the art equipments commensurate to world technology development, inadequate financial support and lack of access to latest information. The need for sweeping reforms in agricultural education for improving quality and standards is well recognized now than ever before because of emerging challenges of making Indian agriculture not only sustainable but internationally competitive. Nationally and internationally there are three major pillars for quality assurance:

(i) Competence of faculty and periodic updating skills and knowledge

(ii) Modern infrastructure

(iii) Curriculum and curriculum delivery

Analysis of the present agricultural education system indicates that despite finalization of academic regulations for UG and PG programmes after Third Deans Committee report and initiatives under the Agricultural Human Resources Development Project (AHRDP), many of the institutions have not yet followed these in letter and spirit and wide variations exist. Universities still suffer from poor governance. The system as a whole has not taken full advantage of modern tools of management for efficient governance. The faculty in SAUs has dwindled with majority chunk of the posts remaining vacant due to financial crunch. Besides curriculum and curriculum delivery have not been changed keeping in view global technology development. There is also no link of curriculum to employment in private agribusiness and pro-

cessing industries and meeting the demands of extension. Quality of education suffers due to obsolete equipments, outdated and poor laboratory, lecture halls, library and instructional farms. In view of this, ICAR has set up IV Deans Committee with a wider mandate and Term of Reference so that a holistic view could emerge on quality assurance and relevance in agricultural education. The Terms of Reference for the Committee are:

(i) Defining UG and PG degrees for general market needs and for specialist jobs and uniformity in UG and PG degree nomenclature.

(ii) Restructuring of UG programmes for increased practical and practice contents.

(iii) Central assistance for strengthening of higher agricultural education.

(iv) Guidelines for assessing training needs and performance of teaching faculties

(v) Reforms in governance of SAUs.

The Committee held its first meeting on May 24, 2005 in which it deliberated on TOR and manner in which various issues flagged to the committee, could be looked after. So far as revision of the course curricula is concerned, the Committee decided to follow faculty-based deliberations involving different stakeholders in the system. For this purpose, Chairman was authorized to write to different Universities to initiate the process. The following mechanism was devised:

All SAUs to organize meeting of each faculty at Universities level involving their faculty and different stake-holders including alumni of the institution, agri-business personnel, concerned government department representatives, farmers etc. Major emphasis was on involvement of different stake-holders. The skills needed among graduates to be first articulated and courses designed by reverse engineering, taking care to provide adequate practical skills. The recommendations of these Committees were sent to Coordinators identified for each discipline who compiled the information received as per the format developed.

Central Assistance for Strengthening Higher Agricultural Education

Over the years we have been able to develop a sound base for Agriculture Education in almost every state mainly on account of tremendous support provided by Indian Council of Agricultural Research. In 1960s and 70s major support was provided under development grant for infrastructural development including construction of buildings, hostels, library, faculty training nationally and internationally, library strengthening including procurement of text books, journals and databases, student and faculty amenities, students study tour, development of facilities for practical training as well as hand on training including internship. Up to the VI Plan almost 33 per cent of the ICAR budget was devoted for strengthening agricultural education in the country and this is the major reason that most of the universities established during that period have excellent infrastructure which is largely contributed by ICAR.

The share of agricultural education within ICAR budget increased from 8.9% in VIII Plan to 14% in X Plan. However, there is a need to step up this support for agricultural education to at least 20% of ICAR budget. The states contribution related mainly to establishment costs as well as sharing of infra structure development especially civil works. Realizing the importance of Agricultural Education for propelling agriculture development in during 60s & 70s states, various state governments were also very liberal and in fact accorded high priority.

The situation changed drastically and became worst after the implementation of the Fifty Pay Commission recommendations. Many factors have contributed to decline in the quality of agricultural education but the main contributing factors have been lack of adequate financial support for infra structure development, faculty improvement and library strengthening. During IX and X Plan, ICAR has stepped up financial sup-

port and this has now made reversal of the decline in the quality of agriculture education. But it is still much below the stakeholders' expectation and certainly not in consonance with the developments taking place globally. Since quality assurance is the national over riding priority for bringing in research excellence, it is essential that adequate central assistance is provided for strengthening of Higher Agriculture Education. This is the only and surest way of providing world-class human resource to meet the demands of global competitiveness and meet highly professional competence requirements of modern agriculture.

