



Vision 2050



Central Tobacco Research Institute

Rajahmundry - 533 105

www.ctri.org.in



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शरद पवार
SHARAD PAWAR



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

It is a pleasure to see that Central Tobacco Research Institute (CTRI), Rajahmundry, 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 CTRI all success in realisation of the Vision-2050.

(SHARAD PAWAR)

डा. एस. अय्यप्पन
सचिव एवं महानिदेशक
Dr. S. AYYAPPAN
SECRETARY & DIRECTOR GENERAL



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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 Central Tobacco Research Institute, Rajahmundry has been prepared, based on the assessment of present situation, trends in various factors and changes to 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 time to come.

Dated the 20th June, 2013
New Delhi



(S. Ayyappan)

PREFACE

Tobacco is a low-volume and a high-value commercial crop, providing livelihood to millions of people. Tobacco cultivation, processing and manufacture are a source of employment to about 36 million people in the country. India occupies second place in tobacco production and exports. The crop is grown in an area of 0.45 M ha (0.27% of net cultivated area) and contributes about Rs. 24,000 crores to the national exchequer through foreign exchange and internal excise revenue. Indian tobacco is exported mainly to West Europe, South to South East Asia and Africa. The Central Tobacco Research Institute, Rajahmundry, established in the year 1947 has made impressive strides in tobacco research and benefitted the tobacco farming community as well other stake holders by developing a number of varieties for all the tobacco growing zones in the country. The institute has also developed and disseminated improved crop production and protection technologies that have led to steady improvement in productivity of all tobacco types in the country. Despite the importance of tobacco in terms of generation of revenue and employment to millions, the crop is facing several challenges concerning the environment and public health in recent times. India is a signatory to the WHO - Frame Work Convention on Tobacco Control (FCTC) and as per the convention it is required to take measures for reducing the supply and demand for tobacco.

The CTRI Vision 2050 document is brought out encompassing the Mission and Vision of the Institute and various targets to be achieved. CTRI is mandated to conduct research in the areas of crop improvement, production and protection related to all types of tobacco so as to pass on the benefit to the farmers. It also aims at developing tobacco as a source of varied end uses such as edible seed oil, high value phytochemicals, pharmaceuticals, proteins, enzymes etc. Identification of economically viable alternative cropping systems in various tobacco growing areas will also continue to be a priority for the benefit of the farmers in case of necessity. The document explains the national and international tobacco scenario, tobacco research

in India and its impact in enhancing the tobacco productivity and quality besides profitability. An attempt has been made to define various challenges faced in researchable and other issues along with plan of action to address these issues through innovative and novel scientific interventions. Various strategies for the sustainable enhancement in productivity for traditional and non-traditional uses have been presented in this document.

I wholeheartedly thank Dr. S. Ayyappan, Secretary, DARE & DG, ICAR for conceptualizing the Vision 2050 document for tobacco research and development in the country. I express my sincere thanks to Dr. S.K. Datta, DDG (CS) and Dr. N. Gopalakrishnan, ADG (CC) for their valuable guidance in preparation of the vision document. I am thankful to Dr. C.C.S. Rao, Nodal Officer and Dr. K. Sarala, Member, PME Cell, Dr. U. Sreedhar and Dr. D. Damodar Reddy, Heads of Divisions and all the Scientists of CTIR for their efforts and constructive suggestions in bringing out this publication. Secretarial assistance rendered by Sri C.V.K. Reddy, Sri Md. Elias and Smt. Ch. Lakshminarayani is acknowledged.

4th July, 2013
Rajahmundry.



(T.G.K. MURTHY)

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CONTEXT

Tobacco is a high value cash crop, providing livelihood security to millions of people in India. India occupies second place in tobacco production (750 m kg) and exports (260 m kg) after China (2300 m kg) and Brazil (270 m kg). The tobacco crop fetches more than ₹ 4,100 crores of foreign exchange besides generating about ₹ 17,415 crores of excise revenue to the exchequer annually. It provides livelihood to about 36 million people and about 6 million farmers and 20 million farm labour are engaged in tobacco farming in over 15 states in the country. Bidi rolling provides employment to 4.4 million people in addition to 2.2 million tribals who are involved in tendu leaf collection. Nearly 4 million people are engaged in tobacco trade and related activities. The main beneficiaries of tobacco production are the small and marginal farmers, rural women and tribal youth.

