Vision 2050

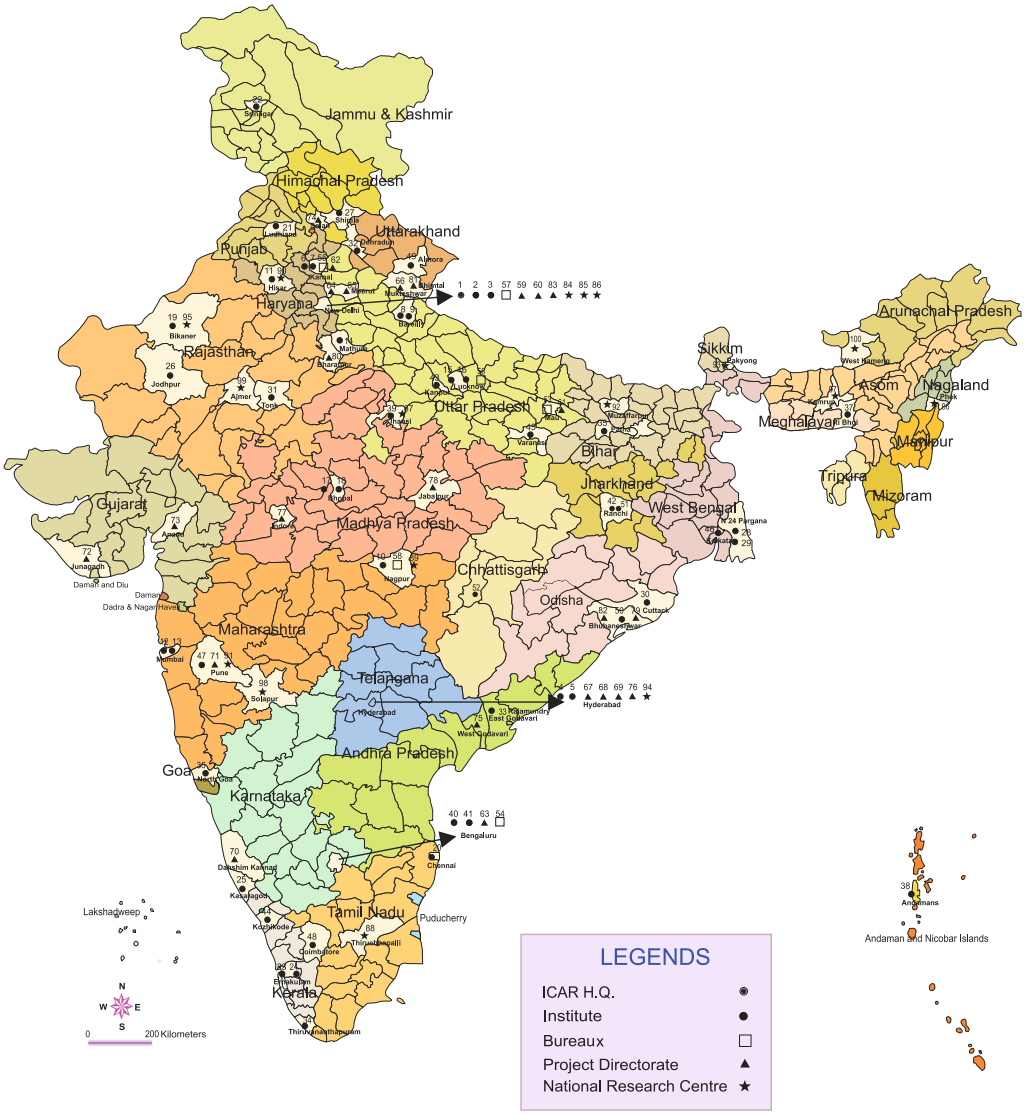


Central Tobacco Research Institute

Indian Council of Agricultural Research

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Institutes, Bureaux, Directorates and National Research Centres



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Vision 2050

Central Tobacco Research Institute
(Indian Council of Agricultural Research)
Rajahmundry - 533 105
www.ctri.org.in

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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। अत: 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-परजीवी 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 Central Tobacco Research Institute (CTRI), Rajahmundry 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)
Secretary, Department of Agricultural Research & Education (DARE)
and Director-General, Indian Council of Agricultural Research (ICAR)
Krishi Bhavan, Dr Rajendra Prasad Road,
New Delhi 110 001

Preface

Tobacco (Golden Leaf), the mandate crop of ICAR - Central Tobacco Research Institute (CTRI), is one of the important commercial crops in India. With the current annual production of about 750 x 10^6 kg cured leaf from an area of 0.45 m ha, India is the second largest tobacco producer in the world, next to China and stands also second in the export of tobacco and tobacco products after Brazil. Tobacco makes a significant contribution to national economy by way of export earnings of about 60 bn INR and excise levies of over 200 bn INR, besides providing employment and livelihood security to an estimated 36 million people engaged in its cultivation, curing, grading, manufacturing and marketing. Despite this huge socio-economic significance, the growing public perception of tobacco in India, as in rest of the world, is generally negative owing primarily to health risks associated with its consumption.

The ICAR-CTRI, established in 1947, is one of the oldest and premier research institutes functioning under the aegis of the Indian Council of Agricultural Research (ICAR), New Delhi and has an exclusive mandate of conducting basic, strategic and applied research on myriad aspects of different tobacco types grown in India. Since its inception, the CTRI has been making impressive contribution to the development of tobacco sector as a whole in the country. It immensely benefited the tobacco farming community by developing a number of improved/speciality varieties with premium leaf quality, and economically viable and eco-friendly agro-technologies for tobacco production efficiency and product quality.

