



VISION 2050

ASSAM AGRICULTURAL UNIVERSITY

Vision 2050



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Mr. Shantanu Saikia

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I am extremely happy to present before the readers the Vision-2050 document of Assam Agricultural University. Needless to say that a lot of thinking, a lot of imaginary but related picture drawing exercises to build a future agricultural scenario for Assam, and a lot of strategic calculations and planning have gone into the preparation of the present document which is expected to serve as a guide in producing the right type and quality of man power for the sector, in ensuring a needed growth for food security, while looking for and developing vulnerability-matching technologies, bringing in commerce to agriculture and also in leveraging right kind of benefit from agri-trade.

Vision can be defined as the capacity of one to see beyond what the ordinary people cannot see and, in that sense, everybody can not be a visionary. Example of a visionary planning could be the Changi airport of Singapore. While building the airport, it was kept in mind that should something go wrong in the runway, there should be some alternative arrangement for landing of aircraft; and the arrangement was that they constructed the exit road from the airport in such a way that, if need be, the road could be converted into a runway immediately. A similar thinking was the guiding principle while preparing the present document in the sense that the document addresses scenarios like, should the stresses confronting agriculture sector today turn graver, should there be a weather pattern shift, how to still produce more food, how to preposition

FORWARD

FOREWORD

the institution to respond and respond effectively to the challenges and produce over 15 million tonnes of food grains from the present level of around 5.4 million tonnes so that around 7 million tonnes could be traded nationally and internationally. The document also underlines the importance of producing science-, society-, farm- and business ready students. It further has dealt with the importance of embracing frontier technologies, building up institutional competitiveness to bio- and nano technologically scan the rich bio-resources of the state for reinvigorating its bio-economy, leveraging from the specialty agriculture of the state, encashing its competitive advantage to become the leader in organic agriculture, becoming a forceful partner in giving a meat/ fish revolution to the country and the likes.

Transformation in Indian agriculture has been marvellous. From a food deficient- rather food starved country six decades back, we have come to the stage of guarantying food security to all those deprived section through an Act of Parliament. This means we have had the capacity and capability thus far to feed our people and live with pride. However, this capacity of ours has been challenged once more and this time by a combined force ranging from weather and climate- to less people in farming- to old, overused and fatigued soil- to contaminated and scanty water resource- to non-remunerative return from farming etc. This time therefore, our success will depend not only on a vision, howsoever good that might be, but also on our fortified knowledge and skill based approach to find problem defacing answers so that we walk over them with ease, confidence and conviction. To that effect, it will be desirable that we lay the research and education road map, the strategy implementation programs and a strong monitoring mechanism to ensure research agenda framing in line with the vision so as to provide required scientific backstopping to the efforts of the stakeholders to take the state on agricultural growth path.

The document, I believe will help the students, pedagogues, researchers and state policy planners in accessing agriculture related information, in having an insight to the state's agricultural scenario for their preparedness to innovate and work and that it will serve as an antibiotic and vitamin in furthering the crop/ livestock and fish architecture of the state under a changed environment covering atmospheric, geo-physical, cultural, political, consumerism and other linked spheres.

I wish to compliment Dr. Prasanna K. Pathak, Associate Director of Research of the University for his support and cooperation in preparing the document. My thanks are also due to the other members of the Faculty who had directly or indirectly rendered their services while preparing the document.



(K. M. Bujarbaruah)
Vice-Chancellor, AAU

Agriculture in Assam

Assam is the most populous state of the North Eastern Region (NER) of India which is situated between 24° and 28°18'N latitudes and 89°4' and 96°E longitudes. The total geographical area of the state is 78,438 km² which forms 2.4 per cent of the country's total land mass. Nearly 89 per cent of the state's population of about 3 crores lives in the rural areas and about 70 per cent of the total work force is engaged in agriculture and allied activities.

The economy of Assam is mainly agrarian with agriculture and allied activities contributing about 30 per cent to the state's net domestic product and providing livelihood support to about 75 per cent of the population of the region. The productivity of the major crops like rice, pulses, and oilseeds is much lower in Assam compared to the national average in spite of the fact that the soils of Assam are, generally, considered to be much better in fertility and other physico-chemical properties compared to that in many other regions of the country. The state has also witnessed, over the years, several changes in its agriculture in terms of production, productivity and cropping pattern. At present, the net and gross cropped areas in the state are 28.11 (35.1 per cent of geographical area) and 40.99 lakh hectares respectively with a cropping intensity of 144 per cent. Rice is the dominating crop of the state occupying around 91% of the gross

cropped area. Pulses and oilseeds, though grown, have not made desired headway. Among cash crops, sugarcane occupies a substantial area followed by jute among fibre crops. Of late, area under potato has also shown an increase. Among other horticultural crops, banana followed by pineapple and citrus fruits are the major fruit crops while potato, cabbage, cauliflower are the major vegetable crops. The state also has potential for spice crops, notable among them being ginger, turmeric, chilli and black pepper.

During X Five Year Plan, the agriculture in the entire country had exhibited a decelerating trend and the state of Assam was no exception. During the fag end of this Five Year Plan the state's agriculture had recorded a negative growth (-0.23 per cent) ringing thereby the alarm bell. Responding to the alarm bell, the state took several growth promoting technology and funding approaches which enabled the state to increase the growth rate to present level of (+) 4 per cent.

The food habit of the people being non-vegetarian, the state has also tremendous potential for the growth of livestock including poultry and fishery sub-sectors. However, poor production potential of the indigenous strains of livestock and poultry leads to dependance of the population on other states for meeting its animal protein requirements. Similar is the case with fish production. Realising the potential of this sector in addressing the very basic issue of inclusive growth in agriculture, several new programs have been initiated to increase the production and productivity of the animals and fishes with greater emphasis on Integrated Farming System mode of food production.

Agriculture in Assam in macro sense is characterized by monocropping, subsistence level and low input-low output system. This weakness, however, could now be converted into opportunities by capitalizing on the hidden strengths in the form of maximizing production through input optimization specially when green revolution belt has experienced fatigue.

From the existing and anticipated R & D support, the state has to gear up itself to produce 120.44 lakh tonnes of food grains by the year 2050 as shown in Table 1:

56,000 km², surrounded by the hills and interspersed with small hillocks, uplands, lowlands and swampy lowlands subject to annual flooding. The Barak valley covering about 7,000 km², is an undulating plain with small hillocks and swamps. The hills unit consists of a part of the Barail and Meghalaya ranges. The northern face of the hills rises gradually to 930 meters while the southern part is steep and falls abruptly into the Barak valley.

Soils

The major soil groups of Assam are Riverine Alluvium soil, Terai soil,

Table 1: Demand supply scenario of food grains in Assam (2010-11 to 2050-51)

(Population (in lakh); food grain (in lakh tonnes))

| Crop | 2010-11 | | | 2030-31 | | | 2050-51 | | |
|--------------------------|---|--------------|-----------------------|---|---------------|-----------------------|---|---------------|-----------------------|
| | [Population (Adult Equivalent): 267.44] | | | [Population (Adult Equivalent): 397.40] | | | [Population (Adult Equivalent): 578.94] | | |
| | Demand | Supply | Gap (Deficit/Surplus) | Demand | Supply | Gap (Deficit/Surplus) | Demand | Supply | Gap (Deficit/Surplus) |
| Rice* | 43.93 | 41.00 | -2.93 | 65.27 | 85.15 | 19.88 | 95.09 | 114.11 | 19.02 |
| Wheat & maize | 6.83 | 0.94 | -5.89 | 10.15 | 25.80 | 15.65 | 14.79 | 42.84 | 27.05 |
| Pulses | 4.88 | 0.70 | -4.18 | 7.25 | 1.70 | -5.55 | 10.56 | 5.12 | -5.44 |
| Total food grains | 55.64 | 42.64 | -13.00 | 82.67 | 112.65 | 29.98 | 120.44 | 162.07 | 40.63 |

*Clean rice

Food requirements were calculated according to NIN standards (Rice: 450 g/capita/day, Wheat/Maize : 70 g/capita/day and pulses : 50 g/capita/day)

Total requirements per day per capita : 570 g

Physiography

Assam can be divided into three distinct physiographic units - the plains, the plateau and the hills. The Brahmaputra and Barak valleys, accounting for 80.8 per cent of total geographic area, are the two main zones for agricultural development in the plains. The two valleys are separated by the two hill districts, Dima Hasao and Karbi Anglong. The Brahmaputra valley, about 700 km long and 50 -100 km wide, is an alluvial plain of about

Lateritic soil and Red Yellow Loam soil. The typical characteristic feature of Assam soils is its acidity resulting from very high rainfall. It is found that more than 75 per cent of the soils in the non-riverine tracts are acidic in reaction. The percentage of neutral soils ranges from 0.6-21.5 per cent in different districts. In general, the pH ranges from 4.2 to 5.8. However, the soil of flood plains has slightly high pH ranging from

6.0 to 7.1 due to presence of free liming materials.

Climate

Being situated in sub-tropical zone, Assam is characterized by hot and wet summer and dry and cool winter. On the basis of data on temperature, rainfall and humidity, four distinct seasons can be identified in the state:

The pre-monsoon season (March - May): Characterized by gradual rise in temperature, vanishing fog and occasional thunder showers, cool morning and hot afternoon wind which occasionally becomes strong causing dust storm. The rainfall during the period varies from 20 to 30 per cent of the total precipitation.

The monsoon season (June - September): Characterized by cloudy weather, high humidity and weak variable surface wind with rising temperature. Temperature and precipitation increase with advancement of the season. The number of rainy days varies between 18 and 20 in a month. August is the warmest month in the year.

The post-monsoon season (October - November): Characterized by fair weather with fall of temperature and rainfall. The number of rainy days per month drops down to about three by the end of November.

The winter season (December - February): Characterized by fall of temperature and rainfall with occasional cool breeze from the north and morning fog.

The state can be divided into four broad climatic types - per humid,

humid moist, sub-humid and dry sub-humid based on Thornthwaite moisture regimes. The average minimum temperature is about 10°C attained in December/January and maximum is about 32°C in July/August. The minimum in some places drops down to 7°C while the maximum shoots up to 37°C. The relative humidity on an average exceeds 80 per cent for the entire state. Even in the dry months of the state, the relative humidity does not go below 75 per cent on an average.

Based on variation in rainfall, physiography and soil characteristics, the state has been divided into following six agroclimatic zones:

- 1) **North Bank Plains** comprising of Lakhimpur, Dhemaji, Sonitpur, and Darrang districts
- 2) **Upper Brahmaputra Valley** comprising of the districts of Golaghat, Jorhat, Sivasagar, Dibrugarh and Tinsukia
- 3) **Central Brahmaputra Valley** with Nagaon and Marigaon districts
- 4) **Lower Brahmaputra Valley** covering Dhubri, Kokrajhar, Bongaigaon, Chirang, Goalpara, Barpeta, Nalbari, Baska and Kamrup districts
- 5) **Barak Valley** comprising of Cachar, Karimganj and Hailakandi districts, and
- 6) **Hills** covering the hill districts of Karbi Anglong and North Cachar (Dima Hasao)

Rainfall is the most important determinant factor for the climate of Assam. Rainfall distribution follows a typical monsoon pattern with peak precipitation during monsoon and scanty rainfall in winter. The highest rainfall occurs during July-August.

A rain-shadow belt comprising Karbi Anglong and Nagaon districts extending partly to Golaghat is conspicuous during the season. Monsoon rainfall in this belt is about 750-1100 mm which then increases in all directions.

The annual rainfall is as high as 3900 mm in the extreme northwest and extreme northeast hilly tracks of the state. The Barak valley also receives rainfall between 2000 and 3900 mm. Except the rain-shadow belts where the annual rainfall is around 1000 mm, the rainfall in other parts of the Brahmaputra valley and the Barak valley varies from 2000 to 3900 mm. Potential evapotranspiration (PET) is less than the precipitation for greater part of the year. PET varies from 995 mm in Dibrugarh to 1722 mm in Nagaon in the Brahmaputra valley and 1186 mm in the Barak valley.