A unique feature of tobacco production in India is that different styles of Flue-cured Virginia (FCV) and non-FCV tobacco are cultivated under varying agro-ecological situations. FCV, *bidi*, *hookah*, chewing, cigar-wrapper, *cheroot*, burley, Oriental, HDBRG, *Lanka*, *Pikka*, *Natu* etc. are the different types of tobacco grown in the country, with FCV and Burley tobacco being the main exportable types.

Indian tobacco has an edge over the leading tobacco producing countries in terms of production cost, average farm price and the average export price. Hence, Indian tobacco is considered as 'value for money'. India is one of the leading exporters of tobacco, occupying second place after Brazil. The country accounts for about 6 % by volume and 0.7% by value of the world tobacco trade. In case of FCV tobacco, its share is about 4.6% and Burley tobacco exports account for 2.6%. The bulk of the exports (80-85%) continues to be FCV tobacco. UK, Germany, Belgium, Russia, South Korea and South Africa are the major importers of Indian FCV tobacco, accounting for more than 60% of our exports. Zimbabwe, Brazil, Turkey, China and Indonesia are the competitors to India in the export market. India's share in the world exports of cigarettes is less than 1% only. However, the exports of scented *Bidis* and non-smoking products like, *Hookah* tobacco paste, scented chewing tobacco and *Zarda* are noteworthy and there is a scope for augmenting the exports of these products in the near future.

Recognizing the importance of tobacco in the national economy, the Government of India had set up the Indian Central Tobacco Committee in 1945, which established the Central Tobacco Research Institute (CTRI) at Rajahmundry in 1947 to introduce scientific cultivation of tobacco in the country. Later, the Institute was

brought under the aegis of the Indian Council of Agricultural Research (ICAR) in the year 1965. CTRI has a network of six Regional Research Stations situated at Guntur, Kandukur, Jeelugumilli (Andhra Pradesh), Veda sandur (Tamil Nadu), Hunsur (Karnataka) and Dinhata (West Bengal) and a Burley Tobacco Research Centre at Kalavacharla (Andhra Pradesh). The Regional Stations are catering to the requirements of tobacco farmers in different agro-climatic zones by developing improved varieties and crop production technologies.

CTRI is the premier institute in India conducting fundamental and applied research on various aspects of tobacco cultivation and serving the tobacco farming community of the country.

Mandate

- * To conduct research on different types of tobacco, with greater emphasis on exportable types, on all phases of production management with a view of attaining economic advantage / benefit to the tobacco growers through improvement in quality and quantity of tobacco.
- * To collect tobacco germplasm from world over and to maintain and operate tobacco genetic resources which will be made available to scientists and national / international institutions.
- * To conduct research on economically viable and sustainable cropping systems alternative to tobacco.
- * To conduct research on diversified uses of tobacco and development of value-added products (phytochemicals).
- * To produce and distribute quality seed of tobacco varieties.
- * To publish and disseminate research findings and latest technologies for the benefit of the tobacco growers, scientific community, policy makers and development agencies.

Vision

Enhancing productivity and quality of Indian tobacco to make it more remunerative, globally competitive and promoting alternative uses to sustain the crop in the country. Identification, demonstration and popularization of alternative

crops/ cropping systems to tobacco in different zones in the country to facilitate release of more area for cultivation of food crops.

Mission

Developing economically viable and eco-friendly agro-technologies for enhancing productivity and quality, reducing harmful substances, developing value added products of tobacco for promoting exports and generating revenue and employment on a sustainable basis.

Since its establishment, the institute has made significant contributions by developing high yielding varieties/hybrids and crop production technologies. In the FCTC (Framework Convention on Tobacco Control) regime, there is a need to examine the priorities in tobacco research to comply with the government policies for ensuring remunerative prices to the farmers.

Research Achievements

The earlier Vision documents (2020, 2025 and 2030) focused on the development of varieties suitable for different agro-ecological situations and evolving viable crop production and protection technologies. Due emphasis was laid on conservation of natural resources and production of pesticide-free tobacco for increasing the exports. Also, thrust was given for developing alternative crops/ cropping systems to tobacco, improving fuel-use-efficiency in curing and improvising energy/labour saving devices. In view of the growing health consciousness, reducing harmful substances like Tobacco Specific Nitrosamines (TSNA), tar and Carbon monoxide (CO) in tobacco leaf and smoke was given priority. As tobacco is an excellent source of phytochemicals, research initiatives on alternative uses of tobacco were made.

