



Vision 2050



National Institute of Animal Nutrition and Physiology
Bangalore - 560 030
www.nianip.res.in



Vision 2050



National Institute of Animal Nutrition and Physiology
Bangalore - 560 030
www.nianip.res.in

Compilation:

Dr. Prakash Khandekar
Dr. J.P. Ravindra
Dr. Manpal Sridhar
Dr. K.S. Prasad
Dr. Raghavendra Bhatta
Dr. S.C. Roy
Dr. A. Dhali
Dr. C.G. David
Dr. Atul Kolte

All rights Reserved
2013, National Institute of Animal Nutrition and Physiology, Bangalore

Published by :
Dr. C.S. Prasad, Director, NIANP, Bangalore - 560 030

June 2013

Message

शरद पवार
SHARAD PAWAR



कृषि एवं खाद्य प्रसंस्करण उद्योग मंत्री
भारत सरकार
MINISTER OF AGRICULTURE &
FOOD PROCESSING INDUSTRIES
GOVERNMENT OF INDIA

Dated the 13th June, 2013

The scientific and technological inputs have been major drivers of growth and development in agriculture and allied sectors that have enabled us to achieve self reliant food security with a reasonable degree of resilience even in times of natural calamities, in recent years. In the present times, agricultural development is faced with several challenges relating to state of natural resources, climate change, fragmentation and diversion of agricultural land to non-agricultural uses, factor productivity, global trade and IPR regime. Some of these developments are taking place at much faster pace than ever before. In order to address these changes impacting agriculture and to remain globally competent, it is essential that our R&D institutions are able to foresee the challenges and formulate prioritised research programmes so that our agriculture is not constrained for want of technological interventions.

It is a pleasure to see that National Institute of Animal Nutrition and Physiology (NIANP), Bangalore, a constituent institution of the Indian Council of Agricultural Research (ICAR) has prepared Vision-2050 document. The document embodies a pragmatic assessment of the agricultural production and food demand scenario by the year 2050. Taking due cognizance of the rapidly evolving national and international agriculture, the institute, has drawn up its Strategic Framework, clearly identifying Goals and Approach.

I wish NIANP all success in realisation of the Vision-2050.



SHARAD PAWAR

Office : Room No. 120, Krishi Bhawan, New Delhi-110 001 Tel.: 23385370, 23782681 Fax : 23384129

Foreword



The Indian Council of Agricultural Research, since inception in the year 1929, is spearheading science and technology led development in agriculture in the country. This is being accomplished through agricultural research, higher education and frontline extension undertaken by a network of research institutes, agricultural universities and Krishi Vigyan Kendras. Besides developing and disseminating new technologies, ICAR has also been developing competent human resources to address the present and future requirements of agriculture in the country. Committed and dedicated efforts of ICAR have led to appreciable enhancement in productivity and production of different crops and commodities, which has enabled the country to raise food production at a faster rate than the growth in demand. This has enabled the country to become self-sufficient in food and emerge as a net food exporter. However, agriculture is now facing several challenges that are expected to become even more diverse and stiffer. Natural resources (both physical and biological) are deteriorating and getting depleted; risks associated with climate change are rising, new forms of biotic and abiotic stress are emerging, production is becoming more energy intensive, and biosafety concerns are growing. Intellectual property rights and trade regulations impacting technology acquisition and transfer, declining preference for farm work, shrinking farm size and changes in dietary preferences are formidable challenges.

These challenges call for a paradigm shift in our research approach to harness the potential of modern science, innovations in technology generation and delivery, and enabling policy and investment support. Some of the critical areas as genomics, molecular breeding, diagnostics and vaccines, nanotechnology, secondary agriculture, farm mechanization, energy efficiency, agri-incubators and technology dissemination need to be given priority. Multi-disciplinary and multi-

institutional research will be of paramount importance, given the fact that technology generation is increasingly getting knowledge and capital intensive.

It is an opportune time that the formulation of 'Vision-2050' by ICAR institutions coincides with the launch of the national 12th Five Year Plan. In this Plan period, the ICAR has proposed to take several new initiatives in research, education and frontline extension. These include creation of consortia research platforms in key areas, wherein besides the ICAR institutions, other science and development organizations would be participating; short term and focused research project through scheme of extramural grants; Agri-Innovation fund; Agri-incubation fund and Agri-tech Foresight Centres (ATFC) for research and technology generation. The innovative programme of the Council, 'Farmer FIRST' (Farmer's farm, Innovations, Resources, Science and Technology) will focus on enriching knowledge and integrating technologies in the farmer's conditions through enhanced farmer-scientist interface. The 'Student READY' (Rural Entrepreneurship and Awareness Development Yojana) and 'ARYA' (Attracting and Retaining Youth in Agriculture) are aimed to make agricultural education comprehensive for enhanced entrepreneurial skills of the agricultural graduates.

