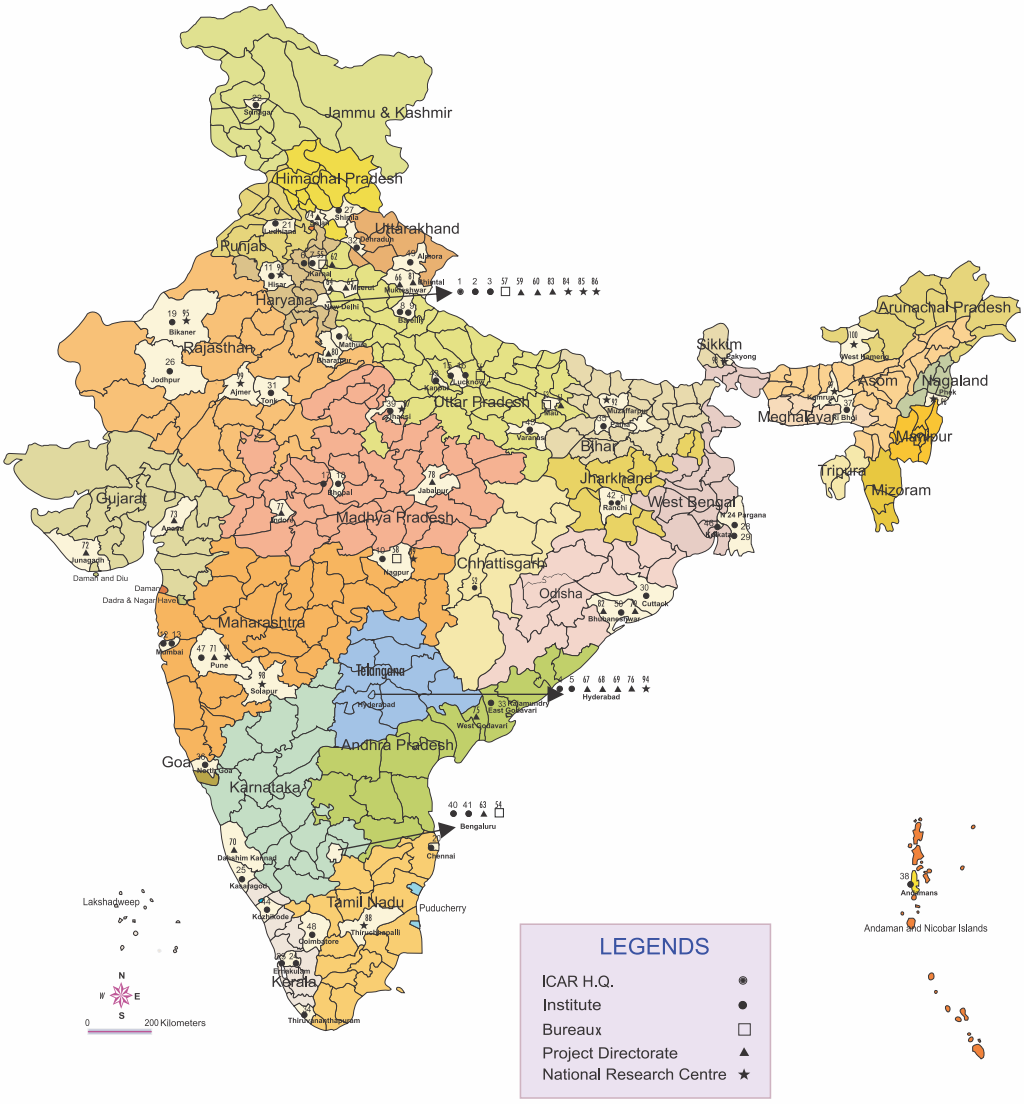
Vision 2050

National Institute of Biotic Stress Management

Indian Council of Agricultural Research

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Institutes, Bureaux, Directorates and National Research Centres



● 64 Research Institutes ● 6 Bureaux ● 15 National Research Centres ● 15 Project Directorates

Vision 2050

National Institute of Biotic Stress Management
(Indian Council of Agricultural Research)
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संदेश