A Glimpse on Educational Improvement Policy of ICAR

ICAR had taken different steps to improve and modernize agricultural education in India as well as to develop the human resources since its inception. The main steps taken to improve standard of infrastructural facilities are as under:

- Uniform academic regulations, examination and evaluation system in all SAUs adopted. Grading made uniform on 10 point scale GPA.
- Then course contents and curriculum of UG programme revised and updated for adoption by SAU.
- Rural Agricultural work experience (RAWE) for agriculture, Internship in Veterinary and Animal Sciences and in plant training programme for agricultural engineering and dairy technology made compulsory for 6 months for all UG students.
- New courses viz. Computer Application, Bio-statistics, Biodiversity, Biotechnology and Principles of Ecology, Agri-Business management, Marketing and Environmental sciences incorporated in all degree programmes.
- Duration of home science degree programme enhanced to four from existing three years.

Capacity building for Human Resource Development

- Modernization of students' laboratory with latest equipment and classrooms through renovation and audiovisual aids.
- Library strengthening by providing international journals, computers, CD-ROM and inter connectivity.
- Establishment of students' computer laboratory at college level.
- Development of health centre and gymnasium for students.

Reduction of Inbreeding

- Arrangement of All India Competitive Examination each year to fill 15% of the seats in UG level and 25% of the seats in PG programme in all SAUs.
- Not more than two degrees from same institute is mandatory for getting SRF award.
- Appointment of Assistant Professor Level in all SAUs only for NET qualifier.

Policy on Biotesting for Safety and Export of Livestock Products

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Livestock farming is emerging as an independent activity in Indian Agriculture Scenario. This is because of better economic returns, higher growth rates and potential to further improve production, productivity, growth rates and economic returns. The demand for livestock products both in rural and urban areas has increased over time and shall further increase because of urbanization, increase in per capita income and population. It is safer to conclude that "Livestock Revolution" in India is demand driven and aims at not merely increasing the quantum of production but also addresses concerns of nutrition, processing quality and safety as related to presence and level of pesticides/drug residues and microbiological profile. The targets of quality and safety are proposed to be achieved through strict implementation of standards and their compliance with appropriate testing programs.

Biotesting and Related Issues

Biotesting aims at examining the level of different forms of 'bio-living' organisms (bacteria, yeast, molds, parasites etc.) and their exudates and metabolites (toxins etc.) in the livestock products. Adulteration of meat and meat products espsecially species identification can also be taken under this account.

Industrialization of animal production has lead to indiscriminate use of drugs, hormones, antibiotics, heavy metals and pesticides etc. Further the livestock products have some limitations such as being highly perishable in nature, good source for growth of pathogens, aesthetic considerations, religious and social taboos and animal welfare etc.

The presence of chemicals (pesticides, heavy metals, drugs, hormones etc.), microbes (Ecoli, *Staphylococcus aureus, Mycobacterium tuberculosis, E. coli* O157:H7, Table 2) and contaminants in food may lead to food borne illness. Other factors which back assurance of food safety include health conscious consumer and global trade in post WTO era and history of various food/ livestock products borne disease outbreaks (recent outbreaks of Avian Influenza and BSE) (Table 1). In order to safe guard health of the consumer and to maintain the nutritional status of food products, there is a need to develop a data base on chemical, microbiological and contaminants in foods of animal origin and formulate standards.

The other issues that need consideration are livestock products obtained from genetically modified (GM)/ transgenic animals as well as feeding of animals on GM fodder crops. The safety considerations of consumers eating resultant animal products need to be considered. Nutritional and safety labeling of the food products is another issue. Each product should carry details in relation to its nutrient content as well as use of any additive and microbial safety considerations on the label for awareness of consumers.

Export Potential and Requirements

The export scenario of livestock products in India (Table 3 & 4) shows a quintessential scene. There is steady increase in export of livestock products, except a decline in 2006-07 of dairy products due to ban on the export of milk and milk products under Essential Commodity Act. This became necessitated due to steep rise in the prices of milk and milk products in the domestic market. The export of buffalo meat has been stagnating; the share of buffalo meat on the basis of quantity showed a decline from 85 to 40%. However on the basis of value of meat, buffalo meat still holds first position among various animal products. The export of poultry meat and products has increased 70 fold during the last 10 years. The export of processed meats is still negligible being less than 1% of the total meat trade as against 84% in USA and Russia. The value addition therefore is critical to expand the value of export of livestock products.