I am happy to note that the Vision-2050 document of National Institute of Animal Nutrition & Physiology, Bengaluru has been prepared, based on the assessment of present situation, trends in various factors and changes in operating environment around agriculture to visualize the agricultural scenario about 40 years hence and chalk out a demand-driven research agenda for science-led development of agriculture for food, nutrition, livelihood and environmental security, with a human touch.

I am sure that the 'Vision-2050' would be valuable in guiding our efforts in agricultural R&D to provide food and nutritional security to the billion plus population of the country for all times to come.

Dated the _ June, 2013
New Delhi



(S. Ayyappan)

Preface

Animal husbandry in India is an integral part of agriculture and contributes for about 30 per cent of agricultural output. The vast potential of livestock is yet to be fully exploited. In this regard, necessity was felt for expanding research activities in the disciplines of animal nutrition and Physiology and with reiteration of the Stripe Review committee and recommendation of the National Commission on Agriculture in 1976, the National Institute of Animal Nutrition and Physiology was established on 24th November 1995 in Bangalore under the Indian council of Agricultural Research, New Delhi to work in close cooperation and coordination with the existing centers in Animal Nutrition and Physiology Research at ICAR Institutes and Agricultural Universities. This institute would become the nerve centre of Animal Nutrition and Physiology research in the country.

The basic and fundamental research in the area of Animal Nutrition and Physiology carried out and contemplated, hold key for providing solutions to the existing and emerging problems in livestock production in the country. The Institute has developed several farmer friendly technologies, which have been adopted in the field and also have been commercialized. The research contributions have been well recognized by the Council and also at various scientific forums.

Challenges in terms of adequate feed and fodder supply, improving the efficiency of animal production and reproduction and thus improving farmers' economy were visualized in preparing Vision 2020 during 1997. The perspective changes required in our approach over a period of time were documented in the "Perspective Plan 2030". The vision 2030 was to enhance productivity in small holder systems with the approach to develop regional specific resource based feeding and management modules. The preparation of vision 2050 document has become necessary as the trends pertaining to livestock sector is expected to transform into an industrialized production system to meet the increased demands of the ever growing population or there could be more emphasis on integrated farming predominantly of small holders and this type of production would be incredibly important in terms of nutrition and providing jobs as well as low carbon foot print. These changes warrant formulation of long term goals.

I sincerely express my gratitude to Dr. S. Ayyappan, Secretary, DARE and DG, ICAR for his invaluable guidance in preparing Vision 2050 document. I also express my gratitude to Dr. K.M.L. Pathak, DDG (AS), ICAR for his encouragement and Dr. B.S. Prakash ADG (ANP) and Principal Scientists of Animal Science Division for their active support. I thank all the staff of NIANP for their active involvement in the preparation of this document.

I am confident that the 'Vision 2050' would be a valuable tool in addressing the problems of feed shortage, improving feed quality and thereby the product quality to meet the nutritional security of the ever increasing population.

C.S.Prasad
Director
NIANP, Bangalore

Contents

Message	i
Foreword	iii
Preface	v
1. Context	1
2. Challenges	5
3. Operating environment	8
4. Opportunities	12
5. Goals/Targets	13
6. Way Forward	20

Context

Animal husbandry in India contributes 3.37 per cent to national GDP. The share of agriculture to total GDP at current prices has declined from 28.3 in 1990-91 to 12.34% in 2011-12, while the share of livestock sector to agriculture has increased from 20 to 27.28 % during the same period reflecting its growing importance. Livestock and dairy development are significantly contributing towards providing employment opportunities, livelihood and socioeconomic security to small holding livestock farmers. By 2050, it is expected that the population in India would increase by 34% and to fulfill the dietary recommended levels of the livestock products by ICMR for a population of 1.7 billion people, the livestock sector should produce 186.2 million tons of milk, 18.7 million tons of meat and 306 billion eggs per annum. From the current level of production, the milk, meat and eggs have to increase by 1.5, 3.7 and 4.7 folds respectively. Fulfilling the feed demand for this huge livestock from same resource base of land and water is going to be a huge challenge. With the peri-urban dairies phasing out, small animal holding systems not being sustainable due to high input cost and non remunerative prices for animal products on one hand and increase in the demand for milk, meat and eggs, on the other hand, it is expected that animal husbandry sector will be transformed into an industrialized production system to meet the increased demands of the ever growing population or there could be more emphasis on integrated farming predominantly of small holders and this type of production would be incredibly important in terms of providing nutrition as well as low carbon foot print (World Dairy Summit, 2012).

In order to address these issues the research thrust needs to be reoriented in the disciplines of animal nutrition and physiology as it is the significant contributor for animal production and productivity. The changing scenario would warrant capacity building in prioritized areas like efficient use of resources and improving the biological efficiency of various productive processes for sustainable animal production.