Sustained research and developmental efforts in tune with the earlier vision documents resulted in evolving high yielding varieties and appropriate agro-technologies, which made a significant impact on tobacco production and exports. The productivity potential of tobacco increased to 3.0 t/ha for FCV and 4.0 t/ha for non-FCV with commensurate leaf quality so as to meet trade preferences. As a result of adoption of high yielding varieties and proven production and protection technologies, there has been quantum jump in average productivity levels in FCV (1,600 kg/ha) and non-FCV tobacco (2,000 kg/ha).

Promising tobacco cultivars



FCV variety - Kanchan



FCV variety - Siri



FCV variety - FCH 222



Chewing hybrid - Kamatchi



FCV cultivar - N 98



Low tar FCV cultivar - JS 117

Improvement in physical and chemical leaf quality attributes of the tobacco including lower levels of harmful constituents like TSNA, tar etc. has made the place of Indian tobacco secure in the international market as a 'quality filler'. Significant reduction in cost of production achieved through the adoption of high yielding varieties and improved crop management strategies have given a competitive edge to Indian tobacco in the international market.

The research efforts also contributed to improve the nutrient-use-efficiency through INM approach and water-use-efficiency through micro-irrigation systems and watershed management technologies. Refined fertilizer management practices developed and propagated by the institute including integrated nutrient management,

withdrawal of K application in black soils and reducing the P doses in Northern Black Soils (NBS), Northern Light Soils (NLS) and Karnataka Light Soils (KLS) have contributed to significant savings in foreign exchange. Adoption of recommended Integrated Pest Management (IPM) strategies for pest management and introduction of new chemical molecules with low active ingredient has considerably brought down the pesticide residue levels much below the Guidance Residue Levels, thus enhancing the acceptability and saleability of our tobacco in the international market.



Significant success has been achieved in energy conservation (40-50%) in flue-curing through barn modifications. Briquettes made of agri-byproducts have been advocated as alternative to coal/wood. Energy and labour saving devices like stubble remover, bale pressing machine, interculturator etc., were developed.

In the area of alternative uses of tobacco, genotypes rich in useful phytochemicals and seed oil have been developed. Further, technologies were developed for extraction of nicotine and solanesol (Patent No.211204) from tobacco and oil from seed.

Emphasis given in the earlier vision documents has resulted in identification of remunerative alternative crops/cropping systems to tobacco in different tobacco growing zones.



Alternative crops to tobacco



Annual Moringa



Potato

At present, the production and market dynamics in the tobacco industry are profoundly influenced by trade requirements, consumer preferences, statutory regulations and environmental and socio-economic considerations. There is a need to reorient R&D activities of CTRI to meet the ever-changing international requirements to ensure protection of consumer's health, protection of the environment, compliance with the government policies, safety of the workers and economic returns to the farmers. The FCTC has added a new dimension to the complex nature of the crop. It envisages non-price, price and tax measures to reduce the supply and demand for tobacco in the world. India being a signatory to the FCTC, it is imperative that the area under tobacco cultivation ought to be reduced. It is against this backdrop that the long-term vision document for tobacco research is prepared.

CHALLENGES

Tobacco being an important commercial crop with export potential, the challenges facing tobacco are many that demand short, medium and long-term vision for research so as to meet everchanging requirements in terms of quantity and quality. The major challenges include:

1. Increase in cost of production
2. Labour intensive nature of tobacco cultivation
3. Depletion of soil organic matter and emerging multinutrient deficiencies in tobacco growing soils
4. Low input use efficiency
5. Non availability of coal for tobacco curing and growing pressure on forest for wood fuel

6. Vagaries of weather / climate change
7. Low proportion of flavourful tobacco available for export
8. Sustainability of the crop as a source of new phytochemicals and bioengineered products
9. National and international policy issues

