



Vision 2050



Indian Institute of Natural Resins and Gums
Namkum, Ranchi-834010, India
<http://ilri.ernet.in>

Compilation and editing

R Ramani

Technical team

A Bhattacharya

AK Jaiswal

KK Sharma

N Prasad

Photographs

RP Srivastava

Production chief

A Bhattacharya

Technical support

Anjesh Kumar

D Ganguly

Printed July 2013

© IINRG, Ranchi

July 2013

Citation: Ramani R 2013. IINRG Vision 2050, Indian Institute of Natural Resins and Gums, Ranchi, India. 24 pp.

Published by Dr R Ramani, Director, Indian Institute of Natural Resins and Gums, Ranchi

e-mail : iinrg@ilri.ernet.in, iinrgmr@gmail.com

Printed at National Printers, Namkum, Ranchi

श्री शरद पवार
Shri Sharad Pawar



कृषि एवं खाद्य प्रसंस्करण उद्योग मंत्री
भारत सरकार
Minister of Agriculture &
Food Processing Industries
Government Of India



MESSAGE

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 prioritized research programmes so that our agriculture is not constrained for want of technological interventions.

It is a pleasure to see that Indian Institute of Natural Resins and Gums (IINRG), Ranchi, 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 IINRG all success in realization of the Vision 2050.


(SHARAD PAWAR)

Office : Room No. 120, Krishi Bhawan, New Delhi-110 001 Tel.: 22383370, 23782691 Fax : 23384129
Resi.: 6, Janpath, New Delhi-110 011 (India) Tel. : 011-23018870, 23018619 Fax: 011-23018609
E-mail : sharadpawar.sp@gmail.com

डॉ एस अय्यपन
सचिव एवं महानिदेशक
Dr S Ayyappan
Secretary & Director General



भारत सरकार
कृषि अनुसंधान और शिक्षा विभाग एवं
भारतीय कृषि अनुसंधान परिषद
कृषि मंत्रालय, कृषि भवन, नई दिल्ली 110 001
Government of India
Department of Agricultural Research & Education
and
Indian Council of Agricultural Research
Ministry of Agriculture, Krishi Bhawan
New Delhi 110 001
Tel.: 23382629, 23386711 : Fax: 91-11-23384773
E-mail: dg.icar@nic.in



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.

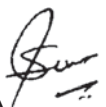
These challenges call for a paradigm shift in our research approach to

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 Indian Institute of Natural Resins and Gums, Ranchi 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 and nutritional security to the billion plus population of the country for all times to come.



S. Ayyappan

Deted the 12th June, 2013
New Delhi

PREFACE

Preparing Vision 2050 is a highly challenging task. It involves visualizing how the sector is likely and expected to evolve during the time frame set and a good understanding of the overall global scenario that would emerge in time to come, with particular reference to those factors which would influence the production and consumption of the NRGs. Envisioning the projected demand of the commodities addressed will be the obvious basis for developing the road map of vision document. The task is relatively easier with regard to food commodities which would be based on projections of population growth as well as changes in food preferences. Envisaging demand for natural resins and gums (NRGs) after about four decades is rather complex. Consumption of NRGs linked to quality of human life, as their strong areas of consumption are in food, cosmetics and pharmaceuticals. Tremendous changes could be envisaged in these sectors by the middle of this century, which is expected to positively impact on the demand for NRGs. Similarly development of novel areas of consumption will also push up the demand. Thus a multifold increase in demand is envisaged necessitating concomitant increase in NRG production.

At present the demand-supply gap appears rather wide indicative of adequate scope for boosting the production to desirable levels. The estimated production of NRGs in the country during 2012-13 had been around 8.4 lakh tonnes. It is hoped that demand would grow stronger due to increased interest on use of natural products. The world would move towards environment-friendly production technologies and safer raw materials that are renewable and can be produced on sustainable basis.

NRGs are inherently vulnerable to climatic conditions leading to fluctuations in supply and price, both of which are important for achieving a sustainable demand. All the R&D efforts will be to achieve higher and sustainable productivity with optimal inputs, ensuring high quality of NRGs and development of novel and specialty applications especially in low-volume high-value products; emergence of new frontier areas would trigger paradigm shift in application domains. Biotechnological tools would enable harnessing genes for

mass production of useful molecules in bio-factories. Such production systems would complement rather than replace the conventional production systems; drastic changes are nevertheless foreseen with introduction of highly organized plantations with advanced parameter monitoring, automated management systems for precision farming for sustainable production. Advanced information and communication systems would lead to management of production systems at national level, for demand-production matching, on annual basis.