Major challenges

- Productivity increase in agri-horti-animal-fish crops on the face of shrinking/fragmented land holdings, ailing soil health, diminishing water resources and increased human population
- Checking post-harvest losses and processing for high value/designer food products
- Current and impending impact of climate change on productivity of crop/livestock/fishes and development of climate resilient agriculture
- Addressing malnutrition and hunger through development of varieties fortified with vitamins, minerals as well as products with nutraceutical properties
- Harnessing the benefit of bio-nanotechnology for developing

stress tolerant crops/animals.

- Bio-resource inventorization, prospecting and their use for augmenting food production while developing food safety protocols
- Achieving 3 Ps i.e. productivity, profitability and permanency in agriculture through multi-stakeholder partnership for benefitting from technology
- Skill development at different levels through quality education and training by positioning Assam Agricultural University as a power house of information and technology so as to develop regionally, nationally and globally competitive skilled manpower in agriculture and allied sectors
- Embracing urban and peri-urban agriculture mode of food production by capitalizing on the untapped opportunities of roof-top/lawn agriculture as well as holistic agriculture options in peri-urban areas
- Leveraging the benefit from specialty agriculture of the state

Major opportunities

- Opportunity to increase the productivity of crops by 3-4 folds through varietal intervention, awareness building and input optimization.
- Another major opportunity lies in capitalizing on the potential of livestock and fishery sub-sectors, awaiting driver's pin pointed attention, in achieving and sustaining inclusive growth and addressing rural poverty.
- Yet another opportunity lies in pursuing organic agriculture.



Bhut jolokia plantation in farmer's field

How to meet the challenges

- Revamping and scientifically motivating the players of Assam Agricultural University so as to make the University responsive to zonal, regional, national and global requirements for a technology led growth in agriculture benefitting each stakeholder in the process
- Market intelligence based production planning and information percolation, using ICT based tools, to the producer groups by the extension personnel attached to KVKs by way of rejuvenating the extension machinery with empowered knowledge and motivation.

Goal

- Developing and accessing modern tools and technologies for enhancing agricultural production, increasing farm income, accelerating agricultural growth on a sustainable basis while conserving the natural resource base
- Competitiveness building in the University and man power therein to face the current and upcoming vulnerabilities confronting agriculture sector like environmental stress, soil fatigue, advent of IP regime and globalization as well as impending food crisis while building similar competitiveness down the line among the stakeholders

SWOT Analysis of Assam agriculture

Strengths

- Rich bio-diversity: More than 5000 crop germplasm, 240 fish species, 30% of the country's bamboo resources, 43 citrus germplasm, 23 indigenous fruits, countless resources of medicinal and aromatic plants besides a host of wild flora and fauna and 24% forest areas
- Rich water resource: Of 425 lakh ha metre of water in the region, the state has a water resource of around 280 lakh ha meters
- Six different agro-climatic zones that offers growing conditions for a variety of crops
- 72% population against 52% in the country in agriculture and allied sectors
- Fertile soil, untouched by chemo-centred agriculture unlike in green revolution belts, offers scope for evergreen revolution
- Availability of trained human resource to take the sector forward

Weaknesses

- Lack of quality seed and planting materials
- Natural disasters - mainly flood and periodic droughts
- Lack of mechanization
- Inadequate storage, processing and value addition
- Unorganized market
- Inadequate service delivery mechanism
- Extremely limited irrigation facility
- Technology shy farmers

Opportunities

- Development of agro-climatic zone specific farming systems --- six such zones offer different scopes
- Opportunity to increase production by 3-4 folds through input maximization
- Opportunity for being world leader in organic farming
- Opportunities for bio-resource (including soil, plant, animal and microbes) inventorization, characterization and their use in addressing various stresses through conventional and molecular means
- Increasing irrigation potential through ground water tapping and use
- Opportunity for giving the country a meat and fish revolution
- Opportunity to benefit from 'Look East Policy' of the government through the development of agriculture centric employment agenda

Threats

- Bio-piracy due to five international borders of the state
- Invasion of trans-boundary crop and animal diseases and pests
- Old age of the people engaged in farm sector
- Relatively investment unfriendly environment for technology commercialization



THE UNIVERSITY

Historical Background

The embryo of the agricultural research in the state of Assam was formed as early as 1897 with the establishment of the Upper Shillong Experimental Farm (now in Meghalaya) just after about a decade of creation of the agricultural department in 1882. However, the seeds of agricultural research in today's Assam were sown in the dawn of the twentieth century with the establishment of two Rice Experimental Stations, one at Karimganj in Barak valley in 1913 and the other at Titabor in Brahmaputra valley in 1923. Subsequent to these research stations, a number of research stations were established to conduct research on important crops, more specifically, jute, pulses, oilseeds etc. The Assam Agricultural University was established on April 1, 1969 under 'The Assam Agricultural University Act, 1968' with the mandate of imparting farm education, conduct research in

agriculture and allied sciences and to effectively disseminate technologies so generated. Before establishment of the University, there were altogether 17 research schemes/projects in the state under the Department of Agriculture. By July 1973, all the research projects and 10 experimental farms were transferred by the Government of Assam to the AAU which already inherited the College of Agriculture and its farm at Barbheta, Jorhat and College of Veterinary Sciences at Khanapara, Guwahati. Subsequently, College of Fisheries at Raha, Nagaon, College of Home Science at Jorhat, a second agriculture college at Biswanath Chariali and a second veterinary college at North Lakhimpur were set up under the University. Thus, with a network of colleges and research stations spread across the state, the AAU became almost solely responsible for conducting research in agriculture and allied sciences, and also producing the needed human resources to man the sector.

Research network

The University has a fairly good network to conduct research. This includes six Regional Agricultural Research Stations (RARS) and five commodity research stations as indicated below:

RARS, Titabar: Established in 1923 as a Rice Experimental Station, this became a part of the University in 1980 to conduct research in Upper Brahmaputra Valley Zone (UBVZ) comprising of Tinsukia, Dibrugarh, Sivasagar, Jorhat, and Golaghat districts. The station is located at Titabar town which is about 20 km south of the Jorhat campus of AAU.

RARS, Shillongani: This station was initially established to work on pulse crops, oilseed crops and jute under the State Department of Agriculture. The station was transferred to the University in 1973 and was reorganized in 1980 as the Regional Agricultural Research Station for the Central Brahmaputra Valley Zone (CBVZ) which comprises of Nagaon and Marigaon districts. The station is responsible primarily for conducting research on pulses, oilseeds, jute and allied fibres and wheat. It also conducts research on boro rice.

RARS, Gossaigaon: Established in 1980, this centre caters to the research need of Lower Brahmaputra Valley Zone (LBVZ) comprising of Kamrup, Nalbari, Borpeta, Goalpara, Kokrajhar and Dhubri districts. This is the lead station for entire Assam in respect of research on crops like buckwheat, niger, linseed etc.

RARS, North Lakhimpur: Established in 1980, this station works for the North Bank Plains Zone comprising of



Worker in the tissue culture lab

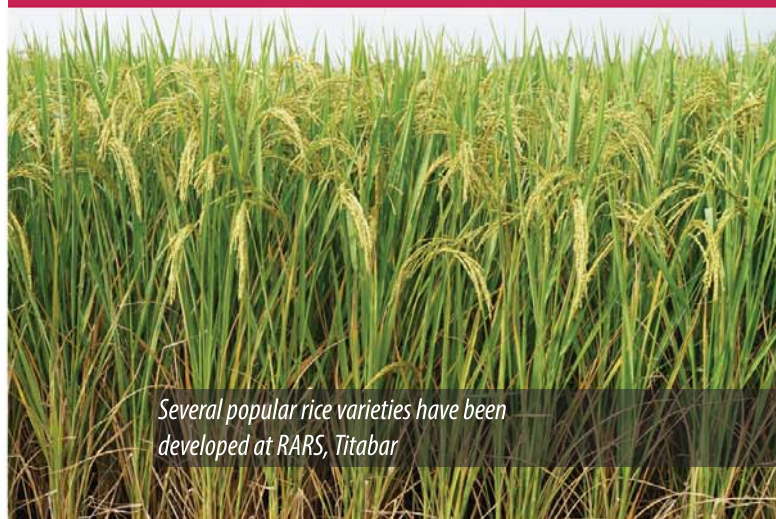
Lakhimpur, Dhemaji, Sonitpur and Darrang districts. It serves the lead function for research on deepwater rice and diaraland agriculture for the entire state.

RARS, Karimganj: Established in 1913, this station was transferred to the University in 1973 for research in the Barak Valley Zone (BVZ) comprising of Cachar, Karimganj and Hailakandi districts. The station is still mainly devoted to research on rice.

RARS, Diphu: Located at Diphu, this station was converted in 1980 to a RARS for the Hill Zone (HZ) comprising of Karbi Anglong and North Cachar districts. The station is presently conducting research for the zone primarily on rice, vegetables, maize, tuber crops, and millets.

Commodity research stations

Horticultural Research Station, Kahikuchi: This station was established in 1950 primarily to conduct research on coconut and was transferred to the University in 1973. This is now a leading research station for the horticultural crops.



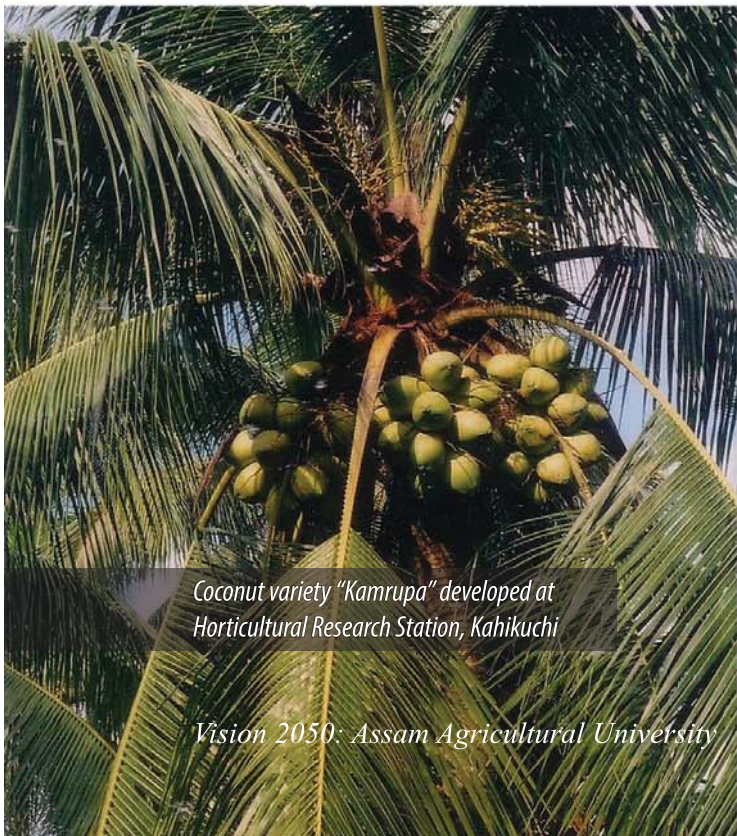
Several popular rice varieties have been developed at RARS, Titabar

Sugarcane Research Station, Buralikson: The Station came into existence in the year 1969 for conducting research on sugarcane. This farm was earlier owned by the State Department of Agriculture which was later transferred to the University.

Citrus Research Station, Tinsukia: The North Eastern Region is an important part of the centre of origin for citrus crops with enormous variability. Considering the importance of the crop, the Citrus Research Station was established at Tinsukia in 1976 to conduct research on all aspects on citrus.

Goat Research Station, Byrnihat: This station, located 18 km away from the College of Veterinary Science at Khanapara, Guwahati; was established in the year 1978 with the mandate of carrying out research on Assam hill goats as well as developing suitable cross bred variety using proven Indian goat breed.

Livestock Research Station, Mandira: Located 110 km northwest of Guwahati, this centre was established in 1981 with the mandate of developing a livestock based farming system. Presently a plan for developing intensive Integrated Farming System in this centre has been taken.