In spite of the growing public concern on its traditional uses, tobacco offers enormous scope for its exploitation for non-conventional uses. The success and survival of the tobacco enterprise in the country, *inter alia*, depends on the concerted and holistic research approaches that we adopt to convert the challenges into opportunities. Policy initiatives to restrict the horizontal tobacco growth while promoting the vertical expansion is going to be in the economic interest of Indian tobacco farmers as the prices of the tobacco are driven by demand-supply forces in the global market. Increasing the productivity and quality, reducing the area and cost of production and improving the profit margin to the farmers are the immediate concerns for researchers. Exploiting tobacco for production of valuable chemicals including pure nicotine, solanesol, edible oil etc. would be the long-term strategy. Also, identification and popularisation of economically viable alternative cropping systems is another challenge. The research approaches for addressing the above challenges are given below:

S. No.	Challenge	Approach(es)
1.	Increase in cost of production	<ul style="list-style-type: none"> ❑ Improving the leaf yield potential to 4.0 t/ha in FCV and 6.0 t/ha in non-FCV tobacco. ❑ Incorporating resistance to TMV, CMV, leaf curl, damping-off, black shank, brown spot, <i>Fusarium</i> wilt.
2.	Labour intensive nature of tobacco cultivation	Mechanization of tobacco production
3.	Depletion of soil organic matter and emerging multinutrient deficiencies in tobacco growing soils	Rational and integrated use of organic and inorganic inputs for soil fertility restoration. Eco-smart soil fertility management using customized and farm specific fertilizers and fertilisation
4.	Low input use efficiency	Improving the water and nutrient use efficiency through precision farming techniques

S. No.	Challenge	Approach(es)
5.	Non availability of coal for tobacco curing and growing pressure on forest for wood fuel	Up-scaling of alternative fuels and refinement of curing technology for curing tobacco
6.	Vagaries of weather/climate change	Climate resilient interventions for management of biotic and abiotic stresses
7.	Low proportion of flavourful tobacco available for export	Developing high yielding tobacco varieties with superior quality and flavour
8.	Sustainability of the crop as a source of new phytochemicals and bioengineered products	Developing genotypes for various end uses like seed oil, high value phytochemicals, pharmaceuticals, proteins, enzymes, biorational pesticides, industrial chemicals, paper and board making
9.	National and international policy issues	Identifying and popularizing suitable alternative cropping systems to tobacco crop with emphasis on non-FCV tobaccos for different tobacco growing regions

In long run the problems foreseen are strict regulatory mechanism on smoke constituents & residues of crop protection agents, trade/consumer preferences, shifting to sources of quality FCV tobacco at a competitive price and genetic restructuring of the crop to serve as a source of human-friendly products.

Resource base

Scientists of the Institute are well trained and competent for pursuing research with the objectives of enhancing productivity and quality of Indian tobacco so as to make it more remunerative, globally competitive and to promote alternative uses to sustain the crop in the country. The institute has well equipped laboratories with sophisticated equipment to meet the requirements of research programmes. There is a need to augment the facilities/infrastructure for research in the priority areas along with human resource development through training in frontier areas of research.

OPERATING ENVIRONMENT

India is endowed with favourable climate to produce FCV tobacco of different styles catering to the international market requirements. In view of the price competitiveness and positive features of Indian tobacco substantial growth in exports is foreseen. Also, there is an opportunity for export of Indian cigarette brands.

At present there is a perceptible change in smoking habits as people consuming *bidis* are slowly shifting towards cigarette smoking. Instead of direct consumption of raw form of tobacco, people are getting habituated to consume branded tobacco products. In view of the stringent measures on tobacco consumption in public places, consumption of smokeless tobacco products is increasing. Due to increased health consciousness, tobacco cessation products are also gaining importance.

At present there is less demand for the tobacco grown on black soils compared to that of light soils. Demand for tobacco grown in light soils of Karnataka is gaining momentum due to its preferable quality parameters. FCV tobacco cultivation in unsuitable areas is being discouraged due to low production and poor quality. In tune with FCTC emphasis is given for developing economically viable alternative crops/cropping systems to *bidi* and chewing tobacco. Economically viable and sustainable farming systems need to be developed in different agro-ecological regions as an alternative to tobacco. Tobacco is a source of several value added chemicals of medicinal and industrial applications providing greater scope for alternative uses of tobacco.