The National Institute of Animal Nutrition and Physiology, established in 1995, is a premiere research hub under the Indian Council of Agricultural Research, New Delhi. The vision, mission and mandate of the institute are as follows:

Vision: Productivity enhancement for profitable and sustainable livestock production.

Mission: Improving production and reproduction efficiency in livestock through basic physiological and nutritional approaches.

Mandate: To conduct fundamental studies on basic physiological and nutritional problems related to bio-physical translation of nutrients for productive functions in livestock by:

- Unraveling basic physiological and nutrition principles and conducting research on fundamental aspects arising out of research in animal production in the country.
- Effectively utilizing the scientific man power at specialized level at one place and demonstrating how nutrition and physiology principles function in practice and thereby improve rural economy through better livestock feeding and management approaches.

In order to address the mandate, the institute is working in a matrix mode of management having three divisions, namely, Animal Nutrition, Animal Physiology and Bioenergetics and Environmental Sciences in addition to other supporting units to conduct basic and fundamental research in the area of Animal Nutrition and Physiology. Being a discipline oriented institute, it has a pivotal role in providing solutions to the various problems concerning livestock productivity and production by understanding the basic principles involved in the biophysical translation of nutrients and the physiological processes which are not being addressed by other species specialized institutes or the state agriculture universities.

The institute research priorities are sensitized by the emerging problems in livestock production and accordingly the research activities are formulated to address the problems like climate change and its impact on animal production, alleviation of enteric methane production, enriching the feed basket with alternate feed resources, enhancing the bioavailability of nutrients, improving reproductive efficiency especially in buffaloes, understanding the nutrient kinetics and biophysical translation of nutrients, molecular tools for detecting nutritional and reproductive deficiencies, and enabling lignin biodegradation using biotechnological approaches.



Database on methane production and mitigation strategies

The Institute has developed several technologies like area-specific mineral mixture, feed resource management, enhanced egg production in birds, improving the reproductive efficiency in livestock, adaptation strategies to climate change, approaches to reduce enteric methane emission, biotechnological approaches to deconstruct lignocellulosic biomass, value addition of agricultural byproducts etc. Some of these technologies are commercialized or adopted by end users. The research outputs have helped in adoption of better feeding and management strategies for improved productive and reproductive efficiency in livestock and poultry, efficient feed and fodder resource management, unraveling fundamental mechanisms of productive and reproductive processes to provide solutions for improved animal production.



Areca Sheath as an alternative dry fodder for livestock



The research contributions have been well received by various stakeholders and adoption of some of the technologies like area specific mineral mixture has resulted in improved reproductive efficiency by about 50-60%; strategic supplementation of protein and energy have resulted in improved milk production by 10-15%; hormonal modulation has resulted in increased egg production by 4-7% in poultry and also newer feeds have been identified for replacing the costly conventional protein supplements to reduce the feeding cost.

The earlier vision was to enhance productivity in small holder systems with the approach to develop cost effective technologies in the areas of feeding and management. The preparation of vision 2050 document has become necessary as the trends pertaining to livestock sector have considerably changed warranting formulation of long term goals. The turbulence observed in agriculture sector like



plateau in productivity, rising food prices accompanied with the impact of climate variability across different agro-climatic zones would have a cascading effect on livestock sector. Focus on enhancing crop productivity, with less emphasis on quality of crop residue that is used for animal feeding and an increase in demand for bio fuel production from energy feed stock would further aggravate the availability of quality feeds. Probably these factors may lead to a change in the livestock farming conditions where it is expected that animal husbandry sector would transform from an extensive/semi-intensive to organized intensive/ industrialized production system or to integrated farming approach to meet the increased demand for quality and value added livestock products. Further, in order to meet the challenges of climate change, natural resource degradation, globalization and IP regime, there is a need to reorient our research priorities to address this issues which has been reflected in this document.

Challenges

Being a discipline based institute looking at the general perspective for the demand for agricultural produce, the institute has to address the following challenges to provide sustainable food security through animal produce (milk, meat, egg etc.) to the exponentially growing population.

A. Animal Factor

- Low productivity and reproductive efficiency
- Poor nutrient utilization efficiency

B. Resource management

- Shortage of quality feed and fodder
- Conflict between food and feed security
- Imbalanced feeding
- Water quality and quantity for livestock
- Diversion of feed resources - biofuels, export
- Capacity balancing amount stake holders

C. Environment

- Natural resource degradation
- Impact of climate change

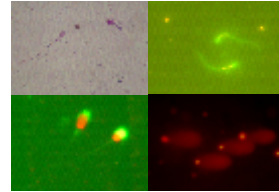
D. Market

- High cost of feed and fodder
- Changing global trade policies
- Meeting consumer preferences in animal products
- Feed and livestock product safety



Detoxified karanja and neem seed cake

Based on the mandate of the institute, to address the above challenges, the following programmes have been taken up with a focus on basic research.