Coconut variety "Kamrupa" developed at Horticultural Research Station, Kahikuchi



Students at molecular laboratory

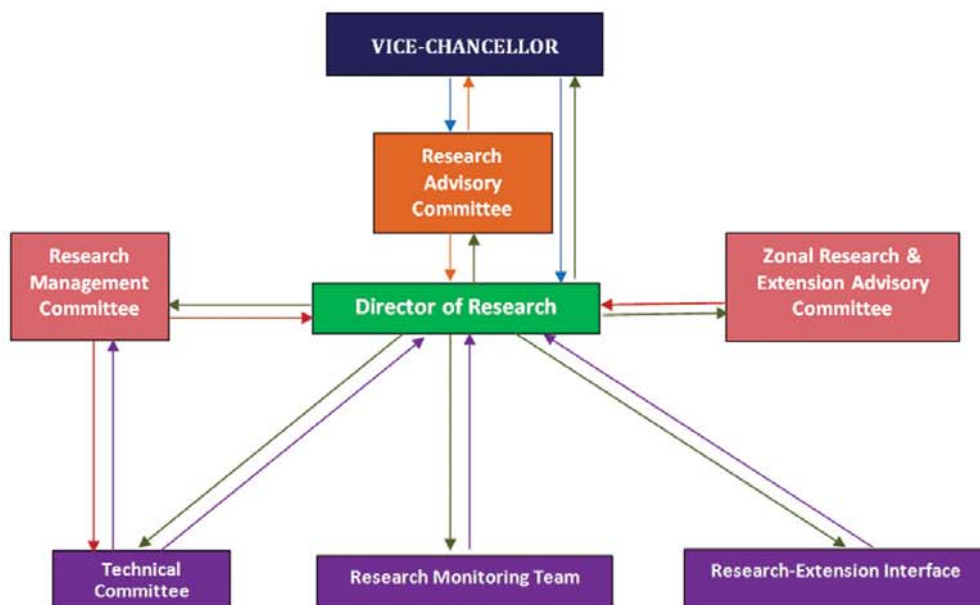
Research Management System

The University follows a well laid out Research Management System to systematically carry out need based, demand driven, situation specific and problem oriented research. Under the current management system (Figure below), the research problems are identified based on the information collected by the scientists from the farmers' fields and also on the basis of the feedback received from the line

departments of the state government. The system ensures project based funding and effective monitoring of the programs to make them sharply focused to the relevant problems only.

Extension management system

Agricultural technologies evolved in the University are percolated to the user groups through a network of 20 KVKs supervised and coordinated by the Directorate of Extension Education.



Research Management System of Assam Agricultural University



Smart classroom

SALIENT ACHIEVEMENTS

Education

Till 2012-13, the University produced altogether 11,643 graduates and post-graduates, of which 8407 are Bachelor's, 2860 Master's and 376 are Ph.D degree holders (Table 2).

Research

Crop science

* The AAU has developed and recommended 91 varieties of various field and horticultural crops. These include 49 in rice, 5 in pulses, 5 in toria, 1 in sesame, 9 in sugarcane, 2 in jute, and 2 in fruit crops. Varieties like Ranjit,

Table 2: Graduates and Post-Graduates produced by different faculties of the University till 2012-13

| Faculties | Graduates | Post-graduates | | Total Graduates and Post Graduates |
|--------------------|--------------|----------------|------------|------------------------------------|
| | | Masters | Ph.D | |
| Agriculture | 4,199 | 1,911 | 243 | 6,353 |
| Veterinary Science | 3,147 | 697 | 118 | 3,962 |
| Home Science | 807 | 252 | 15 | 1,074 |
| Fisheries Science | 254 | --- | --- | 254 |
| Total | 8,407 | 2,860 | 376 | 11,643 |



Ranjit, one of the most popular rice varieties of AAU

Vision 2050: Assam Agricultural University

Bahadur, Luit, Dishang, Joymati, Kanaklata, Aghoni, Keteki of rice; TS 36, TS 38 and JT 90-1 (Jeuti) of toria; CoBln 9605 of sugarcane, Pratap (SG-1) of green gram have significantly contributed towards production augmentation.

* Important crop varieties developed in the very recent years are Mulgabharu, Gitesh, Jalashree and Jalkuwari in rice; TS-46 and TS 67 in toria; SG-21-5 in green gram; Tarun and Apeswari in jute; Nambor, Kapilpar and Doiyang in sugarcane; Shyamalima in rice bean etc.

* The most promising varieties of horticultural crops developed at AAU include Kamrupa, Assam green tall and Kahikuchi hybrid-1 of coconut; JC-1, JC-2 of brinjal; and AAUJ-2 and AAUJ-3 of ridge gourd.

* Many varieties developed elsewhere have been recommended to the farmers after their extensive testing. The most recent among such varieties are the two short duration, high yielding wheat varieties (DBW-14 and HUW-468) that can be harvested before pre-monsoon showers.

* Bt-chickpea lines resistant to pod borer have been developed and transferred to India's leading Seed Company for further testing and commercialization.

* Biofertilizer based INM packages have been developed for rice based cropping systems.

* Biocontrol agents like *Trichogramma* (Tricho cards) for rice stem borer and *Beauveria bassiana* for hispa have been developed.

* Bio-pesticides-Biofor-PF (Jaiva-Kiran) and Biozin-PTB containing virulent cells of *Pseudomonas fluorescens* and *Trichoderma harzianum* in organic substrate has been developed for management of wilt disease of crops like tomato, potato, brinjal, chilli, ginger, cabbage, cauliflower, etc.



Bahadur, a rice variety developed at AAU



Tarun, a jute variety released at National level, being demonstrated in farmer's field



TS-46 of toria developed at AAU



Bt-chickpea line developed at AAU



Protected cultivation of gerbera flowers



Mass-multiplication of banana through tissue culture



Biofor PF- a bio-pesticide developed at AAU



Packaging box developed for distant transport of pineapple

* Post-harvest packaging and handling technologies have been developed for long-distance transportation of pineapple, orange etc., extending shelf-life of perishable vegetables and also for commercial floriculture.

* Technologies for off-season cultivation of vegetables and flowers have been perfected and popularized.

Animal Science

* Upgraded pig variety with 87.5 per cent Hampshire inheritance developed and propagated.



Piglets bred with 87.5 per cent genes from Hampshire



Beetal x local goat cross (with 75 per cent Beetal blood)

* Beetal x local goat cross with 75 per cent beetal blood developed.

* DNA fingerprinting of Swamp buffalo established its closeness to riverine buffalo.

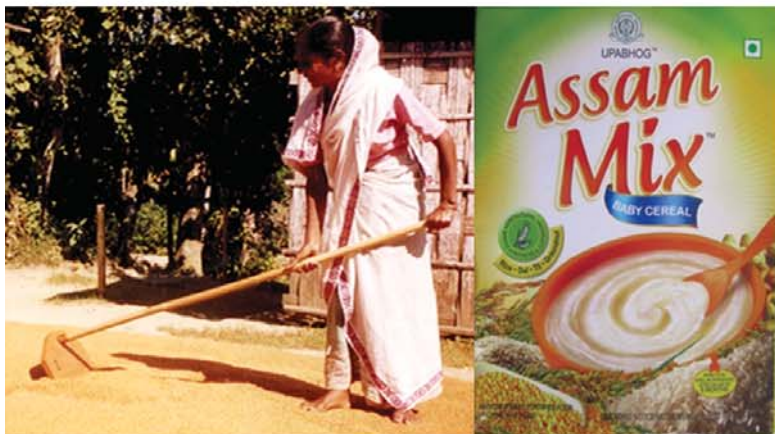
* MOET (Multiple Ovulation Embryo Transfer) protocols in goat standardized.

* Cell culture vaccine for Swine Fever developed which is now being mass produced in a PPP mode.

Home Science

* Assam mix – a promising weaning food has been developed for both infants and lactating mothers and commercialized.

* Several traditional recipes were nutritionally fortified using the process of nutfication.



Women-friendly farm-tool “Kuhuna” and Assam Mix developed at AAU

* Women-friendly farm-tool “Kuhuna” for drudgery reduction was developed and tea plucking basket was improvised.

*Standardization of methods for extraction of natural dyes from locally available plants.

* Smokeless chullah was validated and propagated.



Products prepared from banana fibre

Fisheries Science



Polyhouse built for advance fish breeding

* Developed polyhouse fishery for advance breeding of fish.

* Crop - fish - livestock based Integrated farming system models have been developed for Assam conditions.

* Cat-fish magur (*Clarias batrachus*) seed production successfully carried out.



AAU's carp hatchery model

* Developed low-cost model of carp hatchery.

* Developed low-cost fish feed under the trade name “Sushama”.

* Capacity built to produce 8 crore fingerlings per year.



“Sushama” - a fish feed developed by AAY and breeding programme of “magur” fish (from L to R)

The Vision

‘Provisioning of quality human resource to facilitate technology led agricultural revolution ensuring both production and environment sustainability targeting a minimum of ‘8 per cent plus’ agricultural growth; while addressing the issues of household nutritional security, farmers’ distress, commerce in agriculture as well as regional, national and global food crises taking the advantage of innovative technology, market reforms and liberalization.’



Brain storming infrastructure for strategy framing and implementation

The University plans to walk the following paths to convert the vision into reality:

A. Education

Quality of higher education including agricultural education, in India, has become a subject of discussion due mostly to the lower rate of gross enrolment ratio (GER), the syllabus followed, un-employability of university products in present day competitive job markets, non-exposure of faculties to the innovation in teaching, likely entry of foreign universities etc. Increasingly, people in general have started differentiating education from knowledge and skill. While it is very clear that universities are to create knowledge, a paradigm shift is necessary to reorient the faculty mindset towards imparting more knowledge creating and skill capturing education so that the universities are placed suitably not only to impart education in the form of information but also help the student to come up with a creative mind to leverage from the present day knowledge economy. Accordingly, following shifts in education is envisioned:

- A shift from teacher to learner-centric education
- A shift from conventional to market-driven education
- A shift from state/regional /national to global level education
- A shift from information intensive to knowledge and skill intensive education
- A shift from fragmented to cross-fertilized education
- A shift from C & T (chalk and talk) mode of education to a combination of C &T and D & D (Demonstrate and Discuss) mode

using ICT and virtual class room concept.

- A shift from lecture centric to interactive mode of education
- A shift in evaluation system from expected answer providing question setting to comprehensive understanding based question answering-home work, both for teachers and students.

It is likely that in the years to come, more and more people will join agricultural education for jobs only, that too for comfortable office jobs and this will defeat the purpose of agricultural education. The state/ region and the country is also going to need science, society, farm and farmer ready agri-graduates so that they can exhibit expertise as per the demand of the chosen area. It is therefore envisioned to address such issues through the following alternatives:

* Continued production of current number of agri-graduates with the aim of giving the platform to 50 per cent of them to fill up the manpower gap in other countries

or

Reducing the intake capacity of students at Bachelor's Degree programs so as to produce quality human resource to pursue high end agricultural research for generating newer technologies.

* Facilitating a gradual shift to Integrated PhD course to attract brighter students to research by reducing total years for Masters and PhD by one year.

* Increasing the number of diploma and certificate course schools to produce skill and technology empowered semi-professionals in agriculture to pursue technology led field agriculture.