OPPORTUNITIES

Cultivated tobacco (*Nicotiana tabacum* L.) has a large genome size with approximately 4.5 billion base pairs (~ 15 times the size of the human genome). The Tobacco Genome Initiative (TGI) has generated over one million gene-space sequence reads (GSRs) from methylation-filtered tobacco genomic DNA libraries. The availability of GSRs along with sequenced chloroplast and mitochondrial genomes facilitates genome wide-analysis, large-scale functional genomics and discovery of candidate genes involved in metabolic and regulatory processes of tobacco using bioinformatic tools.

Tobacco is an ideal plant bioreactor for molecular farming because of its higher biomass production potential. Several recombinant proteins, pharmaceuticals, industrial enzymes and antibodies are being produced in transgenic tobacco plants for large scale production.

Current developments in Nanotechnology assisted nutrient/pesticide delivery systems will help to attain the precision in input application for enhanced efficiency. Host plant driven bio-degradation of pesticides would receive increased research attention so as to address the issue of pesticide residues in soil-plant-human continuum.

Information and Communication Technology (ICT) revolution has lead to the development of algorithms for prediction and exploitation of micro RNAs in tobacco for reducing the carcinogenic compound synthesis and development of varieties for alternative uses. Decision support systems for transfer of technology will be useful to the farmers for instantly obtaining situation specific information. Web based forecasting systems, expert systems for systematic dissemination of information on pests and diseases, weather parameters, soil characteristics and germplasm accessions on tobacco provide ready access to comprehensive and up-to-date information.

GOALS/TARGETS

In the next 40 years, the Vision envisages research in the following critical areas:

1. Developing high yielding tobacco varieties with superior quality, pest and disease resistance and high input-use-efficiency
2. Genetic resource management
3. Climate resilient interventions for management of biotic and abiotic stresses
4. Managing resource constraints for production efficiency and product quality
5. Developing green technologies for production, protection and processing
6. Farm mechanization to reduce cost of production
7. Exploiting tobacco as an oil seed crop and as a source of valuable phytochemicals and bio-engineered products
8. Promoting alternative cropping systems /farming systems to tobacco
9. Energy and time saving post-harvest technologies

The targets to be achieved through the proposed research in the above areas are:

- ❑ Vertical increase in productivity (4.0 tonnes/ha in FCV and 6.0 tonnes/ha in non-FCV) and reduction in harmful substances through conventional, hybrid and biotechnological means will result in enhanced exports and considerable reduction in tobacco area.



FCV tobacco
pipeline variety TBST-2



FCV tobacco
pipeline hybrid NLSH-1

- ❑ Germplasm management and evaluation for traits of non-conventional uses will offer the scope for exploitation of tobacco for different end uses
- ❑ Improvement in the input-use-efficiency and imparting tolerance/resistance to biotic and abiotic stresses will reduce the cost of cultivation, stabilize the productivity and improve farmers' income
- ❑ Mechanization of tobacco production including seedling production, transplantation, leaf stitching, field operations, barn technology, seed processing and delivery will reduce the labour cost and drudgery



Mechanical transplanter



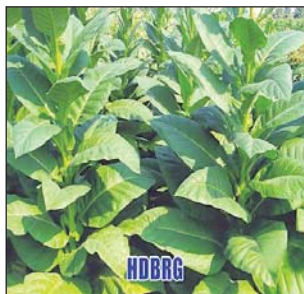
Tray seedlings

- ❑ Reduction of area and production of non-FCV tobaccos through identification and popularization of economically viable farming systems and alternative cropping systems
- ❑ Upscaling of alternative fuel materials in place of firewood and coal, further improvement of curing technology and use of solar energy for reducing the pressure on forest wood

- ❑ Validation and refinement of location specific IPM technologies for minimizing pesticide residues and improving exports
- ❑ Refinement of techniques for extraction and purification of phytochemicals from leaf and edible oil from seed for exploitation of tobacco crop for diversified end uses



