

EXECUTIVE SUMMARY

Under the auspices of the Agricultural Innovation Partnership (AIP), Banaras Hindu University (BHU) and Cornell University organized the first Curriculum Development Workshop on April 2–4, 2011, in Varanasi, India. Participants in the workshop reviewed and assessed the agricultural, food, veterinary, animal and dairy sciences, as well as cross cutting themes including library, gender, information and communication technologies and extension/delivery, policy and general agriculture curricula with the goal of identifying opportunities and gaps in the existing curricula. Action plans were then developed to update and upgrade the curricula.

After the BHU-Cornell Curriculum Development Workshop, AIP supported a three-member faculty team from Sardar Vallabhbhai Patel University of Agriculture and Technology (SVPUA&T), Meerut, India, to spend three weeks in the US exploring curricula reform. During their three-week visit, the SVPUA&T team collaborated with faculty from Cornell University, University of Georgia and Tuskegee University to develop 23 new curricula in Agricultural Biotechnology, Food and Animal Sciences.

Following this event, four BHU faculty members were sensitized to the SVPUA&T curriculum report through a validation workshop on course pedagogy held by AIP at SVPUA&T. At the workshop, additional suggestions were made to strengthen curriculum in soft skills, experiential learning and technical courses.

To implement the action plans developed at the BHU Curriculum Workshop and by SVPUA&T faculty members, AIP organized a five-week study tour for a four-member team from BHU to visit Cornell University, University of Georgia, the University of California-Davis, Tuskegee University and the University of Illinois, Urbana-Champaign, to develop reformed curriculum in emerging areas of agriculture and rural development.

Team members agreed on the following guiding principles:

- Review the existing course curricula and enhance it with relevant courses in soft skills, gender and socio-economic issues and experiential learning
- Introduce new degree, diploma, certificate and vocational courses to meet the emerging needs of domestic and international markets
- Seek short-term deliverables, which should be possible only after one year, but build toward long-term goals
- Develop e-Learning modules
- Connect with the private sector in all relevant courses
- Generate employable graduates to meet both domestic and global needs
- Build strong collaborations among BHU, SVPUA&T and other AIP partners in India and the US
- Encourage rural business development to minimize rural migration to urban areas

The members reviewed the report of the fourth Dean's Committee and the reformed curricula from SVPUA&T, the first workshop held at BHU, and US collaborating universities in the areas of agricultural sciences, biotechnology, food science, animal science and dairy science and agreed that there is a need to produce society-ready students with good problem solving skills, ethical and moral values, leadership qualities, communication skills, international awareness, and an appreciation for lifelong learning. These students will have a strong knowledge base in

agricultural sciences and will thus be able to contribute to India's emerging needs in the agricultural sector. The BHU team reached the following consensus:

- Agriculture education in India should sensitize students to emerging market needs
- Greater number of opportunities to be created for increasing the income of India's rural mass
- An e-learning expert from Cornell University to visit BHU to work with the BHU faculty and establish an e-learning center for preparing e-learning modules
- A BHU faculty to be trained at Cornell to establish a Center for Teaching Excellence at BHU

The members visited various research and extension facilities and the dairy and food industry. They conducted detailed discussions with several US faculty members to address curricula and experiential learning needs and deficiencies in each of the five areas (agricultural, food, veterinary, animal and dairy Sciences) and developed a detailed curriculum for implementation at BHU as a pilot program and for subsequent use as a model for revamping curriculum in other State Agricultural Universities (SAUs).

BHU, unlike other SAUs, has a very strong multi-disciplinary focus with two campuses, four institutes, 16 faculties, 140 departments, four advanced centers and four interdisciplinary schools. The 2,500 faculty members at BHU cater to the needs of 35,000 domestic and 650 international students from 34 nations. The availability of such a rich faculty resource with knowledge in all areas of science and technology should enable multi- and inter-disciplinary collaboration in implementing the proposed revised curriculum at the Institute of Agricultural Sciences at BHU.