In addition to meat and dairy products, there is potential for increasing exports of live animals, semen, and embryos of indigenous breeds, animal feed, poultry products (day old chicks, hatchery eggs, chicken meat), milk products (buffalo mozzarella cheese, casein, ghee etc.) and processed meats. This would call for improving required hygiene standards and introducing and implementing quality control standards.

The export of agricultural products (including livestock products and processed foods) is coordinated by the Export Inspection Council and Agricultural Produce Export Development Authority, Ministry of Commerce and Industry, Govt. of India. In General, the livestock products for export should comply to standards of Codex Alimentarius and fulfill SPS measures. The standards of products should be certified by the accredited laboratories (ISO Guide, 25/65, ISO 17065). The Export Oriented Plants are invariable inspected by importing countries/ agencies for quality assurance programmes such as Hazard Analysis Critical Control Point (HACCP) and Good Manufacturing Practices (GMP), Good Hygienic Practices and animal welfare norms.

Quality Standards of Livestock Products:

In India the quality standards for food are covered under 8 different laws namely;

- Prevention of Food Adulteration Act, 1954,
- Milk and Milk Products Order, 1992,
- Meat Food Products Order, 1973,
- Fruit Products Order, 1955,
- Vegetable Oil Products (Control) Order, 1947,
- Edible oil Packaging (Regulation) Order, 1998,
- Solvent Extracted Oil, Deoiled meat and Edible Flour (control) Order, 1967 and
- Essential Commodity Act, 1955

The quality standards are regulated by various agencies such as Director General of Health Services (Ministry of Health and Family Welfare), Ministry of Food processing Industries, and Ministry of Agriculture. In order to stream line all these food safety laws, Indian Parliament recently passed Food Safety and Standards Act, 2006. The act shall be regulated by newly constituted body, "Food Safety & Standards Authority of India", which shall develop science based standards for foods and regulate and monitor the manufacture, processing, storage, distribution, sale and import of foods.

Although establishment of Food Act, 2006 created many hopes in the food industry, it is yet to be implemented. The separate department of Standards should be created to streamline the issues concerning food safety and trade. The standards need to be harmonized with relevant international standards such as (i) Codex Alimentarius commission of FAO – for food safety standards, (ii) International Plant Protection Convention (IPPC) – for plant health standards and (iii) Office International Epizooties (OIE) – for animal health standards.

Quality Testing and Networking of Laboratories

The quality assurance program of livestock products starts from farm level and continues through processing cycle, storage till it reaches the consumer table. It identifies the hazards at farm level such as health of the animals, quality of water and feed (pesticides, rodents, mycotoxins), drugs (antibiotics, hormones), probiotics, biosecurity measures, animal welfare and supply of clean and wholesome livestock and their products to the processing unit. The systematic scientific approach should be applied to identify the critical processing steps, which influence the quality of end product significantly, and subsequently the packaging, storage and transportation requirements for ensuring safety and quality.

The bio-testing of livestock products at domestic level are being done by food inspectors at State level. These laboratories are mostly ill equipped, lack trained manpower and under the control of local bodies. The bio-testing for export purposes is being carried out in approved accredited laboratories by National Accreditation Board for Testing and Calibration Laboratories (NABL). These laboratories follow the guidelines prescribed under ISO Guide 25 and 65 and accredited in accordance with ISO/IEC 17025 and ISO 15189: 2003 for medical testing laboratories. NABL also conduct proficiency testing program of accredited laboratories under APLAC M001 on regular basis. There are BIS and APEDA approved laboratories.

It is suggested that there should be at least 2-3 national laboratories with all the facilities at par with the international benchmark. There should be six regional laboratories, which may be exact replica of national laboratories and share the burden of national laboratories. There should be atleast one state level laboratory in each state. These laboratories should have all the testing facilities with reference to the national food laws for food safety and quality. The district laboratories should have at least the testing facilities for physical, chemical and microbiological parameters. Their number may correspond to total number of districts in India. Each food processing plant should have their own laboratory for ensuring compliance with the standards.

Policy Interventions and Actions

Food safety is becoming a major concern today. Development of baseline data on use of chemicals, pesticides and microbiological profile for foods of animal origin, and using these data to development standards and appropriate legislations should be integral part of the policy intervention and action plan to produce safe foods. Appropriate guidelines and implementing mechanisms need to be streamlined. Our efforts should be to discourage indiscriminate use of pesticides/drugs in livestock production system and lay down guidelines for withdrawal time for drugs and hormones. Safer pesticides and herbal drugs should be developed. A residue-monitoring plan should be put in place.