Strategies to achieve the above

- Upgrading the skill of the faculty, both at home and abroad, so as to groom them to fit into the changed structure of education indicated above
- Developing linkages with domestic and foreign universities and institutions of learning for faculty/student exchange program
- Revisiting the course curricula for bringing in effective modifications including introduction of subjects of upcoming interests as per the need of the hour
- Introducing the concept of virtual classroom, e-teaching and Discuss & Demonstrate mode of teaching
- Modernising the class rooms, experimental farms and the overall ambience of the University to attract both regional and foreign talents
- Making provision for visiting/adjunct faculties as well as guest lecturers for knowledge and expertise exchange
- Preparing needed percentage of students to man different agricultural sectors by way of imparting hands on training in those specified areas
- Opening up of diploma courses in important farm and non-farm sector areas
- Opening up of certificate courses across the state using the regional research stations and KVKs of the University
- Creating a database on HR for manpower need assessment in agriculture and allied sectors and adjusting student intake sector wise accordingly
- Orienting teaching to produce job ready, science ready, farm and

job ready, science ready, farm and farmers ready and business (regional, national and global) ready students through appropriately categorizing/classifying the students on the basis of their aptitude and abilities and then blending teaching with needed level of grooming, counselling and injecting the skills

B. Research

I. AGRICULTURE SECTOR

Agricultural research capacity and competitiveness building among technology providers as per perceived technology need visioning is crucial to address emerging and upcoming challenges. The University proposes to preposition itself in this line through public and private funding mobilization so that public good in terms of situation specific technology solutions could be provided by it to make the state and the region self sufficient in food. For this, different scenarios like excessive flood, drought, monsoon pattern change, change in food habits of people, climate centred diversification need in cropping pattern and sequence, gene/ genome based productivity increasing technology options etc. were built while preparing the vision. The way the people, the environment and the whole biosphere is changing, a time after around 2050 might come when neither the people will prefer cereals nor the environment might support their production necessitating thereby a complete diversification from cereal based farming to farming for food products other than cereals. Considering all these aspects, following vision for AAU is penned down.

a) Research for state and regional food security

Cereals:

As of now the state of Assam is experiencing a food deficit of 7 lakh tonnes and the deficiency in the entire region is 18 lakh tonnes. Ninety per cent of this deficiency is due to poor productivity of rice - the dominating farm crop. The first vision is therefore, to bridge this gap by optimizing rice production in the following manner:

- Out of 17 lakh ha area under *sali* rice in the state, 10 lakh ha area shall be earmarked for high yielding varieties developed by the University, like Ranjit with yield potential of 6-7 t/ha targeting an average production of 5.5 t/ha (paddy) i.e, a gain of 3.2 t/ha (5.5-2.3t the present average) i.e, a production enhancement of 32 lakh tonnes (3.2 x 10). Together with the present production of 23 lakh tonnes (1.0 m ha x 2.3 t/ha), total rice production from this area will be 55 lakh tonnes.
- About 4 lakh ha flood-prone *sali* rice area shall be covered under the University developed submergence tolerant rice varieties viz., Jalashree, Jalkuwari, flood escaping varieties like Luit, Dishang etc. Technology options like staggered planting of Gitesh and Prafulla with two month old seedlings shall be applied to obtain an average of 4 t/ha yield against the present paddy productivity of about 1.8 t/ha i.e. a gain of 2.2 t/ha. With this gain, the production is envisioned to be increased to 8.8 lakh tonnes from 4 lakh ha. Together with present production of 7.2 lakh tonnes from this area, the total production will be 16 lakh tonnes.

- Of the remaining 3 lakh ha area under *sali* rice, 2 lakh ha shall be put under aromatic and other specialty rice in organic mode of production and 1 lakh ha shall be devoted to hybrid rice which will be increased to 10 lakh ha by 2050.

For aromatic/sticky rice, the University developed varieties like Keteki/Bokul joha, Aghoni bora shall be promoted with yield potential of 3.5 t/ha with a total production of 7 lakh tonnes. For hybrid rice, the University proposes initially to screen both public and private hybrids for their suitability in the state with concurrent attempt to produce its own hybrids. With an average productivity of 7 t/ha from the hybrid rice, total availability of paddy is expected to be 7 lakh tonnes.

- The state has around 7 lakh ha area under summer/autumn rice. Present productivity in this area is around 2.5 t/ha (both summer and autumn). The vision is to cover 60 per cent of this area i.e, 4 lakh ha under summer rice with HYV like Joymati, Kanaklata, Swarnav, Dinanath etc. developed by the University with an yield target of around 6t/ha. From this intervention, it is envisioned to produce 24 lakh tonnes of paddy against the present production of 15 lakh tonnes. In order to achieve this production, assistance from the state govt. shall be explored for increasing irrigation potential from 20 to 40 per cent.
- 30 per cent area i.e, 2 lakh ha out of a total of 7 lakh ha is envisioned to be under hybrid rice with an yield potential of 8 t/ha to achieve production of 16 lakh tonnes.
- Remaining 10 per cent i.e, 1 lakh

ha will be under autumn rice cultivation. This area will be covered with newly developed high yielding varieties to increase the yield level to at least 2 t/ha from today's level of 1.5/ t/ha.

- Together with the varietal interventions, it is also envisioned to keep on producing needed production and plant health protection packages as per the changing vulnerabilities expected to confront agriculture.

Thus with these interventions, rice production in the state is envisioned to be raised to 131 lakh tonnes from the present level of 51 lakh tonnes thereby not only meeting the regional shortfall of 18 lakh tonnes but also producing 62 lakh tonnes extra rice [13.1- 6.9 (5.1+1.8)] to be traded nationally and internationally. All necessary inputs like quality seed, fertilizers both organic and inorganic, plant protection measures, and farm tools and machineries shall be provisioned in a participatory mode. Appropriate strategy for state land and water use policy shall be developed in consultation with the state government. Besides, the University shall constantly keep on developing newer varieties and agro-techniques including that of hybrids to continuously backstop varietal needs and agro-techniques as per the call of changing climatic and other situations.

The 2nd approach shall be to increase area and production of maize in the state. Maize has somehow been a neglected sub sector in the state with very low productivity. An area of around 5 lakh ha is envisioned to be covered under rabi maize (*sali* rice fallow) increasing the irrigation

potential of the state with a productivity target of 5 t/ha. Quality Protein Maize (QPM)/single cross hybrid is proposed to be included to achieve a production of 25 lakh tonnes.

The agriculture in the state and the region as a whole being rain-fed, appropriate strategies and preparedness are necessary to keep the sector performing under both flood and drought situations. While, the University has already developed varieties for flood situations as stated above, it also envisions to introgress Sub 1 gene in high yielding varieties like Ranjit so that increased production on the face of flood situation is sustained. Similarly, should the rainfall pattern in the state change like in the year 2007-08 when the state suffered severe drought, the University envisions to explore crops like wheat as alternative to the more water demanding crop, viz., rice. In this case, the vision is to increase area under wheat exploring the ground water use potential as well as introducing short duration – pre-monsoon escaping wheat varieties. The University has already selected such varieties and the effort of such screening shall be doubled keeping an eye on climate shift pattern.

With the envisioned technology and package support to rice and maize, the University foresees a total cereal production of 156.8 lakh tonnes including the current production 0.8 lakh tonnes of wheat. Production increase in wheat due to proposed area expansion has not been included in this assessment.

The University is aware that the strategies outlined above can work only when there is seed sufficiency, and therefore, the vision of the University is

to produce the needed seed particularly of the HYVs in a participatory mode with the farmers. Since hybrid rice is expected to be a demand driven option in foreseeable future, the University shall develop its own hybrids taking the parent lines from the proven high yielding varieties. Similarly, hybrids for the local aromatic rice, joha is also planned to be developed screening the maintainer and rescuer lines.

Should the environment discourage cereal based farming in the region owing to climate change and other factors, the vision is to develop technologies for pursuing rice minus agriculture. In this case, major emphasis is envisioned to be laid on crops like buckwheat, root crops and the likes

Pulses and Oilseeds: Present areas under pulses and oilseeds in the state are 1.23 and 3.08 lakh ha producing only 0.68 and 1.59 lakh tonnes, respectively with an average productivity of 680 and 515 kg/ha. The country today has pulses and oilseeds varieties producing up to 1800 and 1600 kg, respectively. There is therefore, tremendous scope to increase both productivity and area in these two crops. Despite Technology Mission on both oilseeds and pulses, the area under pulses in Assam has been static at 1.23 lakh ha, while the area under oilseeds exhibited a decline from 3.39 in 2002-03 to 3.08 lakh ha in 2007-08. This trend is envisioned to be reversed by bringing in more areas under these two crops capitalizing on the increased char/silted areas through the active involvement of 20 KVKs operating under the University. Development, screening and provisioning of high yielding varieties with needed agronomical background is planned to

push up productivity to 1.4 t/ha for pulses and 1.2 t/ha for oilseeds, i.e, a gain of 720 kg /ha for pulses and 685 kg /ha for oilseeds which will facilitate total production of 1.72 and 3.69 lakh tonnes of pulses and oilseeds, respectively. With the gene based technology to raise pod borer resistant chick pea already developed by the University, for example, raising the production and productivity of these two crops is no longer a distant dream. Thus, together with 1.7 lakh tonnes of pulses and 156.8 lakh tonnes of cereals, total food grain production in the state would be 158.5 lakh tonnes. The University plans to include both pulses and oilseeds in the cropping sequences in those areas where relatively short duration rice varieties are grown. Support for this programme is also planned to be sought under National Food Security Mission (NFSM). Cropping intensity in the state is also planned to be increased through the medium of summer pulses, particularly, in the intervening period between *kharif* and *rabi* rice cultivation. Pulse crop is also planned to be introduced in the organic belt to encash the benefit of its tap root system in organic farming.

Other crops for tapping the market

Jute and Sugarcane: The state has 0.6 and 0.24 lakh ha area under these two crops. The University has already developed one jute variety (Tarun) with high yield potential and disease resistance that has been recommended by the Central Varietal Release committee for the jute growing areas of the country. Similarly, the University has nine sugarcane varieties with yield advantage and disease resistance to its credit. These varieties are planned to be pushed in a Mission Mode approach to

increase per ha yield of these two crops and bring higher economic benefit to farmers. An appropriate tie up between the University and the state department is planned to be developed, as it exists for crops like rice, for a concerted effort to commercially exploit both these crops for development of value added products. A tie up is also proposed with the sugar barons from the state like Maharashtra and Directorate of Jute Research for revamping these two sectors. Site specific technology generation and refinement of technologies developed elsewhere in the country for these two crops are envisioned.

b) Placing the state in organic map of the country

The cropped area of the state is planned to be surveyed for input (both organic and inorganic) use pattern in order to earmark the areas that could be straight way identified for organic cultivation practices and the areas that could be converted, over a period, into organic blocks. Having completed this task over a period of one year, potential crops for organic production are planned to be identified agri-zone wise and guidelines for organic cultivation practices as recommended by IFOAM and NPOP as well as the practices generated locally shall be followed. Based on the identified crops and area, organic inputs (bio-fertilizers and bio-pesticides) already developed by the University are envisioned to be mass produced in a PPP mode involving private partners. Initially, emphasis on glutinous and aromatic rice followed by select horticultural crops is planned for organic production. An assessment of the area presently claimed to be under organic cultivation is also planned in

order to compensate the missing components, if any. Considering the high certification cost of organic products charged by the agencies presently operating in the state, the University might also come forward to take this responsibility, if need be. The University initially plans to target 10 per cent of the gross cropped area of 27.5 lakh ha to be put under organic agriculture with associated programme of increasing the area eventually to 35 per cent or 9.63 lakh ha by 2050.

c) Bioresource inventorization and utilization

The state has an enviable bio-resource repository in the form of its floral and faunal including microbial resources which is envisioned to play a significant role in shaping tomorrow's agriculture as they are believed to be the store house of a vast gene pool of agricultural significance. It is therefore, planned to inventorize and categorise them genetically to record their worth in seeking productivity enhancing and disease controlling technological solutions with an aim to capitalize on the upcoming gene trade. The University has already taken a step in this direction by researching on the soil microbes for possible identification of acid tolerant genes in them so that the same, if found, could be delivered as capsules for crops to be grown in acid soil environment. Similarly, sequencing of the genes of holy basil is also planned to transfer the insect resistant properties of the plant to crops. A database on these bio-resources is planned to be developed for monitoring the risk level so as to forewarn the players under CBD to resort to conservation plans as well as

to protect the Intellectual Property Right. The University also plans to capitalize on the FAO's program on global plant and animal biodiversity conservation and utilization for agriculture.