The pace of technological strides has tremendously increased in recent decades and this trend would continue during the forthcoming decades as well. Besides, the institute could in future take in related new areas such as biopolymers, derived especially from agrowastes, ushering new domains of research. Thus, even a realistic portrayal of the roadmap and sector scenario by 2050 in the NRG sector is likely to read like a science fiction. This document may therefore be viewed as rather a conservative picturization of NRG sector by 2050 and R&D framework to a meet the requirements that would emerge.

Indian Institute of Natural Resins and gums
Namkum, Ranchi 834 010

R Ramani
Director

July 2013

Context

The Indian Institute of Natural Resins and Gums (IINRG) was founded on September 20, 1924 in Ranchi, as Indian Lac Research Institute during the colonial era of India. The Institute was established by the Indian Lac Association for Research, on the basis of the report of Lindsay-Harlow Committee, constituted for development of lac in the country. Subsequently it came under the control of Indian Lac Cess Committee before ICAR took over in 1966.

Ever since the establishment, the Institute had made tremendous contributions towards development of lac in the country. Recently, the lacuna for R&D of other natural resins and gums was realised due to lack of any dedicated institutional support. Responding to an ICAR initiative the Institute transformed itself by expanding its mandate to encompass all the natural resins and gums (NRGs), during the XI Plan.

In the era of value-chain and holistic approach in research, the Institute is already future ready, addressing the research and development needs of natural resins and gums, at various stages starting from production, to processing and application development through the institutional programmes and in network mode. The IINRG plays a definitive role in technology development, popularization and dissemination; human resource development in production, processing and utilization and providing inputs in policy-related issues of the sector. The institute thus provides the R&D backbone besides playing a catalytic role in health and development of the sector.

The NRGs could be considered as low volume – high value commodities. They are used in a broad spectrum of areas particularly in food, cosmetic and pharmaceutical industries. At present, the important NRG-producing countries in the world are: USA, China, Russia, Indonesia, Thailand, India for resins; India, Nigeria and Sudan for gums and Afghanistan, Iran, Spain, Ethiopia and Somalia for gum-resins. India is traditionally the largest producer of guar and karaya gums as well as lac. Besides these, a large number of other minor gums are also produced in India. One of the important facets of NRGs in the economic context is their role in livelihood of the farmers. Out of the 150 disadvantaged districts identified by the Planning Commission, NRGs are

important source of subsidiary income to farmers in around 70 disadvantaged districts. But, it is envisaged that the economic, educational and social picture of such farmers would undergo a vast improvement in the forthcoming years. Looking forward, the income pattern of various sections of Indian population would have undergone sea change by the middle of present century. Therefore, sustenance of interest in production systems of NRGs would necessitate proper tuning of production economics coupled with appropriate operation scales.



Tribal lady carrying harvested lac

Globalization of various activities would touch new heights during the next four decades, the period under consideration in this document, and this would make a tremendous impact on the research as well as functional components of R&D institutions; ICAR institutes will be no exception to this. ICAR would be looking beyond production and envision broader role for the holistic development of different agricultural commodities under its purview. These changes would obviously percolate to constituent units of the ICAR.

A paradigm shift would be needed in the priorities and functioning style of the institution, backed up by concomitant changes in the rules and regulations of the system, providing required powers and freedom to the constituent institutions. There should be special drive to reduce the time needed in decision making at various levels. The IINRG will have to think global and develop linkages with international bodies and industry to tune the R&D programmes as per the needs and industrial dynamics.

The relative contribution of different types of NRGs to the total production of the country is about 80 per cent gums, 19 per cent resins and a small fraction of gum-resins. The gums are basically water-soluble whereas the resins are soluble only in non-aqueous solvents. The variations in molecular size, structure and other functional groups, which confer unique properties to them, have to be advantageously harnessed for development of different applications of NRGs.

In the forthcoming decades greater emphasis will be laid on quality of human life with enhanced stress on human

and environmental safety of products and technologies. The production and application of natural resins and gums would receive more attention than in the past and it may be really challenging task to meet the demand potential, which is likely to emerge in future.