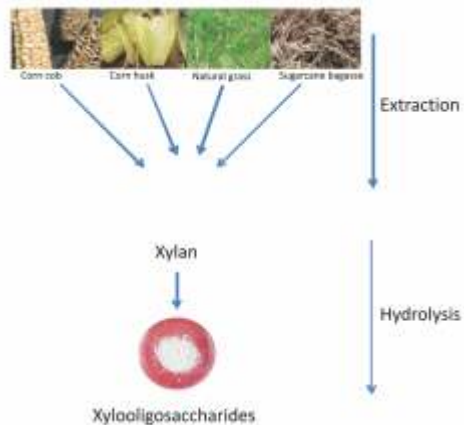
Semen evaluation tests for improved fertility



Solid state Fermentation and production of lignolytic enzymes from white rot fungi through Immobilization

- Deconstruction of lignocellulosic biomass for improving feed utilization (Flagship programme)
- Biogeography of gut microbes in animals (Flagship program)
- Novel approaches for assessing and improving nutrient bioavailability, and productive and reproductive efficiency in animals

- Feed Informatics, Feed quality & safety and value addition
- Climate change impact on livestock
- Technology translation to connect discovery with application



Human Resource needs

A shift in strategic approaches to meet the future challenges in animal production through nutritional and physiological inputs requires trained human resource to conduct research in relevant niche areas like metabolomics, bioinformatics, nanoscience, biosensor development, computational biology, biotic and abiotic stress management, etc.,

To achieve the envisioned challenges, a quality human resource is indispensable. NIANP has already developed human resource base that is well trained in advanced areas of nutrition and physiology. To meet the future challenges, the scientists need to be continuously abreast with changing technologies and have collaborations with counterparts in other countries. To achieve the vision 2050 goals in the perspective of total animal science, NIANP shall lead the trainers group to develop quality human resource in NARS through advanced trainings, interactions and collaborations across the institutions.

Operating environment

By 2050, it is expected that the population in India would increase by 40% and to fulfill the dietary recommended levels of the livestock products by ICMR for a population of 1.7 billion people, the livestock sector should produce 186.2 million tons of milk, 18.7 million tons of meat and 306 billion eggs per annum. From the current level of production, the milk, meat and eggs have to increase by 1.5, 3.7 and 4.7 folds respectively. Increasing consumer nutritional awareness, preferences and changing lifestyle warrant increased demand for quality value added milk, meat, egg and other animal products. Concomitantly, there will be demand for high quality feed and fodder to sustain high production and produce quality products. This could invariably mean high cost of production and producing more. In other words the target would be to produce 'more from little for more' (MLM)

The compounded annual growth rate for cattle, buffalo, sheep, and goat for the period 2003-2007 was 1.46, 1.47, 3.09 and 2.48 respectively. Recent estimates for the feed balance, i.e., feed availability vis a vis the requirements for the period 2009-10 have shown that resource wise the shortage of crop residues, greens and concentrates works out to be 32, 25 and 47% respectively. Assuming that the growths continue at the same rate, based on the projected crop production and livestock population data, the deficit by 2025 would be 21.3, 40.0 and 38.1 per cent respectively while the requirement would increase as against the availability (Table 1).

Table 1. Feed balance

Feed resource	Availability (MT)	Requirement (MT)
Dry Fodder	433	550
Green Fodder	600	1000
Concentrates	65	105

Ref: Gorti et.al., 2012 pub: NIANP.

2050 Scenario

Livestock and dairy development are significantly contributing towards providing employment opportunities, livelihood and socioeconomic security to small holding livestock farmers. With increased demand for quality animal products and reduction in the availability of resources, the scenario would change to mixed farming or integrated farming with crop- livestock- fish integration. The other scenario could be livestock centric farming where farmers would own large livestock holdings with intensive farming (fodder + livestock) with each farmer owning 100 to 200 animals and having his own milk processing and distribution network. By 2050 it is expected that livestock centric farming would be predominant and research focus of the institute has to be addressed for such situation. Multi-sectoral approaches for investment in water, soil, crop and livestock will have greater development impact and profitability than developing water and livestock independently in a specified area. In India animal numbers and densities along with their demand for water will increase following development of agricultural water resources limitation. The geographical area of our country may need to be re-classified in water-livestock investment domains (WLD) according to the different production system.

The scenario of livestock in 2050 would be to have crossbred cattle, buffaloes and indigenous cattle with a milk output of 6000, 3750 and 2200 kg per lactation, respectively. For this situation, the number of milch animals, total milk production and per capita milk availability is given in table 2 and 3.