The University is aware of the bio-piracy threat particularly because of the five international borders and therefore plans to safeguard the gene pool available in its bio-resource by way of genetic characterization of the resources and obtaining Geographical Indicators (GI) for them.

d) Managing the Effect of 'Climate Change'

It is now very clear that climate is changing. It is also being clear that it is impacting agriculture in more than one way. A technological solution for green agriculture that leads to less GHG (Green House Gases) emission is the call of the time. It is therefore, envisioned to develop less GHG emitting agricultural practices. Some of the possible areas of research planned are:

- Conversion of C_3 plants to more carbon responsive C_4 plants
- Research on carbon sequestration through *in situ* carbon conservation, enriching organic carbon in soil through crop residue incorporation, green manuring, adopting conservation tillage practices, crop rotation and identifying suitable cover crops
- Research on increasing photosynthetic efficiency of different crops
- CO_2 tapping from paddy fields, their diversion to the Azolla tanks for conversion of CO_2 into oxygen
- Development of suitable water management practices in lowland

paddy fields to create intermittent aerobic conditions to reduce methane and nitrous oxide production

- Resorting to IPNS to reduce nitrogenous fertilizer use and thereby check nitrogen loss from the soil
- Reduction in the number of unproductive animals but retaining the production level through high yielding cattle/buffalos
- Research on changing rumen microbial fermentation through identification of methanogenic archaea, fibre degrading bacteria, fungi and enzymes
- Development of vaccine against methanogens along with changes in dietary composition like lipids in the diet of ruminants
- Designing of specialized shelters for animals to facilitate their adoption to climate change impact
- Monitoring of weather pattern at micro level, block-district-wise for making contingency plan and adaptive measures

In addition to the above, constant monitoring of climate with the active participation of meteorology department and space research institute shall be ensured to gauge the impact of research findings and their adoption by the clients in food production chain.

e) Development of molecular technologies

Having observed production saturation in green revolution belts due to the negative impact of chemo-centred technology on

environment, a gene and nanotechnology based agricultural revolution is planned taking the advantage of vast bio-resources of the state. Bio-prospecting and allele mining for novel genes of productive and disease resistance importance and their introgression for varietal improvement of major crop, livestock, poultry and fish, strengthening heat/cold tolerance and pest and disease resistance traits in them as well as improving the keeping and processing qualities of the commodities through wide hybridisation and *in vitro* rescue of superior genotypes are envisioned. Development of transgenics and application of marker aided selection, gene pyramiding and embryo transfer/ *in utero* selection of embryos etc. shall be given due focus besides developing insect and pest management measures using nanotechnology. Development of micro- satellite/SNP markers for tagging important genes, creation of genetic map, study of gene flow etc. is envisioned. Immediately, within a year or two, soil microbes are planned to be screened for possession of acid tolerant genes since soil acidity is a major problem of the state. Together with this, around 4000 accessions of rice germplasm available in the University are planned to be screened for drought/disease resistant genes. Tulasi (*Ocimum* spp.) genomics is envisaged for identifying pests/disease resistant gene in it so that same could be used for developing transgenics.

Similarly, it is envisioned to develop molecular animal disease diagnostic kits, use of suitable biomolecules for development of portable kits to diagnose elitensess in bulls, conversion of stray male cattle into improved bulls through epididymal manipulation,

identification of bacteria/fungi/enzymes from the rumen of cattle and buffaloes for degrading plants cellulose more effectively, developing technologies for preservability and value addition to different livestock products, development of transgenic pigs, chicken as well as development of biotechnologically effective animal vaccines.

f) Addressing the constraints of deliverables

In order to continuously support agricultural production enhancement on a sustainable basis, cost effective technology backup shall be provided by the University for addressing constraints like soil acidity/toxicity, heavy metals, macro- and micro-nutrients, flood/drought tolerant crop/animal variety, weather based disease forecasting models, farm tools and machineries, quality seeds of plant/animal/ fish, nutrient and water use efficiency modules, animal and fish feed constraints, post-harvest handling and value addition protocols, information and technology flow to stakeholders engaged in the sector and provisioning of production augmenting inputs in collaboration with other private and public sector players. Technology and information support necessary to bring in commerce into various aspects of agriculture is envisioned to be put in public domain to facilitate business centric agricultural growth. The University also envisages introducing certificate courses for entrepreneurs desirous of pursuing trade in DNA fingerprinting, bio-molecules, plant and animal DNA/RNA, plant-weather modules as well as the diagnostic kits and vaccines.

g) Natural resource conservation technology

Natural resource degradation in the state of Assam has taken alarming proportions. While its riverbeds are being raised due to the silt deposits from surrounding upstream hills, its river banks are being perennially eroded under the influence of flood. Technology and policy support are therefore needed to address the situation from becoming worse. The University plans to approach the government for physical aspects of halting this erosion by way of digging the two major rivers of the state with concurrent creation of embankments so that water carrying capacity in the rivers is increased and erosion-prone areas of the riverbanks are protected. The University on its part plans to be instrumental in providing:

- Soil quality map identifying the deficient nutrients
- Crop planning for ground water recharge
- Water quality analysis and value addition
- Bioremediation of the degraded land
- Technology for judicious use of water in the principle of 'crop per drop'
- Up-scaling water use efficiency and water productivity
- Fine-tuning rain and roof water harvesting models
- Getting a regional body constituted through DoNER, Govt. of India for drawing up research and development agenda for checking downstream effect of natural resource degradation due to upstream activities

II. HORTICULTURE SECTOR

North Eastern Region (NER) in general and the state of Assam in particular has been nationally accepted as the potential area for horticulture. Under Technology Mission program of Govt. of India on Horticulture, a renewed thrust has been given to capitalize on the unexplored potential of horticulture sector in the state, which is the home of many promising horticultural crops.

The state has 5.94 lakh ha area under horticultural crops presently producing 14.02, 13.16 and 2.18 lakh tonnes of fruits, vegetables and spices, respectively. In terms of productivity, fruits and vegetables are in the range of all India level of productivity. However, the state has considerable scope to expand the area as well as to increase the productivity in these two crops.

a) Fruits

The state has a cultivable waste land of 0.8 lakh ha, half of which i.e. 0.4 lakh ha is envisioned to be covered under area expansion for production of high value fruits crops. Considering the present productivity of 15.0 t/ha, an additional quantity of 6.0 lakh tonnes (15.0 x 0.4 lakh ha) could be realized from this area. The University shall, in a participatory mode, produce and provision needed planting materials and agro-techniques for the purpose. In addition, technology back up to increase per ha productivity from 15 to 18 t shall be provided for realizing additional quantity of 3.48 lakh tonnes (3 x 1.16 lakh ha fruit area) thereby facilitating the state to produce additional quantity of 9.48 lakh tonnes (3.48 + 6.00 lakh t) of fruits. The University shall develop input-responsive agro techniques to

support the projected growth. The University plans to generate the needed seed and planting materials for the purpose using greenhouse /protected cultivation, fertigation and other technologies including V-Type nurseries. Another area of research to be pursued is on indigenous fruits of the state, many of which are gradually disappearing. Indigenous fruit based orchards shall be established at Biswanath College of Agriculture initially followed by another such orchard at College of Horticulture which is planned to be established soon.

b)Vegetables

The state has 1.86 lakh ha area earmarked as fallow land of which around 1 lakh ha is under current fallow. This area is envisioned to be covered under seasonal vegetable crops. With an average productivity of 16 t/ha, an additional quantity of 16 lakh tonnes of vegetable is envisioned to be produced. Another vision is to cover 0.3 lakh ha area under permanent fallow for high tech horticulture aimed at producing high value – low volume vegetable crops. With 16 tonnes average productivity, another quantity of 4.8 lakh tonnes is envisioned to be produced raising thereby the total vegetable production to 33.96 lakh tonnes, thus making the state not only self sufficient but also positioning her to feed the neighbouring states. For the purpose of ready availability of seeds for the expanded areas, the University shall take up hybrid vegetable variety development programs together with screening and accessing the screened hybrid varieties from other public and private sectors. The University shall also develop suitable bio-agents to support

organic vegetable production. In addition, collection, genetic characterisation, conservation and utilization of indigenous vegetables of the state for developing stress tolerant varieties is also planned. Technology development for urban horticulture, particularly the vegetable production using roof tops, trays and the garden space is kept as another area of research.

Since the state of Assam has the comparative advantage of vast water resource, research on hydroponic mode of agriculture for vegetable production shall be pursued. Similar attempts for soil less vegetable production modules will be taken under protected cultivation. Models suitable for hydroponic agriculture for the state shall be developed and prototyped.

c) Spices

The state is rich in spices sector producing 1.49 lakh tonnes marketable surplus of spices from a total area of 0.86 lakh ha. Major areas are covered by coriander, ginger, chilli and turmeric followed by garlic, onion and black pepper. With the increase in per capita income and change in food preference to low volume-high quality and tasty food, demand for spices is increasing and the state can play a dominating role in this sector particularly after the state being declared as AEZ for ginger and turmeric. Another dimension to spice based economy is the potential use of Assam chilli- Bhut Jalakia, in hand grenade making- a recent discovery by DRDO, Assam. Since spices like onion and garlic are grown only in some select pockets of North East India, the vision is to develop such varieties and growing practices for spices that can aid in productivity and value increase in these crops so that commercial advantage

could be competitively tapped.

Present productivity of turmeric in the state, for example, is only 0.7 t/ha against an All India average of 3.9 t/ha. Curcumin content is also very less compared to some other varieties being grown in the region. First attempt shall therefore, be to increase its productivity up to All India level and curcumin content up to at least 6.8 per cent by using clone from varieties like Lakadong in Meghalaya facilitating thereby an additional production of 0.35 lakh tonnes of quality turmeric from the present area of 0.12 lakh ha. Area expansion under each spice is also contemplated through their inclusion in Agro-Forestry based farming system mode of operation as well as earmarking suitable land under the KVKs of the University. Spice-based trade and commerce is also planned to be given a boost by building the capacity of the unemployed youths for establishing semi-commercial to commercial venture. Post harvest handling, processing, value addition and packaging shall be other areas of research thrust in the coming years.

d) Plantation crops

Assam has a competitive advantage in capitalizing on its plantation crops particularly areca nut and coconut. Its further propagation under the bari (homestead garden) system of farming is envisioned together with exploring the use of its bi-products. Appropriate technology support for value addition to their main and bi-products is also envisioned together with technologies to counter the disease problem in the two crops. Transboundary trade at least with the five countries bordering the north east shall be another agenda. Together with the propagation of already

developed varieties like Kamrupa and Kahikuchi hybrid 1 of coconuts for productivity increase, the University also plans to continually work on developing newer hybrids for both coconut and areca nut. Plantation crop based farming system module development is another research agenda.

e) Tuber crops

Among various tuber crops, Assam has a sizeable area of 0.78 lakh ha under potato crop. However, its productivity is lower than the all India average and the state also is deficient in quality seed. The advantage of the latter is apparently being taken by some of the neighbouring countries to clandestinely push their varieties leading to the production of inferior quality potato. Skill of the farmers is envisioned to be upgraded for production of True Potato Seeds besides increasing the storage facility for seeds of recognized varieties. At least 20 per cent potato growing area shall be attempted to be covered under processing quality potato for which needed agronomical background shall be created. The vision is to benefit the potato growers through potato based tertiary industries. Similar effort shall be taken to systematize and augment the productivity of other tuber crops, namely, sweet potato, tapioca, yam, diascoria etc. through varietal evaluation/ development and generating appropriate value addition technologies.

f) Floriculture

Although the state has quite a substantial resource to promote and propagate floriculture based industries, the much needed breakthrough in this



Lilium cultivation under polyhouse

sub-sector is yet to be achieved. With the rapid conversion of the towns into either metropolitan or close to metropolitan cities with mushrooming of star quality hotels, domestic demand for flowers within the state is increasing, and so much so that the state has to meet the flower requirement either from the neighbouring states outside the region or all the way from places like Thailand. The accruable benefit from flower farming is envisioned to be guaranteed to the state population through the breeding, screening and developing competitive flower growing

technologies both under open and poly house conditions as well as technologies for enhancing vase life and packaging quality. Joint venture with the Technology Mission on horticulture is also contemplated to showcase the evolved technologies for location specific flowers through the operational area under the domain of ATMA and KVKs besides partnering with other private players. The University envisions screening, developing and recommending suitable flower varieties for better economic return to the farmers.

Generation of technologies for summer marigold production, cut flowers and orchids of the state shall be given weightage. Lotus is another flower of special significance of the state and complete technological package development for this and other similarly placed flowers shall form an important research agenda of the University. Another area of research will be to develop models for use of the vertical space in the green houses to optimize output per green house that provides a controlled environment. Aeroponics, in the line of hydroponics, shall be yet another research canvas.

Precision/high-tech horticulture

Increasingly scarce natural resources namely, soil and water fuelled by climate change scenario shall demand, it is envisioned, resource and stress responsive technologies to keep on keeping the sector on driver's seat. Accordingly, technologies for precision horticulture that would indicate the optimum requirement of temperature, humidity, water, fertilizer and seed treatment are envisioned to be generated so that conducive environment for continued production

is created. Through technology generation for precision farming, the University envisions to advise farmers on crop specific input need (water, fertilizer) provisioning on per ha basis.