भारतीय सभ्यता कृषि विकास की एक आधार रही है और आज भी हमारे देश में एक सुदृढ़ कृषि व्यवस्था मौजूद है जिसका राष्ट्रीय सकल घरेलू उत्पाद और रोजगार में प्रमुख योगदान है। ग्रामीण युवाओं का बड़े पैमाने पर, विशेष रूप से शहरी क्षेत्रों में प्रवास होने के बावजूद, देश की लगभग दो-तिहाई आबादी के लिए आजीविका के साधन के रूप में, प्रत्यक्ष या अप्रत्यक्ष, कृषि की भूमिका में कई बदलाव होने की उम्मीद नहीं की जाती है। अतः खाद्य, पोषण, पर्यावरण आजीविका सुरक्षा के लिए तथा समावेशी विकास हासिल करने के लिए कृषि क्षेत्र में स्थायी विकास बहुत जरूरी है।

पिछले 50 वर्षों के दौरान हमारे कृषि अनुसंधान द्वारा सृजित की गई प्रौद्योगिकियों से भारतीय कृषि में बदलाव आया है। तथापि, भौतिक रूप से (मृदा, जल, जलवायु), बायोलोजिकल रूप से (जैव विविधता, हॉस्ट-परजीवि संबंध), अनुसंधान एवं शिक्षा में बदलाव के चलते तथा सूचना, ज्ञान और नीति एवं निवेश (जो कृषि उत्पादन को प्रभावित करने वाले कारक हैं) आज भी एक चुनौती बने हुए हैं। उत्पादन के परिवेश में बदलाव हमेशा ही होते आए हैं, परन्तु जिस गति से यह हो रहे हैं, वह एक चिंता का विषय है जो उपयुक्त प्रौद्योगिकी विकल्पों के आधार पर कृषि प्रणाली को और अधिक मजबूत करने की मांग करते हैं।

पिछली प्रवृत्तियों से सबक लेते हुए हम निश्चित रूप से भावी बेहतर कृषि परिदृश्य की कल्पना कर सकते हैं, जिसके लिए हमें विभिन्न तकनीकों और आकलनों के मॉडलों का उपयोग करना होगा तथा भविष्य के लिए एक ब्लूप्रिंट तैयार करना होगा। इसमें कोई संदेह नहीं है कि विज्ञान, प्रौद्योगिकी, सूचना, ज्ञान-जानकारी, सक्षम मानव संसाधन और निवेशों का बढ़ता प्रयोग भावी वृद्धि और विकास के प्रमुख निर्धारक होंगे।

इस संदर्भ में, भारतीय कृषि अनुसंधान परिषद के संस्थानों के लिए विजन-2050 की रूपरेखा तैयार की गई है। यह आशा की जाती है कि वर्तमान और उभरते परिदृश्य का बेहतर रूप से किया गया मूल्यांकन, मौजूदा नए अवसर और कृषि क्षेत्र की स्थायी वृद्धि और विकास के लिए आगामी दशकों हेतु प्रासंगिक अनुसंधान संबंधी मुद्दे तथा कार्यनीतिक फ्रेमवर्क काफी उपयोगी साबित होंगे।

(राधा मोहन सिंह)
केन्द्रीय कृषि मंत्री, भारत सरकार

Foreword

Indian Council of Agricultural Research, since inception in the year 1929, is spearheading national programmes on agricultural research, higher education and frontline extension through a network of Research Institutes, Agricultural Universities, All India Coordinated Research Projects and Krishi Vigyan Kendras to develop and demonstrate new technologies, as also to develop competent human resource for strengthening agriculture in all its dimensions, in the country. The science and technology-led development in agriculture has resulted in manifold enhancement in productivity and production of different crops and commodities to match the pace of growth in food demand.

Agricultural production environment, being a dynamic entity, has kept evolving continuously. The present phase of changes being encountered by the agricultural sector, such as reducing availability of quality water, nutrient deficiency in soils, climate change, farm energy availability, loss of biodiversity, emergence of new pest and diseases, fragmentation of farms, rural-urban migration, coupled with new IPRs and trade regulations, are some of the new challenges.

These changes impacting agriculture call for a paradigm shift in our research approach. We have to harness the potential of modern science, encourage innovations in technology generation, and provide for an enabling policy and investment support. Some of the critical areas as genomics, molecular breeding, diagnostics and vaccines, nanotechnology, secondary agriculture, farm mechanization, energy, 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. Our institutions of agricultural research and education must attain highest levels of excellence in development of technologies and competent human resource to effectively deal with the changing scenario.