The BHU team reviewed the curriculum at U.S. land grant institutions and picked relevant courses to suit India's needs. The customized degree, diploma, certificate and vocational courses developed through this study tour will be shared with senior administrators in BHU for approval by the relevant academic boards for future implementation. The team feels that it is time for the Indian Agricultural Education System to offer major courses in different disciplines of agriculture at the undergraduate level, as well as the postgraduate level.

The team also believes it is important that a national-level dialogue be organized to discuss the reformed curricula so that it is implemented across India. AIP's efforts to organize an International Workshop on strengthening the academic library to enhance agriculture education at BHU (December 15-16, 2011), followed by a collaborative workshop in Delhi (December 19-20, 2011) on strengthening agricultural professional development through education and accelerated technology absorption through extension, will facilitate more discussions by senior administrators from the Indian Council of Agricultural Research (ICAR), Vice-Chancellors, the academia, industry leaders and policy planners on the proposed new curriculum. The Delhi workshop will formulate further interventions to augment professional development, rural transformation and the food industry value chain.

To quote Cornell's past President, Frank H. T. Rhodes, on the benefit of faculty-driven curricula planning, "There is no one-size-fits-all model curriculum available for all institutions. A successful curriculum, like a successful life, is strictly a do-it-yourself job. It needs local agreement; it depends on local resources; it is conducted by local faculty members; and it benefits local students. It cannot be exported; it cannot be imported. It has to be a home-grown product. Models may exist elsewhere; consultants may give advice; campus presidents may

exhort; students may demand. But in the end, the curriculum is the responsibility of the local faculty.”

The BHU team developed a total of 17 curricula to result in five bachelor degrees, four of which are new and one revised, five new diploma programs, three certificate programs and four new vocational courses in the areas of agricultural, veterinary, animal and dairy sciences and food science and technology. Out of the 17 courses, 16 are self-financing. For some of the experiential learning programs proposed at BHU, supplemental support will be provided from AIP.

Agricultural Sciences

The reformed curriculum for B. Sc. in Agriculture introduces new courses in the areas of natural resource conservation, bio-energy and climate change. The six new courses are:

- Water Management, GIS, Remote Sensing and Modeling
- Issues in Renewable and Sustainable Bio-fuels/Bio-energy
- The Climate System
- Climate Resilient Agriculture
- Nanotechnology Applications in Agriculture
- Gender Issues and the Role of Women in Agriculture

Relevant compulsory support courses in the areas of soft skills, experiential learning focusing on the rural sector, and gender and socio-economic issues have also been added.

To make experiential learning more extensive and educational, it is proposed to restructure the Rural Agricultural Work Experience program with two new innovative experiential learning programs, namely (i) Student Applied on Farm Agricultural Research (SAFAR) program and (ii) Student Market Applied Research Team (SMART).

A new B. Tech four-year-degree course in Biotechnology has been proposed with new experiential learning modules, namely (i) Plant Biotechnological Applications, (ii) Biodiversity and Biotechnology, (iii) Biological Production Technologies, (iv) Genomic Technologies and (v) Bioinformatics. New courses that incorporate soft skills, gender studies and socio-economic issues, e-learning, entrepreneurship development with a strong focus on industry experience via student participation in bio-science internships, applied biotechnology experiences in industry (SABEI) and market applied research teams (SMART) as proposed by SVPUA&T will be implemented as a pilot projects at BHU.

To sensitize rural youth, two diploma courses each of one-year duration in the emerging areas of entrepreneurship development, marketing and employment generation are planned. These are – Diploma in Vegetable Production and Diploma in Seed Technology and Business. Qualifying students will be able to have a career in the emerging seed and vegetable production, marketing and processing sectors.

For rural youth who are unable to continue their higher education and want to become small-scale entrepreneurs, a six-month certificate course in bio-pesticides and plant health is proposed that will prepare them to take jobs as crop consultants or establish their own plant health clinics.

Veterinary, Animal and Dairy Science

Livestock as an important segment of agriculture makes significant contributions to the development of India by promoting the health and nutrition of the people in general and by strengthening the socio-economic condition of the farmers in particular. Livestock has the capacity to transform Indian agriculture by its positive multifaceted contributions towards health, social wellbeing, environment and the national economy.