The consumers of Assam are seen to be at a disadvantageous position to have adequate access to fruits and vegetables of non-seasonal nature particularly due to the state not pursuing the high-tech means of production of off-season vegetables. Needed technological support is therefore, envisioned to be provided for production of high value-low volume vegetable crops using high end technologies.

Tea

Tea is a forerunner industry of Assam which produces around 51% of country's tea. The crop was introduced in this state by the Britishers and having observed its potentiality in this state since that time, Assam Agricultural University took up the responsibility of



The University intends to incorporate more valuable crops like areca nut as shade tree in tea gardens

producing the needed human resources to back this sector imbibing science and technology. The University thereby earned the unique distinction of becoming the first ever institution in the world to produce human resource

for tea sector and it continues to do so with greater responsibility of even producing doctorate degree holders today. Considering the influence of tea sector in socio-economic as well as the business fabric of the state, the University envisions to take up the following aspects of research and education:

Research:

- * Development of complete production packages of organic tea
- * Development of tea husbandry based agro-forestry models incorporating, among others, cash crops like mandarin orange, black pepper etc.
- * Development of eco-friendly biopesticides and biofertilizers as alternatives to chemical pesticides/fertilizers together with tea farming friendly Integrated Pest and Nutrient Management modules
- * Delivery of techno-economic feasibility models for small holder tea growers so as to promote small holder tea production as well as restrict their mushrooming growth based on economic feasibility and quality parameters
- * Considering decreasing demand of Indian tea in international market, the University shall take up research on quality control and production economics to facilitate recapturing the market.
- * Since processing of tea is a problem for small holder producers, it is envisioned to carry out research on the efficacy of currently available smaller tea processing machines while making attempts to develop suitable prototypes indigenously.

* Considering increasingly decreased labour to production output ratio, the University plans to initiate research on tea farm mechanization establishing at the same time tea-weather relationship for optimum output.

* In view of the presence of health friendly indicators in tea, the University plans to work on developing different health friendly tea beverages targeting inculcation of nutraceutical values through the use of frontier technology.

* The issue of climate change is also likely to show its impact on tea and therefore the University plans to initiate work on developing climate neutral tea husbandry practices while exploring part of the tea areas for diversification into medicinal garden/floriculture /sugarcane etc.

* NE region houses around 50% of the bamboo resources of the country. An attempt therefore is envisioned to be made to explore bamboo leaves for producing bamboo tea.

Education:

* Client and market need based human resources in tea sector is envisioned to be produced so that the products could fit well into the requirements of tea factories, gardens, quality control laboratories, processing and value addition industries, small farmers' advisory board, banking and financial sector, patent, marketing and policy framing bodies.

* Provision for visiting faculties/adjunct faculties is planned to be created for attracting highly experienced professionals in national and international tea

business and quality control for preparing the students of the University to suitably match such requirements.

* Since a century old tea research station at Tocklai is in the next door, PhD students are planned to be given research programmes, in a collaborative mode, still unaddressed by them for a holistic development of Assam tea sector.

* The students and faculties will be given proper exposure and training to write and submit winning competitive research projects for generating external funding.

Sericulture:

It is an area attached to the socio-economic fabric of Assamese society since time immemorial. All the four types of silkworm viz., Mulberry, *Bombyx mori*; Muga, *Antheraea assama*; Eri, *Philosamia ricini* and Tassar, *Antheraea mylita* are grown in Assam making it the



only state in the country to house all four species which contributes 95% and 65% of the country's total Muga and Eri production, respectively. However, the contribution towards the production of Mulberry and Tassar silk is not very significant. During 2011-12, Assam produced 2,109 tonnes of silk, next only to Andhra Pradesh (6,109 tonnes) and Karnataka (7,800 tonnes). Of the state's

total production, muga accounts for 115 tonnes and Mulberry 18 tonnes, while Eri at 1,976 tonnes.

This traditional silk industry of the state is presently experiencing a tough time because of various environmental and economic reasons. Earlier, the industry thrived well alongside the tea industry. Of late, however, increased use of chemo-centred technology in tea appears to have shown negative impact on sericulture industry. Plantation areas for muga host plants are gradually being replaced by tea. Productivity decline due mainly to lack of quality seeds has added further stress on remunerative income. Considering the attachment of the people to this sector of agriculture as well as to sustain the trade the product of which has a direct bearing on Assamese culture, the University envisions to mitigate the problems confronting this sector by way of:

- * Promoting complementarity with neighboring hill states for production of P-2 level quality seeds since the current environment for quality seed production in the state is not as conducive as it was earlier.
- * Introducing certificate, diploma and degree courses in sericulture to produce skilled human resources to man and carry forward the sector.
- * Introducing improved equipments for reeling etc. under tribal sub-plan programme to bring in efficiency in quality silk production and processing
- * Tying up with state government and Tea Board of India for creating a sort of neutral zone between tea plantation and sericulture to minimize negative impact of

pesticide used in tea

- * Applying engineering skill to design and improve handloom and other equipments while working on energy friendly power-loom development
- * Extending a sub-unit of NICRA project to sericulture area for climate resilient sericulture
- * Undertaking research for developing bio-pesticides that are not harmful to muga silkworm or developing pesticide resistant strains of muga silkworm.
- * Scientific exploration of muga culture under controlled/protected environment
- * Applying molecular biology on both sericogenic insects and their host plants for disease resistance, productivity increase and other traits.
- * Generating technologies for producing silk via microorganisms
- * Developing bivoltine races of muga silkworm from the multivoltine one

III. ANIMAL HEALTH SECTOR



Technology for feedblock manufacturing for livestock commercialized

The state has a good repository of livestock and poultry. However, the output from this resource has not been very encouraging leading to a deficit in

almost all livestock and poultry products. Several limiting factors for this mismatch have been identified, out of which the composition of the resources (most of them being non-descript in nature), limited grazing land, a sound breeding policy not being in place are important ones with noteworthy constraints in other input and service delivery fronts. The vision therefore, is to counter these limitations through appropriate technology and developmental support.

a) Breeding and production

Two pronged approaches to systematize and improve the production performances of milk, meat, egg and fibre producing livestock are envisioned. In the first approach, conservation and up-gradation of indigenous germplasm through conventional and marker assisted selection shall be undertaken. The conservation shall cover both *in* and *ex situ* mode-the University concentrating more on *ex situ* part, conserving semen, ova and at a later stage the DNA and RNA. Through the process of intensive selection pressure backed by health and production supportive technologies, an increase by around one litre of milk per milch cow per day, one kg more increase in live weight of meat producing animal every week and raising egg production at least to 140 numbers in the indigenous bird shall be the target. In the second approach, cross breeding percentage particularly in cattle and pig shall be increased to a minimum level of 30 per cent in each from the present level of around 10 and 5 per cent, respectively. For the purpose, establishment of a bull mother farm with the state-of-the-art semen processing laboratory and a model farm of upgraded livestock are

envisioned so as to achieve 30 per cent more milk and meat. Similarly for poultry breed, dual purpose poultry with higher egg (240 numbers) and meat (2 kg in 50 days) producing qualities shall also be introduced and their seed production program taken up in a participatory mode. Together with this, the University shall also draw up a breeding policy for different categories of livestock keeping in view production target meeting and appropriateness of breed to be included in the program.

Creation of facility for production of progeny tested males, sexed semen, undertaking studies on gene based solution to develop disease resistant animals with increased productivity are also envisioned. Areas like frontier genetics are also contemplated to be pursued to effect *in utero* selection for production of elite animals. Stem Cell therapy is planned to be used in the stray bulls for production of elite male germplasm together with popularisation of technologies like cloning. Introgression of genes like fec-b in the indigenous goats of the state for increasing twining percentage is also envisioned. Since quality animal seed is one of the basic requirements for increasing productivity, nutrient utilization and development of appropriate immune system, and also since the state and university machineries alone is unlikely to meet this requirement, the University proposes to put in place a public-private partnership module for production of quality animal seeds with buy back arrangement by the state machinery. The University foresees a day when the presence of a large number of unproductive animals in the state will be questioned by the

environmentalists and food consumers alike and therefore, it plans to gradually restrict this number through selective elimination of inferior animals replacing them with high producing ones so that required animal products could be produced. However, before requisite numbers of high producing animals are made available, the less producing animals, particularly cattle, are planned to be separated sex wise. The male numbers will be supported for fattening, in a PPP mode, for their trade to neighbouring countries like Bangladesh while the female numbers will be used as surrogate mothers for Multiple Ovulation Embryo Transfer program to produce improved animals. Cloning technique is planned to be standardised using ovum pick up method for large scale production of cloned animals. Development of transgenic animals, namely, pig and goat, shall also be made a part of research agenda.

Maintenance of a sound reproductive health is a pre-requisite to optimize livestock production. Infertility, delayed conception, fertilization failure are some of the problems that need to be addressed on priority. The University envisions developing an IIMS (Integrated Infertility Management System) module for ensuring sound reproductive health.

The likely impact of climate change on livestock is also planned to be assessed for developing climate resilient animal husbandry modules. One area of research will be on design and development of suitable shelters for different categories of livestock. A type of shelter for cattle, for example, will be one that will maintain a THI (Temperature Humidity Index) of 72, above which the cattle are reported to be uncomfortable for sustainable production. Research in the direction of implanting sweat glands in animals like pig and buffalo is also envisioned to be taken up for effective heat dissipation by

these animals. Collaborative research is also planned with institutions like NRC-Camel, Bikaner to explore possibilities of transferring heat tolerant genes of camel to the cattle population of Assam and the North East. Another vision is to breed animals like pig as organ donors for human being incorporating anti - aging genes in the organs like liver, kidney etc. Development of such animals with organs similar in size and shape with human being shall be kept in view.

b) Feeding and Nutrition

Considering the shrinkage in land availability for fodder production, state land use policy is proposed to be revisited in consultation with SLUB (State Land Use Board) so as to demarcate area for fodder cultivation to support proposed production enhancement by way of the University supporting identification and provisioning of quality fodder seeds for different agro ecosystems of the state. Establishment of a fodder bank and research on bio-conservation of locally available fodder are also proposed. Manipulation of rumen microflora for better utilization of non-conventional feeds and fodder resources shall also be undertaken during the period. In addition, research on bio availability of nutrients, nutri-genomics, computation of feed with incorporation of area specific deficient minerals and mass production of complete feed blocks are contemplated. Research initiatives shall be taken on a concept of development of vitamin/ mineral capsules, bio-fortified nutrient capsules with botanicals having nutraceutical properties for animals. Similarly, the bio molecules that might aid and assist in efficient feed utilization and conversion into valuable products shall be attempted to be identified. For this purpose, bio molecules in some of the

wild relatives might have to be screened.

Minimizing the emission of Green House Gases, particularly methane production due to enteric fermentation shall occupy a major place in research thrust. Research on identifying fibre degrading bacteria, fungi and enzyme through rumen micro manipulation is envisioned together with attempts to develop anti-methanogenic vaccines.

Paradoxically, the state of Assam does not have any sound fodder production policy nor does it have any area identified for the purpose. Animal production programs in the state are, by and large, based on zero to negligible input concept for which intended production is not achieved. It is important that this aspect receives due attention of the state government. The concept of pastoralists has to be introduced so that they, as a team, could assist in fodder cultivation, maintenance of animal genetic resources, document Indigenous technical knowledge and thus help in taking the sector forward. The University plans to support such initiative through its KVKs for breed and production improvement.

c) Animal Health Care

Screening the efficacy of molecular disease diagnostic kits developed within and outside the country to provide immediate diagnostic capabilities for on time control measure is envisioned. Depending on specific needs, capacities and competitiveness of the University experts shall be developed to produce animal vaccines based on local isolates. Microbes of animal origin, particularly those having hidden potential to aid and assist in disease resistance and

productivity enhancing genetic make up are also envisioned to be screened and used. Effective research modules to check transboundary animal diseases are proposed to be developed together with region- and location specific bio-security and safety measures. Development of a foolproof weather based disease forecasting model to forewarn the livestock growers about any impending danger is also planned. The University also proposes to develop micro-chips to monitor production and health parameters in the animals, particularly cattle for immediate redressal of the problem. Large scale emphasis is planned to be laid on livestock disease mapping in the region using molecular epidemiology approach. Indigenous livestock population reported to have carried resistance genes for some of the diseases are also envisioned to be screened for benefitting the sector. In general, the following aspects are proposed to be undertaken:

Development of Vaccine/Vaccine Seeds:

Many bacterial and parasitic diseases, emerging and re-emerging infectious diseases like foot and mouth disease in cattle and buffaloes, swine fever in pigs, enterotoxaemia in goats, Ranikhet and infectious bursal disease in fowl and duck plague in ducks are major threats to the livestock and poultry population of the State. Vaccines are the constraints for some of the diseases like swine fever and duck plague. Pig husbandry and duckery although are popular in the region, appreciable growth in these sectors have been hindered due to these dreaded diseases. The cell culture vaccines against the two diseases are not immediately available in the

country (AAU-produced cell culture swine fever vaccine is yet to be produced in large quantity). Therefore development of potential vaccine candidates from the local isolates of swine fever and duck plague viruses will be targeted followed by the development of vaccines/vaccine candidates for other diseases. Development of marker vaccine or genetically modified virus vaccine is proposed for differentiation of vaccinated and infected animals of the State in phase manner for designing an effective vaccination protocol.