Table 2. Number of animals, total milk production and capital availability

Category	Number (millions)	Milk Yield (Kg/lactation)	Number of milch animals (millions)	Milk production (Million tons)	Per capita milk availability (g/head/day)
Crossbred cattle	100	6000	35	210	519*
Indigenous cattle #	25	2200	8.7	19	
Buffaloes	70	3750	24.8	93	
Total	195	-		322	

* Assuming a human population of 1.7 billion in 2050. ICMR standard is 300 g/head/day. The additional milk yield could be used for value added products and exports.

Ratio of indigenous to crossbreds is 1:4

Table 3. Likely scenario of feed requirement (on dry matter basis) for livestock in 2050

Category	Feed requirement for milch animals* (m.t)			Feed requirement for non-milch animals (m.t)			Total Feed requirement (m.t)		
	Conc	Dry	Green	Conc	Dry	Green	Conc	Dry	Green
Crossbred cattle	97	46	63.9	11.9	95	107	108.9	141	170.9
Indigenous cattle	9.5	14.3	7.9	0	24.2	18	9.5	38.5	25.9
Buffaloes	53.1	40.7	41	8.3	66.4	74.7	61.4	107.1	115.7
Total	159.6	101	112.8	20.2	185.6	199.7	179.8	286.6	312.5
Total livestock							254.8	329.6	359.4
Availability of feed#							136.4	466.9	426.8
Feed surplus/deficit (%)							-46.5@	41.6	18.7

* Proportion of milch animals taken as 35 %

Assuming better crop productivity and higher harvest index

@ Concentrates' deficit can be bridged by utilizing surplus green and dry fodder and also, by complete utilization of unconventional feeds with suitable technology.

The major quantum of livestock products in 2050 would be coming from organized livestock industry and the small holder systems would be part of contract farming system with much of the anticipated production booked in forward contracts that will enable the farmers to gain sustainability and support from the contracting firm. The markets would be highly competitive in terms of the cost and product specifications and this will necessitate professional management of the livestock value chains linking the producers, processors, service providers and the consumers through forward and backward linkages along the value chain. Further, feeds would continue to be a major input across the value chains and feed markets and safety issues would be a significant component of the livestock sector influencing the market demand and sustainability of livestock sector. The R & D institutes, development agencies and the policy makers have to work hand in hand together to ensure that the small and marginal farmers benefit from the emerging domestic and international markets through technological interventions, market intelligence, capacity building and policy support.

The institute is mainly focusing on basic and fundamental research in Animal Nutrition and Physiology for proving comprehensive feeding and management packages for improving and sustaining production, across the species and hence there is less likelihood of overlapping with other institutions. The other animal sciences institutes are working on species specific problems and the universities would be addressing local issues. Some of their achievements include a) use of feed additives on nutrient utilization b) value addition of locally available feed resources c) embryo technology d) cloning etc.

Opportunities

The horizon of scientific research is fast expanding. To keep abreast of the fast and rapid changes in R & D in the developed world the scientists have to be trained in the current areas of research and be made skillful to carryout various modern techniques in genomic and proteomics using molecular and other related biotechnological tools. Recent advancement in scientific research warrants use of innovative techniques to understand the tissue level mechanism of nutrient use.

Harnessing the power of molecular techniques and Bioinformatics

Molecular techniques will be harnessed for understanding the biophysical transformation of the nutrients and manipulating the metabolic processes. With the advent of newer methods of analyzing genomes, metagenomes, transcriptomes and proteomes, it is possible to investigate the processes in greater detail. The data handling capabilities will be developed through augmenting the Bioinformatics facilities and developing human resource capability to use these powerful tools in understanding the metabolism and reproduction at genetic/molecular level. This will help in identifying newer targets for manipulation/modulation of the livestock systems for optimizing productivity, product quality and safety.

Understanding of genetic mechanisms and pathways have opened new vistas for bringing improvement in livestock productivity. These gene driven approaches would be helpful in functional genomics and would lead to newer ways for diverse utilization of livestock species. Advance biotechnological approaches like microarray, transgenesis, siRNA and bioinformatics tools have tremendous importance in understanding the complex mechanisms of poor reproductive efficiency in order to evolve safer and potent gene based strategies for enhancement of reproduction and production in livestock. Using meta-genomic approach it is now possible to understand the rich rumen biodiversity and look for specific microorganisms in terms of lignin break down or methane production or detoxification.

In addition to upgrading the available infrastructure and scientific manpower, research networks will be undertaken with other species related institutes of the ICAR to understand the various gaps in research and to address their problems with the new knowledge generated.