Certification issued by Indian Labs is invariably not accepted by other countries. Granting equivalence to Indian standards and accreditation of Indian labs and plants would greatly help in increasing our exports. There is a need to increase the number of testing laboratories and establishing well equipped regional and national referral laboratories with public private partnership. Stringent quality control measures and hygienic practices during production, processing and marketing (labeling and information required) of livestock products should be introduced. A number of new quarantine facilities at major seaports / airports should be established. Our efforts should be to create disease free zones especially for FMD and other important diseases and ensure their acceptance by OIE and the importing countries. The Government should encourage formation of livestock producers and processing associations to defend their interests in the changing global trade and economic liberalization scenario and also facilitate development of organized animal production systems to produce quality and safe foods.

Summary and Conclusions

The implementation and success of biotesting program requires strong research support and data base for development of accurate and rapid methods for physical, chemical and microbiological quality testing of food products. This shall provide support for risk analysis to ensure a high level of protection to human health and life. There is a need to compare and study gap analysis of Indian regulations with international benchmarks with respect to labeling, packaging, enforcement, product standards etc. and to compare the accreditation and certification mechanisms. The supply chain in Indian food system is fragmented and unable to provide traceability to the consumers. It is essential that different steps of food chain including raw material evaluation, processing steps, storage and transportation should be clearly identified and supervised to provide transparency and traceability to different stakeholders. Manufacturers and distributors should develop contingency plans for product recall that can be put into effect if and when needed. The concerned food regulatory authorities should monitor the recalls and assess the adequacy of action plan.

Table 1. Livestock Product Borne Outbreaks from 1990 Onwards

Name of pathogen/syndrome	Type of livestock product	Total no. of outbreaks/cases/ deaths in USA,EU & Canada
C. botulinum (spores)	Meat & Poultry	5/45/0
C. perfringens	Canned foods (including milk & meat products)	24/2743/2
Enterobacter sakazakii	Infant milk	1/12/2
Listeriosis	Milk &Milk Products	3/82/0
Listeriosis	Meat & meat products	6/393/99
Salmonellosis	Poultry &meat products	-/288/-
Trichinellosis	Pork products	9/33/-
Anisakiasis	Marine fish	2/80/0

Jay, J.M., Loessner, M.J., Golden D.A. (2005) Introduction to food borne pathogens. In Modern Food Microbiology; Springer Science Publication, USA pp519-541.

Table 2. Most Recently Recognized Food Borne Pathogens

Pathogens /Syndrome	First Recognized
Infant Botulism	1976
Yersinia enterocolitica	1976
Cyclospora cayetanesis	1977
Norwalk & related viruses	1978
Vibrio cholerae non-01	1979
Listeria monocytogenes	1981
Enterohemorrhagic E. coli	1982
New variant- *Creutzfeldt Jackob Disease* (CJD)	1996

Jay, J.M., Loessner, M.J., Golden D.A. (2005) Introduction to food borne pathogens. In Modern Food Microbiology; Springer Science Publication, USA pp519-541.

Table 3. Export of Animal Products in the Last Decade

	1996-97		2006-07	
Name of Product	**Quantity (000 Tonnes)**	**Value (Rs crores)**	**Quantity(000 Tonnes)**	**Value (Rs crores)**
Buffalo Meat	160	555	494	3212
Sheep / Goat Meat	8.7	56.42	5.5	63.05
Poultry Products	10	26.21	711	315.90
Dairy Products	4.7	32.56	37.4	395.15
Animal Casings	0.3	0.08	0.44	9.51
Processed Meat	0.5	4.07	0.8	6.80
Total for Animal Products	184	674.34	1257.2	4063.03

(Source :http://apeda.com/TradeJunction/Statistics/India_Export_statistics.aspx)

Table 4. List of Countries to which Animal Products were exported in 2006-07 (APEDA, 2007)