Diagnostic Tests/Kits for Rapid Diagnosis of Diseases:

Rapid diagnosis of diseases is important not only to prevent the spread but also to formulate strategies for prevention and control. Diagnostic kits commercially available for some of the diseases are expensive and difficult to use for large scale screening. Therefore, attempts will be made to develop low cost, rapid and sensitive diagnostic tests/kits for important diseases of livestock and poultry. Development of cost effective molecular diagnostic tests are envisioned.

Nanotechnology in Diagnosis and Vaccine Development:

Considering the recent applications of nanoparticles in disease diagnosis and in vaccine development, attempts are envisioned for the development of nanoparticle based diagnostic techniques for animal diseases. Nanoemulsion based vaccine delivery system will be explored for better delivery and enhancing the effectiveness of the vaccines.

Biosafety Level Laboratory (BSL)-2/3:

Establishment of a BSL2/3 laboratory is proposed to handle the emerging pathogens of animals and birds and to maintain the vaccine candidates/seeds from the local isolates.

Establishment of a Regional Microbial Type Culture Collection Centre:

To isolate, characterize and maintain important microbial isolates from livestock and poultry resources of the NE India which is a biological hotspot of the country, a regional microbial type culture collection centre is envisioned during the vision period.

Other aspects like pharmacofarming, use of indigenous animals and birds as bio-reactors and exploration of nanotechnology for effective drug delivery shall form part of some of the research agenda to be carried out during the period.

d) Livestock Product Technology

Demand in the state and the region for value added livestock and poultry products is increasing and considering the food habit and life style changes among the people, this increase is likely to witness an upward swing. However, this aspect of research in the state and the region has not received much attention so far. With the envisioned thrusts on productivity increase, processable surplus of livestock products are anticipated and accordingly, it is envisioned to take up research agenda on processing and value addition to livestock products and increase in their shelf life as per the preference and demand of the consumers. The NE region of India being a large repository of ITKs in processing and preservation

of livestock products including meat and meat products, it is proposed to validate some of the proven ITKs related to livestock food processing and inject scientific know-how in them, wherever necessary, so that products as preferred by the local populace could be produced. In addition to accelerating the process of research on livestock products at university level, it is also proposed to establish a regional quality control laboratory for foods of animal origin in the University with the state-of-the-art technologies. Further, microbial interventions are proposed to improve the quality and uniformity in the dairy and meat based livestock products. Preparation of livestock products with NE flavour treated with products like bamboo shoots, lotus flower, local mint etc. is envisioned.



Livestock farm at Livestock Research Station, Mandira

Traceability of animal products is an issue of concern for health conscious people. Similarly, identification of adulteration in milk and milk products, meats from male/female animals are also important from both health and consumer preference point of view. Adulteration detection kits, molecular kits for tracing the origin of the livestock products as well as kits for differentiating meats from male/ female animals are planned to be developed. In addition, preparation of products with

low cholesterol, products containing rich amount of Omega-3-fatty acids and products with higher concentration of health friendly compounds in the form of functional food are also envisioned to be developed.

IV. FISHERY SECTOR

It is both an irony and a matter of grave concern that a state like Assam which has been blessed with abundant water resources has to depend on other states outside the region to meet its fish



Integrated livestock-fish farming system at AAU

requirements to the extent of around 30%. The main reason for this kind of a scenario is that the sector was not given due attention and interest until very recently. Moreover, culture fishery had not received the attention of both the researchers and planners as the population was apparently contented with capture fisheries that too without rejuvenating the natural habitats and breeding tracts. Since the available water resource of the state measuring more than 3.74 lakh ha is an opportunity to grow more fish not only for the state but also for the region and also since low productivity of around 1.5 t of fish per ha could adequately be addressed by

raising its potential to at least 3.5 to 4.0 t/ha, the first vision is to provision needed quantity of fish seed in a participatory mode followed by propagation of growing techniques including standardizing stocking density. Paddy being the major crop of the state and paddy-cum-fish culture being an age old practice, adequate technological support to derive maximum benefit from this system of farming is envisioned together with developing and propagating fish-crop-livestock based integrated farming systems.

It is observed of late that rice centric agriculture in the state is no longer remunerative, and therefore, one of the alternatives in coming years could be partial diversification of rice fields, particularly in the flood prone areas into fish farming. The University accordingly plans to develop appropriate technologies for reaping a good harvest of fish from such untraditional areas of fish farming. Technological requirement for such farming appears to be the ones like standardizing lime requirement as per site specific soil pH, screening of fish species suitable for such areas, introducing unconventional methods of fish farming like pen and cage culture etc. The university accordingly will mobilize and generate facility to undertake research in the above areas. Considering the swing in climatic pattern leading towards cascading negative impact on fish production due to drought like situation in some parts of the state, appropriate rainwater harvesting ponds of suitable size for fish farming is planned to be designed and developed for fish production through harvested rainwater including identification of suitable fish species for such farming.

The wetland in Assam is another area to target for fish production. The wetlands are also a rich source of organic fertilizer with higher content of organic carbon. Under this scenario, technology for appropriately balancing the soil status conducive to fish production will be developed. Another area of culturing fish is in the small ponds available in the bari system of household farming in the state. The University proposes to provide needed input and technology backstopping to leverage from small pond fish culture. Similarly, within-farm resource recycling is planned to be channelized through integrated mode of fish farming together with agriculture and livestock farming.

One of the major hurdles hampering harnessing of optimum quantity of fish per ha has been identified to be delayed availability of fish seeds. In order to reap maximum benefit from fish farming, this problem needs to be addressed and therefore the University envisions to enter into a program of fish seed production under protected thermo-controlled environment so that the seed could be made available by late March to early April.

With increased production of fish, technology need for fish processing and value addition is envisioned and the university accordingly plans to invest its resources for generating site, fish species and location specific post-harvest technologies including the production of value added dry and processed fish.

It is also observed that major emphasis in fishery sector is given on carp culture ignoring totally the local fish culture. One vision of the University

is therefore, to standardize the breeding and production techniques for locally grown and preferred fish species which also fetch higher price. Small fish culture which is a delicacy for the people shall also be given needed scientific thrust for production optimization. Similar trials will be taken up on ornamental fish culture since the state is the home for a number of ornamental fishes.

Fishery based entrepreneurship development will be another area of research so that technological support could be provided to both the groups engaged in 'On' and 'Off' farm activities. Off farm activity group will include people engaged in fish seed and feed production, fish harvesting equipment preparations, fish processing aspects and marketing the produce.

V. HOME SCIENCE SECTOR

Late Pandit Jawarharlal Nehru once said "When women move, the household moves, the village moves and the country moves forward". As per one estimate, a farm woman puts energy in agricultural operation equivalent to the horse power of two bullocks. Both these statements draw our attention to the involvement of women in diversified fields from agriculture to industry to politics. Home Science College of the University is accordingly preparing a manpower base to serve in areas ranging from housekeeping to textile designing to excellence in cooking and child development. Considering the march of the society towards a women centric growth society, the University proposes to empower and preposition its home science college so that it can produce graduates and post-graduates who are equipped with technology to deal with areas like infant mortality checking,



Students experimenting with various food recipes in Home Science Lab

nutrient balancing in pregnant and lactating mothers, fashion designing and reducing the drudgery of farm women and housewives through the development of gender friendly tools and machineries, smokeless chullah and environment friendly preservation method for food items. The University also envisions to gear up the home science faculty and students to adequately address the area of natural fibre using particularly the natural dyes available in the flora of Assam through appropriate research and thereby place the University in the advantageous position to capture the international market on natural dyes since the state is estimated to be the home of a whopping 90 per cent of natural dye resources. Household expenditure on food items, both for rural and urban areas, are also planned to be regularly monitored through the medium of the home science college so that the University could prioritize its research agenda on the crops responsible for household expenditure increase thus providing economy balancing crop modules.

V. ISSUES OF COMMON INTEREST

Post harvest handling and value addition:

An alarm bell has already been sounded globally about an impending food crisis necessitating thereby all out efforts to generate innovative technologies not only for production optimization but also for effectively saving what we produce. As per one estimate, post harvest losses of food in India are to the tune of Rs. 50,000 crore per annum. If half of this could be saved through appropriate technology injection, the pressure on our land, water and other resources could commensurately be reduced with resultant benefit towards agricultural sustainability. As the years roll by, this aspect of saving the food that we produce is envisioned to be increasingly important as the diminishing natural resources are expected to limit our capacity to double/triple food production as the world population is expected to touch 9.6 billion mark by 2050. Every state therefore, has to gear up its capacity to handle this promising area of food availability. In so far as the state of Assam is concerned, the post-harvest losses of food commodities have been estimated to be much higher than the all India average of around 30 per cent. This is more so with respect to horticultural crops - loss in tomato, for example, being in the range of 30-65 per cent. Unless local population is strengthened with adequate technology backstopping to convert waste into wealth through the establishment of food processing industries, the loss due to inadequate post harvest technology support shall continue and the upcoming importance of promoting non farm agri business enterprises shall remain unaddressed.

The University therefore, proposes to preposition itself in developing state of the art technology to evolve nature friendly post harvest handling and processing options for different food commodities including increasing their shelf life through innovative storage modules. In addition to the on-going research efforts to increase the shelf life of the fruits and vegetables, the University has included in its vision to develop technologies like silencing of genes responsible for fruits/vegetables ripening enzymes /proteins so as to increase shelf lives. Value addition to the produce incorporating technologies that not only aid in better marketing but also increasing the nutraceuticals value to the produce is designed to be carried out using bio-nanotechnological tools. Building competitiveness of the faculty in terms of up scaling the skills from a cross fertilized area/discipline domain in this sector is also envisioned.

Food losses occur in 3 phases. One is at the field level while the crop is under production stage. Here the loss is caused by insect/ pest and diseases; birds, rats, drought and floods. The second loss is after harvesting i.e., from field to storage structure to market and the 3rd loss occur at hotels, ceremonies like marriages, community feast etc. Our loss countering strategies will have to be planned accordingly- phase wise identifying players and saviour actors for different phases. While pre-harvest agricultural technologies will be needed for phase one, a combined technology and management force will be required for phase two and a complete public awareness and precision for phase three.

For phase two again, the University plans to enter into the area of gene silencing / knockdown particularly of the ripening genes so that shelf life of the produce could be enhanced. Similarly, research on developing appropriate packaging material for fruits and vegetables is planned to provide scientific alternative to withstand transportation stress of the produce.

Research on sanitary and phytosanitary measures

With the opening up of global food market and stringent measures in some of the food importing countries, it has become extremely important to adhere to quality of food- and for that matter it is not only for tapping export market but also for ensuring a healthy growth of our own society that food producers and delivery agents stick to quality right from field to fork. It is also visualized that with the increasing pollution level touching even the ground water reserve, the threat to food borne diseases is going to be much more in the coming years. Research on sanitary and phyto-sanitary aspects like HACCP (Hazard Analysis and Critical Control Point) as influenced by growing techniques and agro-ecology is therefore, envisioned to be taken up in the University.