Goals/Targets

- Development of innovative approaches to economize the animal production process either through understanding the nutrient – gene interaction or by creating optimum biochemical environment in the animal systems or studying the environment gene interactions specially with reference to bio-climatic zoning.
- The research investigations aimed at decoding the entire digestive physiology through systems biology approach will unravel the mechanisms of anabolic pathways.
- The knowledge of biochemical mechanisms involved in the production processes at molecular level and understanding the gap between the genetic potential and actual biophysical translation of nutrients can be used to fully exploit the genetic potential.
- In the scenario of diverse animal populations, breeds and production levels, we have justifications for maintaining all the type of animals on socioeconomic and biodiversity grounds. Instead of framing strategies for selection of high producing animals based on genetic selection, the aim of our future investigations would be to develop research outputs that can generate technologies to fully exploit their genetic potential and in turn increase production.

The above interventions can lead to improvement in reproductive efficiency up to 85-90 per cent, milk production in indigenous and cross bred cattle by 25-30 per cent

Present animal science research is constrained due to non availability of full genomic and proteomic knowledge. The Institute is engaged in creating this knowledge to harness the power of transcriptomics, proteomics and RNAi technologies to its fullest potential.

The proposed target, goals & achievements and expected outputs by 2050 are as follows:

Target	Goal & Achievements	Output
<p>Enhancing production through optimized nutrient utilization</p>	<p>Improving bioavailability of nutrients and microbial protein synthesis by 15 - 25%.</p> <p>Metagenomic/ Biotechnological approaches for deconstruction of lignocelluloses for enhancing digestibility by 30 - 35% of fibrous biomass. Enhanced energy availability to the extent of 25 - 35% from low quality feeds.</p> <p>Nutrient gene interaction to improve growth and production.</p> <p>Nutrient partitioning for various physiological state in livestock.</p> <p>Micro nutrient delivery to target sites through nano approaches.</p> <p>Sustained release of micronutrients through implant capsules</p> <p>Nutrient recapture from animal wastes.</p> <p>Smart microbes genomics.</p> <p>Nutrient kinetic studies for feed lot buffaloes (challenge feeding, compensatory growth)</p>	<p>Enhancing production by 25 - 30%.</p> <p>Enhanced bioavailability of minerals by 90 -100%.</p> <p>Reducing cost of mineral supplements by 50 - 60% and instead of daily supplementation to have six monthly or yearly supplementation.</p> <p>Achieving faster growth and availability of quality animal protein.</p>
<p>Feed quality and safety for better animal productivity</p>	<p>Development of non invasive feed evaluation techniques and mineral safety standards</p> <p>Studies on xenobiotics and mycotoxicity and develop ameliorative measures</p> <p>Genetic manipulation of rumen microbes to detoxify anti nutritional factors from feeds.</p> <p>Biofortification for critical nutrients.</p> <p>Designer feeds</p>	<p>Increased quality and safe animal products for human consumption.</p> <p>Ensuring environment safety and reducing feed cost.</p>

<p>Feed informatics and feed resource management</p>	<p>Development of real time database on animal feed resources using newer tools .Instant feed mix for feeding during natural calamities. Touch screen based least cost feed formulation in every village.</p>	<p>Updated knowledge on feed availability in the country Farmer friendly IT on feed formulation and usage with 100% coverage.</p>
<p>Strategies to meet multifunctional demands of livestock resources and their sustainable management.</p>	<p>Sustained precision feeding Phase feeding for different production stages.</p> <p>Increased Biocatalysis, new and improved micro - organisms and enzymes for cattle and other livestock.</p> <p>Mining plant derived feed additives for augmenting milk and meat production.</p> <p>Processing and incorporating potential and public health friendly agro - industrial by - products and wastes in manufacturing feed</p> <p>Residu feed intake (RFI), as marker for breeding animals.</p>	<p>Better Nutritional management of livestock and poultry for productivity.</p> <p>Availability of alternative unconventional feeds and fodders to enrich the feed basket</p> <p>Better feed conversion and utilization.</p>
<p>Engineering better animal products and production systems</p>	<p>Develop and improve technologies for value addition, shelf life enhancement and quality assurance of livestock and poultry products</p> <p>Pilot research models that link production, value - addition and marketing</p> <p>Policies for commercialization of technologies and food processing</p> <p>Biosensor for up or down regulating genes using pen - side kit.</p>	<p>Value added, safe and quality processed products.</p> <p>Established public - private partnership model in agri processing</p> <p>Established linkages with industry and farmers</p>