Vision-2050 document of National Institute of Biotic Stress Management (NIBSM), Raipur has been prepared, based on a comprehensive assessment of past and present trends in factors that impact

agriculture, to visualise scenario 35 years hence, towards science-led sustainable development of agriculture.

We are hopeful that in the years ahead, Vision-2050 would prove to be valuable in guiding our efforts in agricultural R&D and also for the young scientists who would shoulder the responsibility to generate farm technologies in future for food, nutrition, livelihood and environmental security of the billion plus population of the country, for all times to come.

(S. AYYAPPAN)
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Preface

Biotic stress in agriculture encompasses pests and diseases of crops, inimical parasites and microbial infections in animals as well as zoonotic disease-based health problems in animals and humans in the rural setting. Agricultural farms that suffer from biotic stresses cause lag in farm-growth. The sickly animals and crops do result in poor health of the rural people who depend for their nutrition on the commodities of the village farms. Enhanced research in the areas of biotic stress biology in the next fifteen year period is expected to create harmonised management of biotic stresses in agriculture. Considering anthropogenic agro-ecologies as intrusion into natural ecosystems, the striving is to strike balance between judicious temporal exploitation of natural resources for profitable agricultural production. Striking balance between the ecological costs and profitable farm out-turn would decide the evolutionary sustenance of modern agriculture.

Biotic stresses in crops are estimated to cause loss of over 25-30% of the extant value of the commodity annually in the country. Compensation of crop species to biotic stresses has been its metabolic correction process to fight back herbivory and overgrazing. The soil nutrient status provides ideal chemical ecology for enabling crop compensation for severe pest onslaught. Similarly the crop-commodity loss is that quantity which cannot be made available in the quality type for human consumption in spite of efforts to produce them. Estimates of such loss of animal products and commodities are more staggering. Precious little study is available to develop research methods to factor in real-time loss due to biotic stresses in crops and animals. Evaluation of losses due to herbivory and parasitism on crops and animals, respectively in agricultural farms shall be prioritised. Under 'one-health plan', zoonotic diseases arising out of farm-ecologies with vertebrate pest infestation in farms and homesteads is one NIBSM priority for the 'wellness' factor of farm families along with their animals. ICAR has emphasised on integrated farming systems and NIBSM shall undertake risk assessment for biotic stresses in them in medium and long terms in the next thirty five years.

For the mission to focus on undertaking research in multi-dimensional issues of health management through inter-disciplinary national network are visualised in the pattern of ICAR-Consortium

research platform (CRP) mode. Institute proposes to align with research institutions for networked research in the area of (a) herbivory balance and compensation in crops to attain economic crop production, (b) nutrition and health management in crops and animals and (c) policy research on agricultural biosecurity/biosafety. The institute can provide professional manpower to sustain agricultural biosecurity of farms and their commodities for 'one health of human society would make Indian agriculture to face global challenge of biosecurity, biosafety and green agro-ecology. NIBSM shall grow into deemed university that offers degrees for Postgraduate, doctoral and post-doctoral programmes in biosecurity, biosecurity and agro-ecosystem health.

Recent developments in risk analysis of pesticide use in crop commodities for human and animal health has stirred consumers and policy protagonists alike on the possible hazards arising out of pesticide application in crops. Bad practices such as inefficient pesticide application, wastage of toxic pesticides in farms due to poorly performing appliances, damage to agro-ecologies (biological and edaphic) as well as risks of exposure directly on farm families and workers besides the pesticide residues in crop commodities need to be corrected.

I take this opportunity to acknowledge the guidance and mentorship from Dr S Ayyappan, Secretary, DARE & Director General, ICAR in preparation of this document. I thank my colleagues in Crop Science Division and in the institute for enabling the preparation of this significant document of the institute.