Agricultural waste management

Damage to the environment due to inefficient handling and utilization of waste from agriculture and allied sectors has been a matter of concern for the biosphere reserve. Waste handling technologies are therefore, envisioned to be generated in the form of bio-fortification of crop residues,

animal waste like dung, urine, slaughter house waste and their use in rejuvenating the soil as well as a source of bio-energy.

Gender friendly agricultural technology

Involvement of women in farm operation in North Eastern Region is much higher and the state of Assam is no exception. Their involvement right from seed sowing to animal farm maintenance calls for generation of gender friendly technologies to reduce their drudgery and to increase their efficiency in farm operations. Considering the stature and structure of our farm women and also the amount of horse power equivalent energy they are expected to put in while carrying out the agricultural job, suitable farm tools and machineries are planned to be designed besides developing technologies in the area of women friendly entrepreneurship in non-farm sector.

IT in Agriculture

Having observed the success of IT based information dissemination as in the case of e-choupal, this powerful tool of technology and information delivery is proposed to be used to empower the farming community of the state to be in a knowledge society for material and information exchange. The University proposes to develop needed soft-wares for accessing technology and market information as well as to link up the farmer groups with the university advisory body for disaster managing agricultural technology inputs. The University also proposes to develop e-village, smart village, at least one under each KVK. Soft-ware aided teaching and training are also envisioned.

Agri-centric employment and business

Average age of the farmers (50 years) in the state is increasingly becoming a threat to carry forward agriculture. Retaining the youth in this important avocation is the only alternative to ensure a sustainable and vibrant agriculture and unless commerce is introduced in every aspect of agricultural operation, alluring the youth is not going to be easy. It is a matter of irony that at a time when family members of the farm households are leaving agriculture for petty jobs in metro cities, corporate giants like Reliance, Haldirams are entering into the field of agriculture which indicates that there is money in this sector provided business touch is given. It is therefore, envisioned to develop business centric skill for the younger generation. Drawing a parallel to the business of, for example, selling a SIM card for a mobile handset by a youth, this SIM card in case of agricultural business could be the crop/animal/fish seed, a print out of DNA finger printing results, a disease diagnostic kit, a market intelligence report on agri-trade and the like. In this era of labour shortage in agriculture, manufacturing of farm implements suitable for the state and the region could be a handsome business. Production units for materials for green house/ net house, drip irrigation system etc. are viable business which many farmers in states like Andhra Pradesh have already taken up in large scale. The University proposes to impart such skills in the youths to promote agriculture centric business ventures. Accordingly, it is planned to reorient agri-business management course in the University to suit the requirements.

Periurban and Urban Agriculture

Producer-consumer sufferings in terms of market availability for the former and quality for the later has been a long standing issue to be addressed particularly for the state of Assam and North East. In order to gradually address these two issues the University plans to evolve models for periurban agriculture covering initially 2-3 major township areas so as to facilitate production of market driven agricultural commodities with a linkage chain starting from farm to fork. Growers' societies/ cooperatives for different crops and commodities are planned to be formulated and the entire work right from variety selection to production to storage and marketing is planned to be streamlined in a partnership mode involving the key players. The University plans to generate external funding resources to take on this area, which will include all crops and commodities so as to totally reduce the dependence of the targeted cities on outside food sources.

Similarly, research on urban agriculture in the form of roof top farming, lawn farming, aeroponics etc. is planned to be initiated to make available fresh and quality products to the urban households and consumers. Locality-wise complementary urban farming model is also planned together with cafeteria model.

Soil erosion and irrigation concern

Large scale river bank erosion has been a serious problem in the state. The river Brahmaputra alone has destroyed nearly 4000 km² during the last five decades at a rate of 80 km² per year and wiped out more than 2500 villages affecting nearly 5,00,000 people. Soil erosion from the hilly tracts is also a

perennial problem. Severe erosion has made the river beds shallow resulting in increased flood problem. As a novel approach to check erosion and support soil conservation, an integrated watershed development programme for bio-restoration of erosion prone areas both in plains and hilly areas would be taken up with support from the state and central governments. Large scale plantation of bamboo, banana as well as some other soil binding vegetation like vetiver grass would be prioritized in the agenda.

The state of Assam being mostly a valley surrounded by hilly states under a high rainfall zone, it very often experiences water surplus in the rainy season. On the other hand, during the lean rainfall period, soil moisture deficit brings about drought-like situation affecting crop growth and yield. The ample ground water reserve of the state is yet to be adequately harvested for the benefit of agriculture. An integrated approach would be taken up for utilization of surface water and ground water reserve. Moreover, during periods of excess water, drainage becomes a critical factor obstructing successful cropping. Hence the University is planning to design appropriate water management module. Irrigation through surface flow from areas like Gerukamukh by tapping the Brahmaputra at the source and diverting it through irrigation channels to agricultural fields has also been envisioned with external funding

Char area agriculture

The *char* areas created due to the land deposits by the mighty Brahmaputra are chronically flood

prone but fertile and hold very good prospects for certain crops. Char areas account for about 4.6 per cent of the total land area covering around 9.37 per cent of the total population of Assam. Earlier, this area was neglected for agricultural purposes. However, considering its expansion over the years followed by increased numbers of people inhabiting the surrounding areas, char areas are emerging as a viable site to target both traditional and diversified agriculture. The University, therefore, plans to scientifically explore these areas for agricultural purposes particularly for making the state self-sufficient with pulses and oilseeds production, high value fruits and vegetables as well as fodder crops. Medicinal plants like vetiver are also planned to be covered. The University's vision is to develop the needed technological package of such crops in char areas and also to mobilize funding support for semi-commercial to commercial agriculture of select crops in select areas.

Intellectual Property management

Advent of IP era has been considered as a highly viable support not only to protect the resources (in this case, the agricultural resources) of a country but also a means to leverage economic benefit from such resources as well as the processes through which values are added to these resources for the purpose of commercialization. The state of Assam which is known to be the store house of many hitherto unexplored crops, animal and fish genetic resources could reap maximum benefit from these resources provided they are identified and genetically characterized. The University plans to inventorize and characterize the

bio-resources of the state and also to undertake sequencing of genomes of some of the bio-resources unique to the state and having proven record of agricultural vulnerability countering traits. A data base on the bio-resources with their associated quality traits is also planned to be generated for perspective planning as well as targeting candidate genes likely to provide disease resistance and other such biotic and abiotic stress addressing qualities. The untapped genes in the bio-resources are expected to eventually help the state in the upcoming gene trade that is likely to dominate agriculture sector in future. The University, for this purpose, also envisages to impart trade, patent and computer literacy to the human resources it has as well as to the resources it is going to produce.

Convergence Building

Considering likely resource scarcity to confront the sector, the University envisions to develop joint programmes with other partners including the line departments to showcase the strength of technology in increasing productivity, in addressing various stresses, in mobilizing external funding and collaboration so as to put the sector in driver's seat to attract investment ensuring equitable distribution of food and agriculture centric income to the food growers-producers while scaling up the competitiveness of the University in research, education and extension fronts

C. Extension of evolved technologies

The only solution to address the issues of food crisis, productivity,

profitability and permanency in agriculture is a technology led growth in the sector and for this to happen, an adequate mechanism to access the technologies by the masses has to be put in place. Based on the technology need visioning by 2050, the University foresees a newer breed of agriculturists who will prefer to use cutting edge technologies that will position them to be globally competitive. Having foreseen this, the University proposes to reorient and reshape not only the mindset of the technology delivery ambassadors but also the technology showcasing models and means with economic as well as consumer benefit attached to each technology. The technology need is expected to be led by the market drive and accordingly the University proposes to disseminate e-based market driven technologies developed on the basis of regional, national and global market analysis report informing tomorrow's producers as to what and how much to produce, where and how to store and when, how much and where to market dovetailing steps to be followed for quality adherence. KVKs are also proposed to be positioned as a single window information house on sourcing inputs (seed, fertilizer, semen, vaccine etc.), on farming methods, on resource conservation as well as choosing technologies from a technology basket. KVK scientists shall also be engaged in preparing soil health cards and suggesting soil amelioration techniques besides demonstrating at selected farmers' field the innovative farm techniques including climate resilient farming modules. District wise farmers' resource mapping for complementary support is envisioned. Extension division of the University is also planned to be geared up for technology

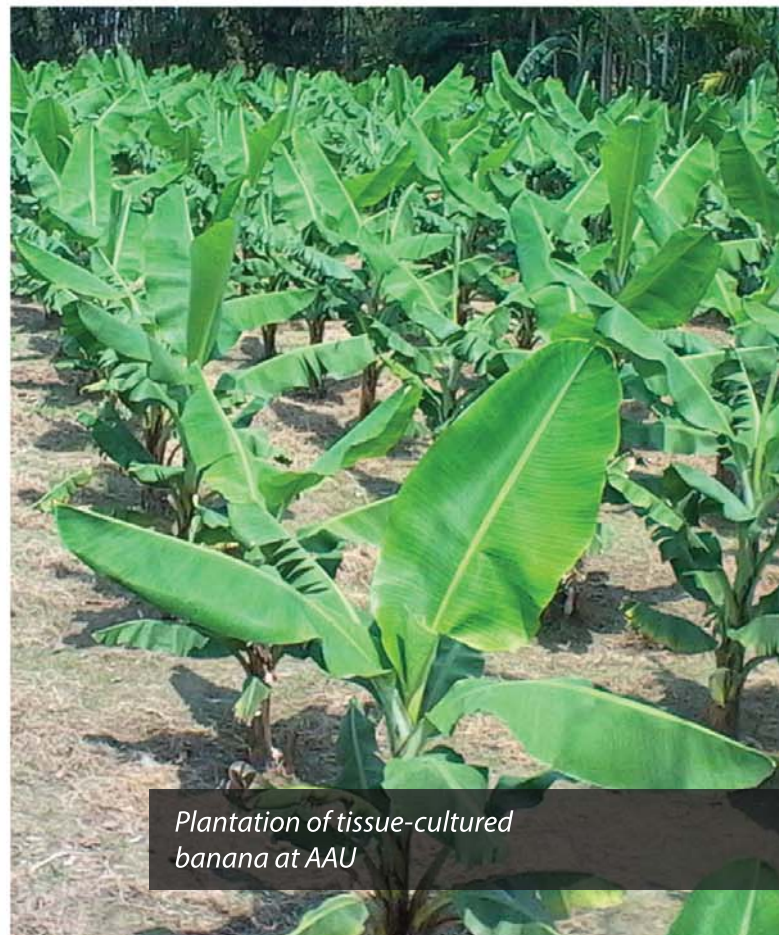
commercialization with private partners including corporate giants. Being aware of the requirement of highly skilled persons in foreseeable future to handle secondary agriculture (processing, value addition), specialty agriculture of the state (like joha rice, Assam lemon etc.) as well as the complimentary agriculture, the University plans to undertake massive capacity building programme for the youths and school drop-outs so as to position agriculture in a business mode for them to manage demand chain like input (seed, fertilizer, machinery etc.) and supply chain like processing, packaging and marketing.

Training of the trainers as well as the farmers on continuous basis is planned. Training shall cover, besides farm related techniques, information delivery system on central sector schemes, PPV&FRA, Intellectual Property Rights (IPR), biodiversity issues, bankable projects and Insurance schemes. Empowerment of farm women on farming and benefit sharing through gender specific training is planned.

The country presently appears to be suffering from a sort of technology fatigue – basically due to half-hearted approach to carry technology to the client groups and this has happened because of involvement of many actors not concerned with technology generation process. The University, therefore, plans to facilitate convergence building among various technology percolating agencies in order to develop appropriate location specific technology capsules by pooling resources from all such departments/agencies involved in technology dissemination.

The University further plans to engage the KVKs attached to it to develop SMART (Small, Measurable, Authentic, Rewarding and Time bound) farm models in each district head quarter with focus on the dominating crop/animal/fish of the district, specially for identifying the target crop/animal/fish of the district for access and commerce.

In this electronic era, the University envisages to use ICT mode in technology and information percolation to the user groups. This is planned to be done by way of establishing e-villages/e-choupals for ready access to technology, information and market trend. Weather and pests/diseases forecasting together with contingency plans are also planned to be made available to the farming community through mobile solutions.



Plantation of tissue-cultured banana at AAU

The newly constructed DBT-AAU Centre at Jorhat campus