Buffalo meat	Malaysia,Philippines,Saudi Arabia, Jordan, Angola
Sheep / Goat Meat	Saudi Arabia,U.A.E.,Qatar,Oman,Kuwait
Poultry Products	U.A.E., Kuwait, Oman, Germany,Japan
Dairy Products	Bangaladesh,,Algeria,U.A.E., Yamen Arab Repu, Egypt
Animal Casings	Germany,Portugal,France,Spain,Italy
Processed Meat	Seychelles ,U.A.E.,Hong Kong,Germany,U.S.A

(Source: http://apeda.com/TradeJunction/Statistics/India_Export_statistics.aspx)

Strategic Issues for Agriculutral Education Policy in Horticulture and Medicinal Plants

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Agriculture is the backbone of our economy and the improvements in the livelihoods in rural areas depend on the profitability of this important sector of our economy. Emphasis on formal agricultural education has paid dividends in the form of improved and efficient farm technology, increased crop yields and thus some stability of agricultural production. Agriculture in the country is now becoming a commercial preposition for the vast majority of our rural population. However, in the light of drastic changes in the farm technology, involvement of private sector in farming and farm R & D activities, fast changing market scenario, and other physical changes like climate change, there is a need to give further emphasis on the agricultural education to meet these changed needs. The challenge before the agricultural Education, Research and Management system is not only in the determination of nature and type of technologies but also the development of technical and managerial human resources capable of bringing about the changes needed for sustainable agriculture.

Horticulture sector, which includes fruits, vegetables, root and tuber crops, mushroom, floriculture and medicinal and aromatic plants and plantation crops, is an emerging segment of agricultural sector. In the recent years, horticulture has emerged as an important and viable diversification option in agriculture. It has been instrumental in transforming the subsistence level farming systems into high value commercial farm enterprises. It has not only led to higher agricultural contribution to the GDP but has also contributed significantly towards generation of employment in the farm sector.

In order to further generate technical and managerial human resource in horticultural sector and to address, in general, the issues relating to promotion of agricultural education, the following points need to be addressed while formulating agricultural education policy for horticulture crops and medicinal plants.

- Assured provisions for funding agricultural universities. Agricultural universities must receive the priority in allocation of resources because of the research/practical oriented component of the education.
- There is a need to strengthen linkages of the agricultural educational institutions, and public and private sector development agencies. This is a must for the generation of easily employable quality manpower. The course curricula, therefore, must focus on promoting technical and scientific skills that are practical and cost-effective.
- The teaching institutions must have good interactions with the farmers and the agro=-industries for the relevance of the knowledge imparted to the students. Linkages with industries will help in generation of funds for higher education through research grants.
- Emphasis on education on the aspects of integrated farming systems, harnessing [production and market niches for remunerative crops, particularly horticulture and medicinal plants.
- There is a need for extensive use of ICT (Information and communication technology) and modern multi-media and other modern aids for effective teaching and research.
- The teaching modules and course curricula must be relevant to local conditions and it must have linkages with the environment for the conservation of the natural resources and thus stability of agro-ecological production environment.

- Strengthening linkages with the international organization s/institutions. Academic exchange of students amongst the institutions can be helpful.
- The educational programmes have to innovative, dynamic and inclusive. Emphasis has to be on capacity building of all market chain participants. Establishing fellowship programmes in horticulture and medicinal plants can attract talent from different areas.
- The emphasis must be laid on practical learning and field training. New short run vocational courses can be introduced for farmers, in-service personnel and laborers and unemployed youth.

Apart from these broader concerns, some of the specific concerns, as under, relating to different aspects of horticultural and medicinal plant growing would also require our due attention.

Horticulture and Medicinal Plants

- Emphasis on protected cultivation, precision farming and pre and post harvest management of perishable crops. Promotion of necessary linkages with the industry for marketing and processing of horticultural produce of the State.
- Emphasis in course curricula on integrated nutrient supply system, integrated pest management, organic farming and, and rainwater harvesting.
- Emphasis on sustained rural livelihoods through training on allied horticultural activities like apiculture and e3ncvouraging fruit based cottage industries.
- Preparing trained human resource to manage international market competitiveness of our horticultural produce, particularly in the light of globalized market and SPS measures.
- Focus on appropriate region specific farm mechanization and management of input supply.
- Reliable agro-meteorological input and introduction of disease and insect-pest forecasting technologies for ensuring timely remedial measures.
- Documentation of diversity and status of medicinal plants and emphasis on *in situ* and *ex situ* conservations measures in course curricula for management of the resources of medicinal plants in natural habitat.
- Establishment of medicinal plant education parks, with attached nurseries for academic inputs.
- Focus on Good Agricultural Practices (GAP)/Good Collection Practices (GCP)/ Good Manufacturing Practices (GMP).