T.P. Rajendran

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Context

Freedom from biotic stresses for enhanced farm prosperity is the axiom on which the National Institute of Biotic Stress Management (NIBSM), Raipur (Chhattisgarh) has been founded during the 12th five year plan period on 7th October 2012. The axis of 'one health' for rural well-being and prosperity revolves around the concept of health of farms, viz., crops, animals and people. Indian agriculture suffers from biotic stresses in all farm sectors, such as crops, livestock, fisheries and others. Indian advocacy for integrated farming system to attain better factor productivity of our farms is significant for achieving higher growth rate. The significance of arising drag due to biotic stresses in terms of metabolic costs to crops and animals as well as mitigation costs to farmers is noteworthy. The result is that the negative impact due to biotic stresses on the farm sustainability in terms of long term profitability is severe. The background arising out of the Veerappa Moily Oversight Committee for educational support of Other backward castes (OBC) report (2006) recommending the establishment of three deemed-university-status-institutes under Indian Council of Agricultural Research to address abiotic stresses, biotic stresses and agricultural biotechnology in agriculture. The National Institute of Biotic Stress Management (NIBSM) was established in Raipur, Chhattisgarh on 7th October 2012 by Shri Sharad Pawar, Hon'ble Minister of Agriculture and Food Processing Industries. Situated in the heritage farm at Baronda where Dr RH Richharia, the world-renowned Rice Specialist of undivided Madhya Pradesh could collect and maintain the second largest rice germplasm from eastern Indian region, the National Institute of Biotic Stress Management (NIBSM) aspires to undertake research and academic programmes that would contribute to the national necessity of manpower in biosecurity and biosafety in agriculture.

The crop loss estimated due to pests (diseases, nematodes, mites, insects and vertebrates) is over 30% of the total value generated by agriculture in farms. The loss in value of commodities of animal sector including fisheries due to biotic stress is about 20%. Frequent episodes of pestilence dissuade farmers for venturesome agriculture. Subsistence farming that is the order of the day in dry-land agriculture is driven by loss of crop and animal commodities which are maintained with patient and careful planning by farmers. Major challenge for Indian

food security arises from the failure of dry land agriculture due to biotic stresses when abiotic stresses challenge consistently the agriculture in that agro-ecosystem. Indian technologies for dry land agriculture have been designed to provide resilience in productivity of crops and animals. The significance of long-term sustenance of high factor productivity in dry lands would be the determinant of robust agricultural GDP growth of those states where in spite of vagaries in dry-land conditions, sustained agriculture production by smartly containing biotic stresses has been attained.

The NIBSM is mandated to take up basic and strategic research in biotic stresses, develop human resources and provide policy support for the national network of research and development organisations in health management and agriculture. NIBSM, as deemed university, has been signified to redeem the strong influence of biotic stresses in the agricultural growth in the country in the context of human resource requirement to service the expected institutional framework once the country enacts the Agricultural Biosecurity and Biotechnology regulatory authority bills. NIBSM shall strive to unify the basic research in the area of factors that afflict health in the farm sector. Public hygiene originated as a speciality from this concept in the late 18th century (Drs Louis-Rene' Villerme (1782-1863) and Alexandre Parent-Duchatelet (1790-1835). 'Zoonoses' as coined by German Pathologist, Rudolf Virchow (1821-1902) shall have no dividing line between animal and human medicines for health.

Biotic Stress - Drag in Growth of Various Agriculture Sectors

The national aspiration of high farm productivity for farm prosperity and commercial profitability has to be met with through well-developed research and education system in the country. Rural health of people as a factor for national prosperity and 'well-being index' needs to be viewed along with the biological attributes of health of crops and animals in farms. Agricultural commodities support nutrition to animals and people enable the sustenance of health in them. Crop plants, being integrated into commercial agriculture from the wild, are designed to yield more quantity and quality of commodities. Providing suitable nutrients for better crop yields is the practice in agriculture. Aberration in nutrition supply in farms result in crops afflicted with biotic stresses. In the case of animals too, similar parasitic approach by pathogenic microbes make them susceptible to various diseases as well as by ecto-parasites and endo-parasites hurting animal well-being. Balanced nutrition in animals is known to sustain the best immune strength in animals. The drag due

to various ailments in the animal productivity of various commodities is to be viewed in this background.

Optimum Nutrition for Health Management in Agriculture

Assurance of appropriate nutrition at appropriate age is known to be the best assurance for upkeep of healthy body. This is true in all living organisms. Crops and animals that form the major living systems in agriculture are subjected to biotic stresses at various phenologies. The knowledge to sustain and manage health is based on the effective nutrition that one organism derives from its food. Being healthy is the life-process that encounter constant and continuous invasion by various organisms that cause biotic stresses. Good health leads to good progeny and good generation value that influence evaluation of organisms.