<p>Manipulation of green house gases emission from livestock and management of stress</p>	<p>Adaptation strategies for climate change through shelter management.</p> <p>Allele mining for abiotic stress and development of molecular markers like HSPs</p> <p>Coding for methanogenic archea and amelioration using vaccines, finding alternate pathways as H sink (propionate enhancers) and entrapping methane using nano adsorbents</p>	<p>Reduce livestock contribution to green house gases to almost zero</p> <p>Technologies and management practices for better stress tolerance in livestock and poultry. Reduction in the risk of fall in production and productivity by 75%</p>
<p>Improving water use efficiency in livestock under climate change</p>	<p>Basic research on water restraint related gene mining in livestock. Identifying regulatory mechanism for efficient use of water in different cellular system.</p>	<p>Enhancing water productivity for livestock to sustain under severe climatic stress</p>
<p>Advanced strategies for optimizing reproductive and productive performance in livestock and poultry</p>	<p>Advancing age at puberty in buffaloes from 24 - 36 months to 12 - 18 months.</p> <p>Reduce incidence of early embryonic mortality in buffaloes by > 60%</p> <p>Develop transcriptome/proteome based tests to identify sub-fertile bulls and improve fertility/quality of semen for AI/IVF and have conception rate of more than 80%</p> <p>Nutrient partitioning for growth and production - milk, meat and egg.</p> <p>Skewing sex ratio through feeding and management strategies</p> <p>Chip based diagnostics and monitoring kits /devices to detect heat, ovulation and pregnancy in dairy animals</p>	<p>Enhance reproductive efficiency in buffaloes from present of about 50% to 80%</p> <p>Growth of elite buffalo population and increased milk production</p> <p>Reduce the semen related causes of failure of conception by 80%</p> <p>10% increase in egg production in commercial layers and 60% in indigenous poultry</p>

	<p>Embryo transfer in place of natural breeding/AI. Production of desired sex/value added off springs</p> <p>Improve egg production, quality and production economy in birds through physiological and managerial interventions to achieve 360 eggs/annum and FCR of 1:1</p>	
<p>Translation of discovery to application, knowledge management, HRD and market linkages</p>	<p>Harnessing ICTs and extension approaches in the areas of animal nutrition and physiology. Development of portals for researchers, teachers and other stake holders. Establishment of technology park and entrepreneur liason centre.</p> <p>Use of webinars and webcasting for knowledge sharing and capacity building.</p> <p>Develop and pilot effective delivery systems and evolve institutional models to link research and development system with farmers and other stakeholders. Marketing through information and communication technology and e-extension.</p> <p>Developing professional management of the livestock value chain linking producer, processor, service provider and consumers through forward and backward linkages.</p>	<p>Empowering stake holders with better knowledge and technology and provide effective backward and forward linkages. Empowering farmers to have decision support and market intelligence Easy access to markets, better price for producers and availability of quality products to consumers at competitive price.</p>

By 2050 the focus would intensify on nutritional security coupled with health promoting foods of milk, meat and egg origin. Quality of animal products, their value addition as functional food would gain significance.

In this direction the research at NIANP would bring forth the following new products/principles/processes and knowledge:

- Precision feeding
- Phase feeding
- Residue feed intake (RFI), as marker for breeding animals
- Smart microbes
- Biofortified feeds (eg. QPM, Micronutrient enriched grains) – Designer feeds
- Biosensors for gene regulation
- Elucidation of heat and nutritional stresses on ovarian, luteal and endometrial function and maternal recognition of pregnancy (MRP) in livestock
- Nanotechnology for nutrient delivery
- Controlled reproductive process – age at puberty, estrus, ovulation, implanting value added, desired sex embryos.
- Interaction between nutrition, reproduction and environment.
- Feed resource management & nutrient recapturing from animal wastes (litter, feather meal, blood meal etc.,)
- Nutrient use efficiency and nutrient kinetics
- Identification of molecular marker for heat stress
- Development of synthetic microflora for enhancing feed efficiency

-
- Development of metagenome fingerprints to optimize feed formulation
 - Metabolic engineering of rumen digestion to develop bioactive compounds in animal products.

These would result in:

Growth: In terms of productivity

Farm income: Improve the farmers' socioeconomical status through better productivity and utilization of nutrients with quality input

Stability: Ensure sustainable productivity of agricultural produce through better feeding and management

Efficiency: Efficient utilization of feed resources and partitioning of nutrients to various productive functions.

Sustainability: In terms of productivity, supply, markets, environment and farm income

Equity: The end users of the technologies developed are livestock farmers and for up scaling and dissemination Agricultural universities, DAHDF, Milk federations, NGOs, KVK and industries will be involved and will have equal partnership.

Clean environment: Quality feeds, better bio-available nutrients, decreasing excretion thereby reducing environmental pollution.