Recommendations

1. There is an absolute need to introduce agricultural education right from the school level upward culminating into vocational courses with particular emphasis on deliverables in each course.
2. The states may be encouraged to set up 'Board of Higher Education' in agriculture for improving the quality of education.
3. SAUs should make efforts to enhance influx of students from rural areas in agricultural programmes. Reservation of seats for students in agriculture education through legislation may be answer to it.
4. Admission to agricultural programmes in all the private/public institutions should be through common entrance test.
5. There is need to reconsider monitoring of teaching quality, evaluation and to re-visit the internal evaluation as existed earlier than shifting to external evaluation.
6. Course curriculum should be made demand-driven to prepare students, to face the newly emerging challenges, and lay due emphasis on practicals.
7. SAUs should have more diverse range of relevant courses which the students can choose VIZ, Biotechnology, Nanotechnology, Information and Communication Technology, Space, IPR, WTO, Agri-business etc.
8. For the sake of quality education, thrust should be given on Human Resource Development (HRD) in cutting edge technology areas as it used to be in the 1970s. No post should be kept vacant.
9. There is a need to establish relation/collaboration with traditional universities, IITS, IIScs, IIMs and industry for perfect wide range updated education.
10. There should also be a separate fisheries, live stock and animal husbandry education policy integrating education, research and extension.
11. Accreditation process needs to be speeded up ad extended to private agricultural colleges. Simultaneously SAUs should be equipped to handle the affiliation of private agricultural colleges to keep up the academic standards.
12. Evaluation system should be combination of both external and internal with 50% weightage given to each. As this is recently recommended, it may be reviewed after gap of some period.
13. There is a great need for open door policy to encourage students and teachers from basic sciences to join SAUs and basic sciences students be admitted to agricultural PG courses.

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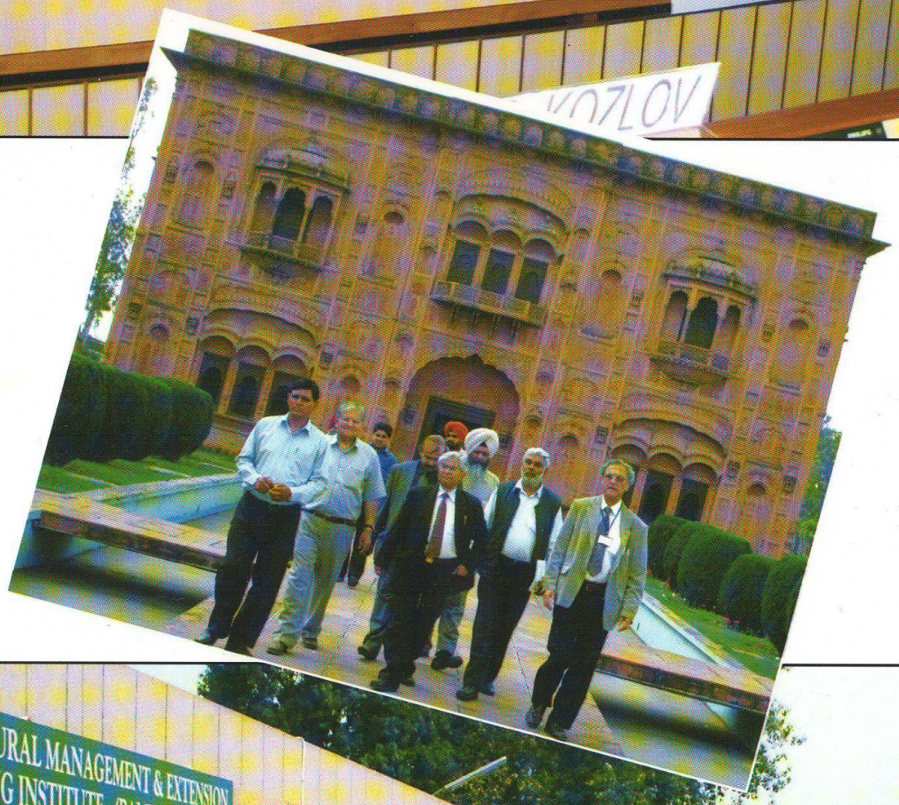


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