Challenges

Good Agricultural Practices and Sustaining Biotic Stress Suppression

The modern Agro-techniques that have revolutionised growth in agriculture rely on the cultivation of high yielding crop varieties and elite planting materials in optimised nutrient supply system through fertilisers, micronutrients and effective integration of pest management practices under the good agricultural practices (GAP). GAP based agro-techniques derived the packages of practices for farmers and state agriculture departments in the country from research data originated from state agricultural universities (SAUs) and crop research institutes of Indian Council of Agricultural Research – comprising as National Agricultural Research and Education System (NARES). Revision of such packages of practices in consonance with the altering weather conditions and crop situations and biotic stress-responses to growing conditions and phonological/metabolic adjustments is desirable.

The appropriately defined GAP can pedal factor-productivity of farms as well as commodity risk-proofing for consumers. Biotic stresses in both crops and animal husbandry, being significant factor that control both metabolism and productivity, would impact on farmers' profitability. Tactical difficulty in crop pest management under widely variable crop husbandry practices of farmers in a region is apparent. Ecological principles that govern food chains and food webs influenced the pest dynamics in crops every season. Geographic variability of weather-supported surge in biotic stresses as well as recent episodes of invasiveness of certain introduced pests on crops have challenged existing patterns in pest management.

The therapeutic approach for animal health management depended strongly on the skill of diagnosis of seasonally occurring biotic stress issues in livestock. Immunisation and nutrition support is wanting in rural setting where subsistence of livestock depends on the subsistence of farmers. Healthy animal stock needs skilled health support in villages and suitable knowledge that would offer scientific animal health management. Ectoparasitic, endoparasitic and zoonotic afflictions in animals that are under open pasturage system or in captive production are challenged with the absence of skilled veterinary public health assistance in villages.

Theory and Practice of Crop Health

Panic-based response of farmers to sudden pestilence in crop fields gives knee-jerk action by the advisory system either during undue biotic stress-pressure or more often as post-episode scenario. During natural calamities, there would be sudden upsurge of various biotic stresses that jeopardise ongoing pest-management efforts. Multiple agencies providing conflicting recommendations of pesticides has been another issue that trigger pesticide marketing system through both traders offering input-credit as well as loans for farming. Over the last three decades, NARS institutions attempted to create expert system for pest management. However, the predictability of crop pestilence episodes has not absolutely won farmers' confidence in relying on such inputs alone for their intervention in crops. In spite of Kisan call centre or SMS advisory system from various public institutions for steering various operations in major crops, the accuracy of predictions in pestilence in crop-districts is not achieved. The inaction at the nick of time when the demand for collective action to mobilise the right advice to farmers as to what-to-do, how-to-do, what-not-to-do, why-not-to-do; tool box containing right tools such as appropriate chemistries, right applicators, right timing of application in terms of targeting vulnerable stage of the pest species etc. would relegate the farms and their hapless owners to be made vulnerable.

The non-approved and misbranded use of pesticides, non-effective and wasteful application and distress application of pesticides add financial burden to farmers in the quest to save crops from pests.
Ineptness in this highly skilful intervention in biotic stress management costs farmers badly on non-productive expenditure. The pesticide-sale/ distribution to farmers without appropriately qualified and accredited shopkeepers make the inefficiency in pest management in villages magnified in terms of increased cost burden to farmers.

The regulatory enforcement is inadequate to manage non-efficacy of counterfeit pesticide formulations to mitigate crop pestilence. In those villages that are not accessed by wheels, spurious, misbranded and false-claimed substances are marketed, causing substantial failure of biotic stress suppression, crop loss and burden the farmers' faith in GAP. Recent efforts of public institutions to build up of farmers' awareness on the use of quality-ensured agricultural inputs can alter the scenario that has the weakness of credit-linked input-supply chain in villages. Quality management of pesticides that are made available to farmers determine enormously the extent of success of crop protection in every season.