With about 40 veterinary colleges and 10 veterinary universities, India produces only about 2,000 veterinary graduates annually. However, the country needs about 7000 veterinary graduates annually. The present ratio of animals to veterinarians is such that there is only one veterinarian available per 25,000 livestock, though the standard requirement is one veterinarian per 2,500 livestock. The insufficient number of veterinarians results in improper health care for livestock and unimproved animal production due to lack of scientific breeding, feeding and management practices.

Moreover, at a regional level, Uttar Pradesh has the largest number of livestock among the Indian states and is the largest producer of milk. Yet, Uttar Pradesh has only two veterinary colleges, one at Mathura and the other at Faizabad, which barely produce 100 veterinarians annually. This is absolutely insufficient to meet the actual demand. BHU, as the central university in Uttar Pradesh, could establish a faculty of Veterinary and Animal Sciences to impart education in this important subject. The students will then be able to staff the Veterinary Science Departments in the state and the growing number of animal-based poultry and dairy industries.

In this regard, a major course on Bachelor of Veterinary Science & Animal Health has been proposed which will have the following important components:

- Teaching Veterinary Clinical Complex
- Instructional Livestock Farm Complex

In order to meet the demand of the growing livestock sector, the following important short-term courses have been proposed:

- Diploma in Animal Husbandry
- Diploma in Meat Technology
- Diploma in Poultry Farming

Dairy Technology

India is the largest producer of milk in the world, producing 117.00 million tons of milk annually. As per FAO, milk production in India is projected to increase at a rate of 5% per annum. India produces about 14% of the world's milk and contributes to 57% of Asia's total milk production. Almost every state in India has a state-run cooperative dairy federation and several private-owned dairy farms and dairy processing plants. There are about 25 state dairy federations, 180 milk cooperative unions and 84,289 dairy cooperatives in the country which procure about 20,000 tons of milk per day on average. The dairy industries have opened new avenues for employment and economy. It is estimated that the dairy industry is generating 100,000 new jobs every year. The dairy sector is expected to expand and generate more employment in the near future. Adoption of the latest and most advanced dairy and value addition technology in milk processing can minimize losses, provide better quality products, improve nutrition and generate more employment opportunities. Dairy technologies offer promising opportunities for value addition and resources recovery in terms of consumer food availability. Simultaneously, the

dairy industry has the potential to improve earnings at both the farmer and industry level. In view of globalization and the increasing purchasing power of the consumer, there is a great potential for the Indian milk industry to grow. This will further increase the need for people trained as dairy technologists and researchers.

In view of this, it is proposed to start a new B. Tech course on Dairy Technology at BHU as a flagship program. This program will have several built-in experiential learning modules for hands-on training, including:

- Manufacturing and packaging of indigenous dairy products
- Manufacturing and packaging of fermented dairy products
- Manufacturing and packaging of fat-rich dairy products
- Frozen dairy products
- Concentrated and dried dairy products

Students will also be provided an opportunity to undergo in-plant trainings in the leading dairy industries in the country to learn the operations in the professionally managed dairy plants. In order to meet the training needs of the dairy farmers, entrepreneurs dealing with milk and milk products, the following diploma and certificate courses have been proposed:

- Diploma in Dairy Technology
- Certificate in Dairy Farming
- Vocational course on Clean Milk Production

Food Science and Technology

A strong and dynamic food processing industry is important for diversification and commercialization of agriculture, which involves 70% of the country's population. A strong food processing sector ensures value addition for agricultural products, generates employment, enhances the income of farmers and creates surplus for export. The food processing sector in India, though in the nascent stage of development, has a market size of \$70 billion, employs 13 million people directly and about 30 million people indirectly. There is an estimate that food grains worth about Rs. 70,000 crore is wasted each year due to the unavailability of proper storage facilities and the lack of processing and packaging capabilities.

Education in food science and technology can produce graduates able to handle the food processing needs of the country. Emphasis must shift from production agriculture to the needs of the processing, value addition, preservation and marketing of agricultural and livestock produce for better remunerative returns to the farmers and also to provide safe and hygienic food products for the domestic markets.