Challenges

The NRG sector is envisaged to pose challenges from several fronts. In the production front, the climate change would throw newer threats affecting productivity and sustainability. At the same time elevated temperatures could be expected to have positive impact on the production of plant exudates : resins as well as gums. Towards the middle of this century the agricultural production systems including NRG production would have to evolve as economically highly viable options, rather than livelihood agriculture. Thus economic returns have to be substantially increased through higher productivity and enhanced scale



Guar splits

of production systems. We have to work towards production technology transition with a negative relationship between the manpower involved, over the period. The production systems would have to be made highly efficient for resource utilisation and pest management need to be highly environment-friendly.



Lac crop on its host *kusum*

As a result of thrust towards greater harnessing of natural materials for achieving better quality of life and environment friendly approaches, the demand would become several-fold; ensuring adequate supply of desired quality at reasonable cost would have to be addressed. The availability of manpower would also diminish over the period under consideration and therefore novel techniques need to be developed to reduce labour requirement and higher yields. The processing sector will have to be geared for greater homogeneity and stringent quality criteria of finished products for industrial consumption.

Totally new application areas would emerge, which would require tinkering the molecules to achieve the desired characteristics for specific application. All the natural gums and resins are inherently heterogeneous; homogeneity requirement needs to be met through precise processing technologies. They also show exceptional versatility of their physico-chemical properties. In future, all the NRGs are likely to be modified before consumption to meet specific application requirements.

Operating environment

The institute addresses an important non-food commodity sector, which provides livelihood support to inhabitants in unfavourable and hilly regions especially in tribal areas. Therefore Natural Resins and Gums have an important place in Indian Agriculture.

Currently constraints of human labor, energy deficit and climate change are posing serious challenges to very sustenance of agriculture. Changes in the

operating environment and opportunities, diverse challenges and constraints such as growing population; revival of preferences towards natural foods and food additives; climate change; slow growth in farm income; new global trade regulations; rising energy bills; evolution of softwares and ICT and preferences for clean energy are some of the factors which demand a paradigm shift in formulating and visualising new research programs for competitive age technology.

Resins are largely used in surface coating formulations for several applications like wood varnishes, paints, lacquers, food and pharmaceuticals, adhesives, cosmetics etc. The gums and gum-resins are mostly used in food (as stabilisers, emulsifiers and flavouring agent), pharmaceuticals, cosmetics, textiles, chemical intermediates. In several application areas there are no substitutes for these natural products while in some cases synthetic alternatives are available. Exudate gum and resin collection is one of the major components of NTFPs (Non Timber Forest Produces), which contribute an estimated value of Rs. 4139 crores, providing 70% employment of the forestry sector. It also provide non destructive utilisation for trees. In view of the revival of interest in NRGs sector, more attention is needed in this sector because of immense social, environmental and industrial development possibilities, empowering the inhabitants to harness the forest trees for economic products under joint forest management would greatly help in providing income to the gum pickers/collectors. Reorientation of processing and product development with expanded mandate has now facilitated to cover primary processing/ value addition/quality control of all the natural gums and resins to strengthen this sector.

Processing and value addition of NRGs need to be boosted for enhanced returns and to carve new areas of consumption. Technological breakthroughs, especially in newer areas of science need to be reflected in the research



Karaya gum

programmes conceived in future to open up new frontiers in production, processing and application of NRGs. Playing a social relevance role for poverty alleviation and income generation would involve collaborative development and application by the public organisations in partnership with producers, private sector and other stakeholders. Application of non conventional sources of energy efficiently and strong primary processing near production sites and its value addition may be helpful in improving economics of processing.

In recent years, a renewed interest in deriving biologically active compounds from natural sources has been witnessed. This world-wide attention can be attributed to the low or no toxicity of the formulations based on natural products, their complete biodegradability, availability from renewable sources and, in most cases, their lower cost, compared to those obtained by total chemical synthesis.

New Opportunities

Production of gums through bioreactors would take a major leap contributing to a major chunk of total gum/resin production. Technological advancement would lead to use of genetically engineered organisms for production of NRGs.

Owing to this renewed attention to pharmaceuticals, agrochemicals and nutraceuticals (functional foods) obtained from natural sources like resins and gums, the study of bioactive secondary metabolites, traditionally carried out mainly by chemists, has increasingly received the attention of pharmacologists, biologists, botanists, agronomists, and others, stimulating collaborative research.

The following applications are suggestive of emerging areas to provide some insights rather than a comprehensive picture of new areas for NRGs in the forthcoming decades.