Tobacco seed oil



High solanesol tobacco line

WAY FORWARD

The production and market dynamics in the tobacco industry are profoundly influenced by trade requirements, consumer preferences and statutory regulations besides environmental and socio-economic considerations. The situation underscores the importance of Good Agricultural Practices (GAP) in tobacco cultivation, encompassing seed integrity; soil and water conservation; fertilizer and agro-chemical usages; crop husbandry; pre- and post-harvest operations including energy and labour saving approaches; protective equipment to farmers; farmers training and afforestation. In this backdrop, developing economically viable and eco-friendly agro-technologies for enhancing productivity and quality, reducing harmful substances, developing value-added products are the key issues, requiring innovative scientific interventions, for promoting exports, generating revenue and employment on a sustainable basis. Research on exploitation of tobacco as a source of phytochemicals has attained prominence in view of economic potential and also due to health risk associated with tobacco consumption. Also as the economic lifeline of millions of people depending on the crop stands threatened in absence of equally viable and remunerative alternatives, it has become imperative to develop the crop as a source of varied end uses like edible seed oil, high value phytochemicals, pharmaceuticals, proteins, enzymes, biorational pesticides, industrial chemicals, paper and board making etc. In consonance with the policy of ICAR, due emphasis will be laid on secondary agriculture to diversify the utilization of tobacco in food and pharma

industries. Besides conducting research, CTIRI will play the role of a catalyst in tandem with the other stakeholders for effective transfer of technology to the farming community.

Theme-wise strategies to achieve the targets and address the challenges are given below.

Tobacco cultivar improvement

- ◆ Improving the leaf yield potential of tobacco to 4.0 t/ha in FCV and 6.0 t/ha in non-FCV tobacco.
- ◆ Incorporating resistance to TMV, CMV, leaf curl, damping-off, black shank, brown spot, *Fusarium* wilt etc.
- ◆ Genetic improvement for reducing TSNA and tar contents
- ◆ Identification and development of hybrids for higher yield combining quality, flavor, resistance etc.
- ◆ Incorporation of tolerance to abiotic stresses to address issues of climate change
- ◆ Germplasm characterization, documentation and utilisation
- ◆ Developing lines for higher phytochemical yield (solanesc, nicotine, seed oil) and tailoring tobacco plant as a source of bioengineered products

Integrated crop management and good agricultural practices

- ◆ Identifying alternative crops/cropping system/farming systems for tobacco
- ◆ Developing of agro-technology for sustainable tobacco production through healthy seedling production, micro irrigation system for improving water and nutrient-use-efficiency, integrated weed management, system based nutrient/moisture/tillage management practices and organic farming for quality and flavour improvement
- ◆ Improving energy conservation in curing through integrated barn technology and source for alternate fuels for curing
- ◆ Farm mechanization (Tobacco transplanter, leaf stitching machine) for reducing labour cost
- ◆ Post Harvest Product Management (Curing, bulking, grading and baling etc.)

Pest and disease management

- ◆ Bioecological and epidemiological studies of emerging pests and diseases
- ◆ Development/identification of promising botanicals/biopesticides/antagonists/insecticides for management of insect pests and diseases of tobacco
- ◆ Application of metagenomics for management of soil borne diseases
- ◆ Management of pesticide resistance and pesticide residues in tobacco
- ◆ Molecular approaches for diagnosis and management of viral diseases
- ◆ Development, validation and refinement of location specific IPM modules

Natural resource management for production efficiency and product quality

- ◆ Soil health management for tobacco production
- ◆ Rationalizing potassium supplies for minimizing losses and enhancing use-efficiency in light textured soils.
- ◆ Physiological response of tobacco genotypes to abiotic stress
- ◆ Development of flavour profiles of tobacco
- ◆ Characterization of soil biota and their use as bio-fertilisers and bio-pesticides.

Exploiting tobacco for phytochemicals

- ◆ Extraction, refinement and evaluation of tobacco seed oil for human consumption
- ◆ Documentation and exploitation of medicinal/industrial uses of tobacco

Technology dissemination and capacity building

- ◆ Ensuring delivery and adoption of situation specific technologies to farmers so as to bridge gap between potential and actual yields and leaf quality
- ◆ Establishing close linkages between all tobacco stakeholders through ICT

It is expected and wished that the innovative approaches and new concepts presented in the CTRI Vision 2050 document will provide a road-map and guidance for tobacco researchers. It is hoped that the document will be useful for addressing the existing and future challenges for growth, development and sustenance of the tobacco crop for the benefit of the mankind.



हर कदम, हर डगर

किसानों का हमसफर

भारतीय कृषि अनुसंधान परिषद

Agrisearch with a human touch