Seed Treatment with Pesticides as Insurance for Hundred Percent Plant-stand in Unit Area

In order to achieve higher efficiency of pesticides in early crop stage, seed treatment with potentially designed formulations of the prescribed insecticides/fungicides and biological products that protect the emerging plumule and radicle of crop seeds from any pest damage and ensure farmers of hundred percent plant stand per unit farm area. How far this could be achieved in practice is challenged by the fact that small-growers do not have enough wherewithal of gadgets that can quickly and accurately get their seeds treated to ensure lethal concentration of the given pesticides on the seed coats of various crop seeds in every season. Both internally/externally seed borne as well as rhizosphere pathogens and pests along with seedling-stage pests in crops need to be contained through this one-shot solution. Many recommended pesticides and their doses do not have suitable formulations marketed and made available to farmers to ensure the uniform lethal pesticide dosage per each seed of different seed coats and sizes. No recommendation for seed treatment describes the mode of treatment of high volume seeds in bulk quantity. Seed treatment with pesticides and bio-fertilisers in pulses and other crops is also an issue that have challenges in attaining the desired goals.

Inefficient Pesticide Application Due to Faulty Applicators

Crop protection efficiency is under challenge to farmers when they use available appliances to spray/dust pesticides in crops of various canopy sizes and densities in seasonal cropping systems. Farmers' quest to attain efficient and effective crop pest suppression is challenged by the inefficiency of the pesticide applicator that they have common access to in Indian markets. Sheer wastage of agrochemicals while operating the applicators with improper and poor ergonomic-support of pesticide applicators such as hand-operated knap-sack sprayers throws challenge to farmers in timely and efficient crop pest suppression in addition to suffering monetary loss due to their inefficiency. The wastage of toxic pesticides from motorised knap-sack sprayers throws challenge on the efficiency in terms of pest suppression-efficacy and economics of crop protection in addition to impact on human and environment health. Both in terms of financial loss and pest control inefficiency, the small-growers' predicament in achieving GAP-based suppression of herbivory in crops is daunting when relying on hand-operated knap-sack sprayers. The spin-off risk of exposure to pesticide chemistries to the farm workers including those from farmers' families is enormous due to the poor pesticide application techniques and required equipments/appliances

in small and medium farms. Even tractor operated sprayers or power sprayers do not give fool-proof protection from direct pesticide exposure to drivers and workers, leave alone the community of animals and people living around the cultivated areas during peak spraying periods of each crop season. Absence of servicing agencies of plant protection applicators catalyses the inefficient pesticide application in crops.

Good Agriculture Practice and Pesticide Residues in Commodities

GAP-based practice will expectedly reduce risk due to overwhelming load of pesticides and their metabolites on crops. Average daily intake of permissible maximum residue limits of pesticides and their metabolites and break-down products in Indian diet is to be considered while analysing the hazards emanating from their use. While hue and cry on detection of pesticides in oft-consumed commodities such as vegetables and food grains (including oilseeds) is there, real-time traceability of pesticide use pattern as well as risk assessment of pesticide-exposure to human and animal diet is absent. The whole issue remains in discussion with unscientific surmises and conclusion without facts. The fear-psychosis amongst literate consumers that all agricultural commodities are laced with poisonous substances that are potential threat to well-being of people is the largest issue of modern life. Anthropogenic threat of agriculture to human survivorship emanates from the fact that agriculture itself is an invasiveness to utilise natural habitats for food production.

Inadequacies in Animal Health Management in Rural Setting

Inadequacy in health management of farm animals has been a) in improper and timely diagnosis of emerging biotic stresses, b) regular monitoring of challenge to animal health due to zoonotic and parasitic invasion in animal populations and c) very inadequate assurance of nutrition to animals due to abject financial burden that farmers carry through their lives. Pasture-grazing based animal management does not often ensure nutrition support. Human and animal nutrition has direct bearing on health management. Food and feed with naturally endowed nutrition is challenged due to crop competition for area between crops that are cultivated under market-driven demand-supply system. The use of therapeutics in containing diseases is to evolve from prophylactics to judicious deployment of drugs including antibiotics. What is the best practice for hygiene and public health management in villages for animal and human communities has not been kept under any frame-work. The public health concepts need conceptual combination for crops, animals

and humans as holistic entity. Mitigating eruptions of biotic stresses in animal populations that are ill-managed due to mighty big reasons of capacity of villagers due to poor economics, financial priority, or even due to sheer ignorance is noticed.