Tamarind gum powder

- Preparation of value added products from different natural resins and gums for food, surface coating, pharmaceutical and cosmetic industries and biomedical applications.
- Identification and process development for the isolation of potential phyto-chemicals from gums and resins for use in nutraceuticals, functional foods as an antioxidant.
- Natural gum based hot melt adhesive for packaging industries and also for baby diapers and sanitary napkins.
- New beverage innovations, such as wine coolers, novel confectionery coatings, high fibre drinks and powders are some examples of new product formulations using gums and resins.
- Nanodelivery systems based on natural gums for targeted release.

Goals/targets

The Institute address the commodity chain – from production to end products for the consumers. Therefore it has to respond to technological requirement for a whole range of areas including production, processing as well as application/product development. The R&D efforts have also to dynamically respond to meet various targets as a result of changed scenario outlined in the foregoing discussion.

With this backdrop, the Vision, Mission and Mandate of the Institute appropriately defined. These could undergo transformation subsequently, in view of enlarged role of this Institute envisaged in future, as discussed in another part of this document. The current Vision, Mission and Mandate of IINRG as follows:

Vision

Harnessing natural gums and resins for livelihood support to resource-constrained farmers and promoting a healthier world, interlacing ecological development.

Mission

Accomplishing the vision through R&D and technology diffusion for sustainable

lac production; processing, value-addition, quality management and application/ product development of natural resins and gums.

Mandate

To translate the vision into reality and accomplish the mission, the IINRG has set the following mandate to bring about the desired change in the national natural resin and gum sector.

- ❑ To conduct basic and applied research on lac production technologies
- ❑ To conduct basic and applied research on processing and value addition of natural resins (including lac), gums and gum- resins
- ❑ Information dissemination and technology transfer to farmers, processors and entrepreneurs
- ❑ To conduct research on harvest and post-harvest processing and value addition of natural resins, gums and gum resins in network mode
- ❑ Conservation of lac insect genetic resources of the country in network mode

Production of NRGs

Major shifts are envisaged in the relative contribution of various sources of NRGs at the national and global level due to change in demand pattern and production forces and economics.

Major thrust in production systems would be to move towards ideal input-output efficiency, reduced labour requirement and long-term sustainability. Therefore greater attention would have to be laid on improving the efficiency of natural resources including water and nutrients, which would become increasingly limiting in future. Consolidation of land holdings would become inevitable in distant future due to paucity of manpower availability for agriculture. Therefore, technology packages would have to



Babool gum

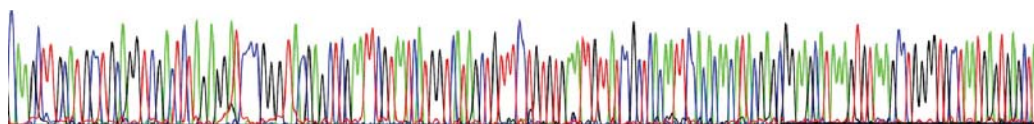
be tuned towards higher scale of operations with higher-level of mechanization of operations.

Deeper understanding of the mechanisms including the lac insect physiology, insect-host relationship, physiological aspects of plants producing exudate gums, factors influencing gum proportion of seed gums, broader understanding and diversity of gum-yielding microbes would be some of the key areas which would be addressed through modern tools and equipment. Greater emphasis would be placed in basic and strategic research and its application for NRG production. Lac insect genome would be completely sequenced and functional genomics would lead to mining of useful genes related to resin, pigment production as well as other molecules for bioprospecting. NRG yielding plants would be linked with carbon sequestration and would thus complement the sector.

It is envisaged that there would be increased shift towards multispecies tree systems for enhanced stability. Therefore, suitable mix of systems would have to be developed based on deeper understanding of the nutrition requirements and complementarity of component species in the long run. Partially and fully controlled production systems would have to be developed for precision farming. Greater understanding of genetic diversity with regard to chemical composition is necessary to harness the full genetic potential. This would be coupled with conservation approaches positioning the Institute as a centre to reckon for genetic resources of NRGs.

In view of the foregoing considerations the following key areas are envisaged, which would receive special attention as move towards 2050. This list does not encompass all the programmes but provides insights into the newer areas and shift in thrust areas in view of future scenario.

- Identification of economically viable sources of production of NRGs and development of technologies for their commercial production.



DNA electropherogram

Use of microbes and industrial production through use of appropriate biotechnological approaches would get a major boost contributing to sustainability in gum-resin production.