BHU started a Master's program in Food Science and Technology in 2008 and a Ph.D. program in 2010. It is proposed to initiate a B. Tech (Food Science and Technology) program as a four-year flagship program at an undergraduate level. The course is designed to provide students with the skills to handle all operations in food processing plants and also to enable them develop marketing plans on sound business models through experiential learning, critical thinking and problem solving modules and a rigorous six-month in-plant training through a food industry internship. Opportunities will also be provided for undergraduate research. There is also greater emphasis given to improving soft skills required for career placement and advancement. These include– improving students' skills in teamwork, communication, leadership, self-management, decision- making, problem- solving and professionalism.

In addition to an undergraduate program in Food Science and Technology, it is proposed to start several vocational courses, including:

- Vocational Course in Bakery Technology
- Vocational Course in Fruit & Vegetable Processing
- Vocational Course in Safe and Hygienic Practices for Sweetmeat Makers and Street Food Vendors

The table given below provides a short summary of the reformed curriculum in the area of Agricultural, Veterinary, Animal and Dairy Sciences followed by Food Science and Technology.

The full report is enclosed as an Appendix that consists of three sections: Section I deals with Agricultural Sciences; Section II with Veterinary, Animal and Dairy Sciences; and Section III with Food Science and Technology. Each of these sections provides a brief introduction, details of new courses and experiential learning for the proposed undergraduate programs. This is followed by details on diploma and certificate programs. The report is written in a format to facilitate further discussion among BHU senior administrators and the academic board for final approval and implementation of a few relevant courses during the next academic year.

SUMMARY TABLE ON REFORMED CURRICULUM IN EMERGING AREAS OF AGRICULTURE AND RURAL DEVELOPMENT

Sl. No.	Degree/Diploma/Certificate/ Vocational	Old or New	Career Opportunities
Agricultural Sciences			
1	Revised B. Sc. in Agriculture	Old (Revised)	Rural Banks, Extension Agents, Crop Consultants, Dealers for seed, pesticides and Fertilizers, Private sector, Agriculture Development Officers and Private entrepreneurs
2	B. Tech. (Biotechnology)	New	Entry level positions in Life Science sector
3	Diploma in Advances in Vegetable Production	New	Nurseries, Garden Center, Greenhouses, Food Processing Units and Governmental Agencies
4	Diploma in Seed Technology and Marketing	New	Seed industry, Seed Analyst, Production Coordinator, Seed Conditioning, Sales Manager, and Marketing
5	Certificate Course in Bio-Pesticides and Plant Health	New	Advisory services to farmers, fertilizer and bio-pesticide industries and to establish plant health clinic
Veterinary, Animal and Dairy Science			
6	B.V. Sc. & Animal Husbandry	New	Entry level positions in Veterinary Dairy and Animal Nutrition sector
7	B. Tech. (Dairy Technology)	New	Entry level position in the Dairy Industry
8	Diploma in Animal Husbandry	New	Supervisory, managerial, technical positions
9	Diploma in Meat Technology	New	Entry level positions in the meat processing sector
10	Diploma in Dairy Technology	New	Technicians for the dairy industry
11	Certificate Course in Dairy Farming	New	Entry level positions in dairy farms
12	Certificate Course in Poultry Farming	New	Entry level positions in poultry farms
13	Vocational Course in Clean Milk Production	New	Entry level positions in milk producing companies
Food Science and Technology			
14	B. Tech. (Food Science and Technology)	New	Food industry, educational institutions, research and development, regulatory agencies, self-employment
15	Vocational Course in Bakery Technology	New	Bakeries, self-employment, bakery inspectors, lab technicians, sales and marketing
16	Vocational Course in Fruit and Vegetable Processing	New	Fruit and vegetable processing industry, self-employment, sales and marketing, educational institutions
17	Vocational Course in Safe and Hygienic Practices for Sweetmeat Makers and Street Food Vendors	New	Hygienic and safe food production facilities, self-employment, hotel, restaurant and catering