Educational Programme in Agricultural Biosecurity and Commodity Biosafety

In the context of modern global trade policies and effective enabling of world trade order-based smooth global trade of Indian export of agricultural commodities the capacity of human resource institutions that are involved in trade set up has to be enhanced in the areas of agricultural biosecurity and biosafety. There is perceived manpower requirement towards establishing robust operational system in the areas of both agricultural biosecurity and commodity biosafety. The anticipated enactment of Agricultural biosecurity bill, 2011 would result in the establishment of National Agricultural Biosecurity Authority. The institute may design suitable curriculum in these important sectors to offer post-graduate degrees in various ICAR-approved plant protection disciplines with specialisation in agricultural biosecurity and agricultural biosafety. In the long term, the institute shall be the hub for scholastic excellence in understanding the basic definition of herbivory in crops by pests and pathogens. Pandemics become the order of the day and invasive species shall harness many vacant niches left behind by exiting pest species that may disappear in the changing weather patterns of the next three decades.

Operating Environment

The uncertainty and inefficiency in crop biotic stress management have to be assessed in order to perfectly assess the operating environments for research on biotic stress management in agriculture. Necessities of mitigative tool boxes for containing biotic stresses are to be considered. Mobilisation of tools in pest management tool box demands full knowledge and skill on managing the biotic stresses in its totality. Organising and galvanising the suitable inputs with purity of quality shall be the first step to reorient the current practices in villages to mitigate pestilence in crops. Biotic stresses in animals of both livestock and fishes need insight on the optimal husbandry conditions in which they are managed in villages.

Mode of Research

Research initiatives shall be in Consortium Research Platform (CRP) mode. The available organisation and method (O&M) reforms and sheer professionalism are expected to be the drivers for executing research programmes on biotic stress in these CRPs. The biotic stress impact of crops and animals due to temporal climatic factors could be assessed and catalogued in the country within short period. The plan funds of NIBSM are adequate for taking up immediate goals on research that are directed towards (1) development of research methodologies for loss assessment of biotic stresses (2) research on zoonotic disease management through rodent management in Chhattisgarh (3) phyto-parasitic nematode dynamics in major cropping systems in central India (4) nutrition and susceptibility to biotic stresses and (5) policy research for agricultural biosecurity and biosafety in farms (for seasonal farming and protected agriculture).

Idea Generation and Intellectual Property on Processes and Products

Biotic stress research has to switch over to seeking ideas from private and public institutions and people at large to smartly attain quick solutions to challenge various emerging and existing biotic stresses in agriculture.

Academic Excellence

The NIBSM would encourage research and education in the fields of agricultural biosecurity and agricultural biosafety. The scholastic brilliance

in the country in both public and private-owned institutions shall be utilised to bring in ideas that produce fruitful output bearing intellectual property. National pool of scientists of NARS shall be networked for taking up recalcitrant issues in biotic stress management. Hub & spoke model academic activities with NIBSM-academic programmes for research towards postgraduate/doctoral degrees and post-doctoral affiliations would stimulate talent pool of both NARS institutions and those NARS.

Educational Programmes

In the light of the ICAR decision to affiliate new institutes of 12th plan period, such as NIBSM with established ICAR-Deemed universities these educational programmes could be commenced within the available framework of policies and rules in this regard. By the end of 2030, NIBSM could aspire for deemed-to-be-university status and continue with its educational programmes in contextual areas and topics of the times.

Public-private Collaborations

The institute shall have memorandum of understanding with its registered collaborators from private research and development system. Need-oriented and identified agencies shall be chartered through skilled search for noticing the right combination of infrastructure and persons to take up research in identified areas. Synergy in execution of research for faster output of fully evaluated technologies for biotic stress suppression would be the outcome.

3.4 Webbing the Networks of Agricultural R & D

Ideas that are promising to attain fast results shall be pursued with commercial angle to develop products and protocols for biotic stress management by webbing the institutions/scientists/expertise/ consultative bodies as well as with laureates in different fields. Biotic stress management is made dynamic due to multiple problems.