- Harnessing the genetic variability of the lac insects their hosts and trees/plants/organisms producing resins/gums from different agro-climatic regions of the country by using conventional and biotechnological tools.
- Converting climate change impact to advantage by suitably geared strategic approaches, for enhanced production.
- Development of lac productions systems under protected conditions for better management of parameters and pest management to ensure high and sustainable production. Such systems would move towards automation with computer-controlled monitoring and management.
- Conservation of genetic resources and biodiversity would receive greater emphasis.
- Complete genome sequence knowledge of organisms (lac insect, plant and microbes) producing NRGs and understanding the functional genomics for commercial gains.
- Gain deeper understanding of the lac insect- host interaction for manipulation of the host and insect related factors to achieve enhanced productivity.
- Mechanism and factors (plant physiological and climatic) influencing exudate gum/resin production for devising mechanised tapping methods.
- Development of exhaustive database of various sources gums/resins and develop means for harnessing them for specific applications.
- Documenting the environmental role of NRG trees and their development of national resource base gum/resin trees to meet the global demand, linking carbon sequestration and other beneficial functions. This would include resource mapping of important and potential NRG plants and development of national production strategy.

Processing equipment would have to be automated for least manpower requirement and enhanced quality of processed products. By-product utilization and effluent management would have to be fully addressed for minimal environmental pollution, especially in lac industry. Zero wastage should be the goal of processing industry for seed gums and lac.

Processing and Application Development

To maintain a healthy market environment matching of demand and supply is primary, which is challenging task that can be addressed only through concerted efforts of several agencies. R&D institution should gear its research programmes based on the current and emerging market scenario back-stopping technologies to facilitate demand-supply match.

The gum and resin molecules would have to be suitably modified for specialty application and food, pharmaceutical and cosmetic segments are visualised as strong grounds for NRGs. The application of NRGs has to be appropriately modified to meet the emerging requirements as the products in these areas are expected to undergo sea change in terms of content and delivery systems in future. Nanotechnology would become inevitable tool in development of newer materials and systems of NRGs.

The following programmes provide insight into future direction to achieve the goals considered above.

Resins and exudate gums production and post-harvest management



Dammar gum

- Development of tools, mechanization and optimization for collection/tapping of exudates gums, resinoids.
- Developing of good handling practices, primary processing techniques, packaging and storage protocols for better shelf life, economic and quality products.

Industrial processing, quality management, raw material engineering

- Processing technology modernization/modification including biotechnological approaches for improved efficiency and quality in lac processing with enhanced shelf life. By-product utilization to achieve zero wastage.
- Pilot plants for key processes/products/by products/derivatives of natural resins and gums.
- Development of process know how for industrial processing, quality management and packaging of exudates/seed gums or resins in network mode aiming at better yield and good quality.
- Application of sources of non-conventional energy (Solar Energy) in primary processing of resins and gums/their by-products.

Characterization and quality management

- Physico-chemical characterization of Natural resins and gums and their derivatives/by products.
- Characterization of lesser known resinoids and gums and application development with an aim to develop their application areas and serve as secondary source depending on their composition and suitability.
- Study of secondary source of resinoids (propolis from different bees) for their potential areas of application.
- To develop/refine national quality standards and testing protocols for important NRGs including minor gums. To provide testing support to buyers and sellers, up gradation of testing facility at the institute.

Raw material engineering

- Isolation/fractionation of potential components/constituents of NRGs for specialized applications (designer products as nutraceuticals, functional foods, pharmaceuticals, cosmetics, etc.)
- Derivatisation/modification of gums/resins for property enhancement.

- Synthesis of high value compounds/active ingredients, novel blends, nano delivery systems for specific applications.

Novel application and product development

- Preparation of value added products from different natural resins and gums for food, surface coating, pharmaceutical and cosmetic industries and biomedical applications.
- Natural gum based applications in specialty areas such as food packaging, diapers, sanitary napkins, etc.
- Use of NRGs in wine coolers, novel confectionery coatings, high fibre drinks and powders are some examples of novel product development areas.
- Use of advanced molecular modelling techniques for designing/tinkering of molecules to confer desired properties for specific applications.
- Application of nanotechnology for manipulating gum/resin molecules for application in niche areas such as domestic appliances, drugs, food processing, cosmetics, etc.

Technological revolution and change in life style would lead to emergence of completely new application areas where NRGs could be used.

Technology delivery system

There is need for achieving desired awareness among all stakeholders about the economic benefits of production to the growers/collectors, industrial potential of the materials to the processors and advantages of using NRGs to consumers. The policy makers at the State and Central levels need to be sensitised from time to time about the sector for required policy and developmental support.