Pollution abatement: Work on environmental pollutants and ameliorative strategies would reduce pollutants in feeds and also in animal products and environment

Vulnerability: Change in farming system

Way Forward

To meet the challenges of animal production under the projected scenario for 2050, the strategies would be:

Feed resource:

- Explore newer and alternate feed resource (Biofortified feeds)
- Develop feeding modules for different production stages (smart feeding)
- Nutrient recycling (soil-plant-animal)

Nutrient use efficiency

- Precision feeding and phase feeding
- Nutrient gene interactions for optimizing nutrient requirement
- Artificial feed / supplements using microbial fermentation

Targeted nutrient delivery

- Nanotechnology for nutrient delivery
- Nutrient partitioning for specific metabolic processes

Harnessing gut microbial diversity

- Deconstruction of ligno-cellulosic biomass through gut manipulation using metagenomic approach
- SSF technology for production of lingo-cellulosic enzymes
- Modulating the rumen metagenome for better nutrient utilization
- Synthetic gut microflora for optimizing metabolism (smart microbes)

Climate resilient livestock production

- Minimizing life cycle GHG emission from livestock
- Abating stress using nutri-physiogenomic approaches.

Water

Creation of water-livestock investment domain (WLD) and advanced research on Livestock- water restrain and assessment of water footprints of farm animal and animal products under changing environmental stress scenario.

Designer products

- **Mining plant derived feed additives for developing nutraceuticals**
- **Smart feed supplements**

Production of customized livestock

- **Targeted gene regulation for lower residual feed intake (RFI) and improved feed efficiency**
- **Increasing production intensity through genomic approaches**

Feeds safety

- **Developing biosensors for detecting contaminants in animal feed and products**
- **Synthetic feed detoxifiers/decontaminators**

Reproductive efficiency and productivity

- **In order to achieve genetically superior livestock with milk yields of 4000 kg and more per lactation and a calf a year, approaches like molecular biology, functional genomics, biotechnology, nutrition-reproduction interactions will be employed to meet the challenges.**

Growth kinetics in feedlot buffaloes

- **Nutritional packages**
- **Compensatory growth**
- **Challenge feeding**

Cutting edge research themes to improve visibility:

- **Precision feeding and phase feeding to tackle problem of feed shortage**
- **Breeding animals for lower residual feed intake (RFI) for improved feed efficiency**
- **Increasing production intensity through genomic approaches**
- **Deconstruction of ligno-cellulosic biomass through gut manipulation for improved bioavailability of nutrients**
- **Mining plant derived feed additives for developing nutraceuticals**
- **Reducing green house gases and environmental pollutants from animal farming (using life cycle assessment methodology)**
- **Developing physiological and nutritional strategies for combating stress**
- **Developing biosensors for detecting contaminants in animal feed and products**
- **Nutrient gene interactions for various physiological functions**
- **Modulating the rumen metagenome for better nutrient utilization**
- **Identifying water efficient crop-livestock systems like hydroponics for fodder production to promote environmentally sustainable production.**
- **Epigenetics-modulating gene expression**
- **Gene silencing**
- **Nanoscience for nutrient delivery**
- **Molecular markers for nutritional and physiological status**

Markets

- Forward and backward linkages involving stake holders
- Feed market and safety issues
- Market intelligence and policy support

Although animal production has changed significantly by revolutionary breakthroughs in biotechnology around the world, benefits are reaching the developing country in only a few areas like conservation, animal improvement, disease diagnostics and the augmentation of feed resources. Understanding of genes influencing animal growth, efficiency of growth, environmental adaptation, meat, milk or egg composition or disease resistance and the application of molecular genetic technologies to animals agriculture should drastically bring about the exciting changes in animal production and the tailoring of animals to produce products needed by humans effectively and efficiently.

The National Institute of Animal Nutrition and Physiology is committed to work on basic and fundamental aspects of animal nutrition and physiology and to come out with information that would form the basis for enhancing animal productivity and production to meet the challenges of improving farmers economy, animal wealth and nutritional demands of the increasing human population. This is envisaged through the various approaches enlisted earlier.

The institute will be the nerve centre of activities to provide inputs to various stake holders in adopting physiological and nutritional approaches to augment animal production. This includes policy makers, scientists of species based research institutes, field officers, extension personnels, farmers and feed industry.

The above approaches are aimed at addressing the issues of an intensive dairy farming scenario or an integrated farming system approach where agriculture – livestock – fish – poultry or predominantly livestock – fodder would be the major scenarios.

References:

Modelling and Forecasting livestock and fish feed resources: Requirement and availability in India- RK Gorti et.al, 2012 pub:NIANP.

Basic Animal Husbandry statistics 2012, Ministry of department for Animal Husbandry and Fishery, Govt. of India

AHService13, Animal Husbandry and Fishery, Govt. of India

**DAHDF, dahd.nic.in/dahd/bahs-2012.aspx,
dahd.nic.in/dahd/default.aspx**

**NABCONS,
dahd.nic.in/dahd/writereaddata/division%20information.pdf**



हर कदम, हर उमर

किसानों का हमसफर

भारतीय कृषि अनुसंधान परिषद

AgriSearch with a human touch