Opportunities & Strengths

National Research Infrastructure

The NIBSM proposes to utilise the ICAR infrastructure for the purpose of nationally networked research areas. The ICAR initiative of Consortia Research Platforms (CRPs) shall be one another opportunity for multi-institutional research plans. Common goals of research interests between other government Departments such as Department of Science & Technology, Department of Biotechnology, Department of Earth Sciences etc. could be utilised for pursuing mission-programmes in System biology for systematic research on biological relationships, Database as strength to develop new data-banks, Computational mathematics and biology, biosensors and bio-regulators, microbes as tools for biotic stress monitoring and management, policy dynamics for natural resource optimisation, new and emerging systems for Indian agro-ecologies etc. The ICAR research set up, viz., national bureaus, research institutes and agricultural universities; research programmes of other public and private research institutions shall be looked for appropriate collaborations under specific documents for enabling inter-institutional arrangement.

Convergence of Research Expertise for Higher Output

The pool of scientists in the NARES as well as of that in other institutions under various government departments shall be pooled towards working on networked solutions in key biotic stress issues. The specialised knowledge created in agricultural biotic stress management shall be maintained as IP protected pool of the team. The research expertise shall create tool boxes in order to match the demands for solutions in the wake of changing agricultural farming scenario under the influence of weather aberrations, dynamic changes in natural resources and agro-ecology. The research expertise could be pooled and deployed to address alien species threats that are looming large through the movement of biological materials under trade and other routes.

Goals and Targets

The institute shall undertake basic and strategic research to provide tools to combat biotic stresses that occur in the current times as also for those that can arise in future so as to afflict farm profitability. In the perspective of natural resources for farming, increase in productivity by reducing avoidable loss in agricultural commodities due to biotic stresses to the extent of 30% of gross value is the goal of the institute. Sustainable livelihood from farming through risk-proofed integrated farming components for fitting agro-ecologies shall be the target. In order to achieve these aspirations, the institute shall (1) undertake basic and strategic research on the pre-emptive, causative as well as epidemiological aspects of biotic stresses in crops using available data-bases converging genomics/proteomics technologies, bio-informatics, biodiversity, bio-security assessment to enable plant protection development; (2) develop human resources, networking institutions and universities at national/international levels for academic excellence and establishing linkages with industry for technology management and (3) policy support research towards servicing the good agricultural practices (GAP).

Objectives

1. Interactive physiological and metabolic studies of biotic stresses in crops and animals under available nutrition regimes
2. Development of tools for loss assessment due to biotic stresses
3. Studies on present policies for good agricultural practices and provide appropriate policy stand for contextual growth of farming.
4. Provide scholastic leadership in contemporary areas and offer post-graduate degree in identified areas

Short Term Targets

1. Establishment of infrastructure, manpower and academic programmes in the four schools:
    - School I – Health management research for research on nutrition-based holistic health management
    - School II – Health biology research for research on biology of crops and animals, as influenced by biotic stresses
    - School III – Resistance system research for research on system

biology on crop plant-resistance/immune systems and pathogenesis biology
- School IV – Health policy-support research for research to develop contextual policy frame-work.

2. Manpower and infrastructure - master plan for the NIBSM campus township
3. Consultation on the road-map for biotic stress research
4. Curricula for Postgraduate programmes on agricultural biosecurity and agricultural biosafety

Medium-term Targets

1. Manpower mobilisation
2. Completion of campus development
3. Commence academic programme towards post-graduation and doctoral programme in the identified subjects.

Long-term Targets

1. Integrated research plan on biotic stresses in agriculture
2. Academic programmes in accordance with national manpower needs for futuristic areas such as agricultural biosecurity and agricultural biosafety

Way Forward

As the institute gets established, NIBSM shall be the centre for research and education along with policy perspectives in the area of agricultural biosecurity and agricultural biosafety. It is poignant that these would scale up in the current decade and beyond in this millennium due to overwhelming enhancement of international trade and commerce. The institute's design to bring about placement of human resource and capacity enhancement programmes for these front-line national requirements will be highly rewarding through national network research programmes and projects. Suitable joint research plans with National Institute of Abiotic Stress Management on basic and strategic research in system biology using frontiers of scientific advancement in the fields of computational and artificial intelligence. The following items shall be focussed in order to fortify academic and research vibrancy of NIBSM.

i. Establishing centres of excellence in core areas of basic research to attract scholastic research and training
ii. Synergistic networking of research institutions for garnering strengths of various research groups
iii. Innovations for out-of-the-box and smart research plans to attain higher resilience in farm output and profitability

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