Karaya gum tree

Multidimensional efforts are required to promote use of NRGs, which needs to be matched with production enhancement to ensure a healthy growth of industry. HRD is a paramount in these efforts encompassing different components of this sector. The energies of all the stakeholders in the value-chain of NRGs are to be synergised to realize the vision set in this document.

- Demonstration, validation and refinement of lac production and resin and gum tapping/ primary processing technologies with farmer participation.
- Information dissemination, advisory services and promotion of technologies to stakeholders through publications such as promotional literature; technical bulletins; project profiles; reference book series; production and exim statistics, etc.; participation in rural and industrial exhibitions, kisan melas; liaison, information and advisory services on NRGs to stakeholders.
- Enhanced coverage on NRGs in the curricula in appropriate courses; supporting education modules related to NRGs to educational systems at different levels (schools and colleges).
- Impact assessment; lac crop surveillance; organising industrial consultations, conferences, academic symposia, brainstorming, etc.
- Socio-economic study of farmers and markets related to lac and other resin and gum production. Compilation of information and data on NRGs of commercial importance, in network mode.



Indian Frankincense

Technology delivery system would undergo a sea change in the next half-century. IT would be instrumental in ushering new era of communications and information dissemination. Automated and networked monitoring system would enable remote management through expert advisory mechanisms.

The technology delivery systems would be complemented by expert

advisory support using IT tools. Remote monitoring of parameters would be developed providing advisory for timely interventions for production systems.

- Awareness and capacity building of farmers, industry (supply and consuming) and developmental machinery through structured and IT-complemented dissemination and delivery systems; web-based information and SMS services.
- IT-enabled real-time monitoring and advisory system in network mode, for providing solutions to production-related issues.
- On-line HRD programmes for the stakeholders.
- Monitoring of climatic parameters and other NRG-production related inputs, market information and timely intervention and advisory services.

India is already one of the leading NRG-producing countries in the world, the vision envisaged aims leveraging this advantage and convert the opportunities in terms of the resource base and also the wide spectrum of climatic conditions suitable for producing different types of NRGs. An R&D institution has limited sphere of activity and therefore cannot single-handedly achieve this goal; it would basically aim to take up a catalytical role. Concerted efforts of the stakeholders with planning and execution of a sound road map would help realize this goal.

Way Forward

The period addressed in this document spans about four decades and would witness paradigm shifts in different spheres including scientific thinking, technological back drop, life style, etc, touching every sphere of life, which will greatly determine the demand and application of various food and non-food commodities including NRGs.

The R&D efforts and technology diffusion would provide the desired impetus to position the country as a global leader in production of NRGs. In this process it would emerge as the Centre of Excellence for research on NRGs.

Adequate emphasis on basic research would be extremely important for carving out novel applications in specialised areas. Industrial linkage right

from conception stage would ensure better relevance and adoption of new technologies. In view of extremely specialized applications, linkages with overseas laboratories would be important for convergence of scientific expertise to develop new products, especially in frontier areas. The partnership between the Institute and others would emerge seamless with the involvement of other national and international labs as well as stakeholders – producers, industry and other related agencies including the line departments of State and Central govt.

It is envisaged that the Institute would have to emerge as an international centre for R&D of NRGs with scientists and laboratories across the borders as research partners; such networks would function in virtual and physical domains; the former would be through net-based systems for information sharing, whereas the latter will be establishing collaborative research efforts. This would enable relevant research driven by global needs and optimization R&D efforts, at global scale.

The R&D efforts should strategically aim at broad spectrum of consumption areas to buffer against erosion of any application. Continual development of newer products would ensure sustained demand for NRGs resulting in a sustained and healthy industry in the country.

A huge quantum of agricultural biomass is generated after recovery of food and other useful products. This agri-biowaste is a treasure-house of potentially useful products, the economic potential of which is yet to be optimally harnessed. They could also be a rich source a wide range of biopolymers with tremendous variations in the chemical structure and properties which would be recovered through appropriate processing and suitably modified for different applications.

Evolution of any institution would be driven by its core competency. In view of the manpower composition and infrastructural facilities, the IINRG holds potential to take up research on development of agricultural biopolymers for various applications. Biopolymers would emerge as a strong sector needing attention in forthcoming decades and it is envisaged that the institute might undergo one more mandate revision to take up R&D on all agri-derived biopolymers. Therefore it may be prudent to start preparing the Institution for such anticipated transition.