Today tobacco sector is in the whirlpool of diametrically conflicting concerns relating to the livelihood security of those who are associated with tobacco production, processing and marketing on one hand and the serious health risks for those who consume it on the other. Another increasing concern about tobacco is deforestation resulting from the use of huge quantities of wood as source of energy for tobacco curing. Further, the emerging issues relating to climate change impacts, resource degradation, biotic and abiotic stresses, escalating production costs, pesticide residues, consumer preferences and regulatory policies are becoming increasingly complex and represent future challenges for

tobacco researchers. It is against this Backdrop that the Vision-2050 for ICAR-CTRI is prepared.

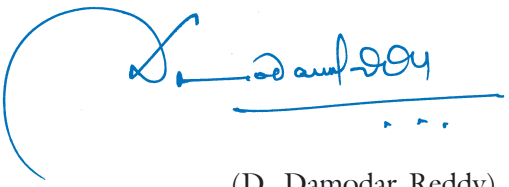
The Vision-2050 articulates perspective of CTRI which is built on the past experiences, present trends and future requirements. Now is the crucial time for the CTRI as it stands poised between the glorious past with proven track record of research service to the farming community, and the future that is fraught with uncertainties about its mandated crop. The main challenges facing tobacco researchers include: (1) producing tobacco with reduced levels of harmful constituents, (2) enhancing farm returns through innovative interventions for sustainable resource use and production efficiency, (3) exploring and effective use of alternative energy sources for tobacco curing to reduce dependency on forest fuel wood and (4) exploiting tobacco for diversified uses (phytochemicals and value added products). Addressing the whole array of tobacco related concerns, issues and challenges requires CTRI to evolve, enrich and expand a strategic research framework by exploring and exploiting new possibilities and opportunities. The CTRI, therefore, envisages a long-term vision in terms of ***providing vibrant research back-up for Indian tobacco to be less harmful, remunerative and globally competitive in the changing milieu of national and international policy regimes.*** The research framework of the Institute, which is built on innovative approaches and new opportunities, is anchored to ground realities and addresses real-time problems with focus on promoting formers' interests and minimizing consumers' health risks.

Besides socio-economic and environmental considerations, the government policy prescriptions, specifically in areas of agriculture, public health, commerce and environment are going to shape the future research agenda of the Institute. The future research framework for tobacco needs to be dynamic in nature so as to fit into all possible policy scenarios. The Vision document spells out a clear research road map of the institute for three likely policy scenarios viz., status quo, gradual phase out and complete withdrawal of tobacco. For a status quo policy scenario, development of tobacco with reduced levels of harmful substances, enhancing farm returns to farmers, environment-smart energy sources for curing and diversified uses of tobacco will become the research priorities. In case of gradual phase out of tobacco, the institute needs to put increased focus on tobacco for export, exploring alternative livelihood security options, rechristening the Institute and broadening its mandate by inclusion of other commercial crops. Rechristening the

Institute and recasting its mandate is a must in the event of a policy scenario forcing complete withdrawal of tobacco from cultivation.

It is hoped and wished that the innovative approaches and new concepts presented in the ICAR-CTRI Vision-2050 document will provide a road-map and guidance needed for addressing the emerging challenges facing researchers. Finally, I reaffirm with firm conviction the Institute's commitment and supreme dedication to provide a dynamic and vibrant research backup for Indian tobacco in the countenance of emerging challenges and in tune with government policies.

The inspirational leadership of Dr. S. Ayyappan, Hon'ble Director General, ICAR & Secretary, DARE and the critical intellectual inputs and support received from Dr. J.S. Sandhu DDG (CS), Dr. S.K. Datta, Former DDG (CS), Dr. N. Gopalakrishnan, Former ADG (CC) and Dr. P. K. Chakrabarty ADG (CC)-Acting, ICAR have served as catalyst in preparation of ICAR-CTRI Vision-2050 document and are placed on record with gratitude. The Vision document reflects and embodies collective wisdom of scientists at CTRI and takes into account the suggestions made by QRT and RAC. The efforts and contributions of PME Cell members and all Heads of Divisions / Research Stations towards preparation of this document are praiseworthy and as such acknowledged with thanks. The technical and secretarial assistance provided by Sri C.V.K. Reddy, Sri Md. Elias and Smt. Ch. Lakshminarayani is appreciated.



(D. Damodar Reddy)
Director
ICAR-Central Tobacco Research Institute,
Rajahmundry, Andhra Pradesh

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Context

Tobacco is one of the important high value cash crops in India generating excise revenue of about Rs.20,000 crores to the exchequer annually and fetches more than Rs.6,000 crores of foreign exchange besides providing livelihood security to ~36 millions of people. The main beneficiaries of tobacco production are the small and marginal farmers, landless agricultural labourers, rural women and tribal youth. The crop is grown in area of 0.45 million hectares in over 15 states in the country. Major tobacco growing states are AP (45%), Karnataka (26%), Gujarat (14%), UP (5%), Tamil Nadu (2%), Bihar (2%) and WB (1%). India occupies second place in world tobacco production (750 m kg) after China (2300 m kg).

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

Tobacco, occupying less than 0.3% of countries arable land, plays a vital role in the Indian economy. Indian tobacco with relatively lower production cost, average farm price and average export price enjoys an edge in the international market over the tobacco from other countries. India ranks second in the tobacco exports (260 m kg), after Brazil (270 m kg). The country accounts for about 6 % by volume and 0.7% by value of the world tobacco trade. Indian tobacco is exported to around 100 countries

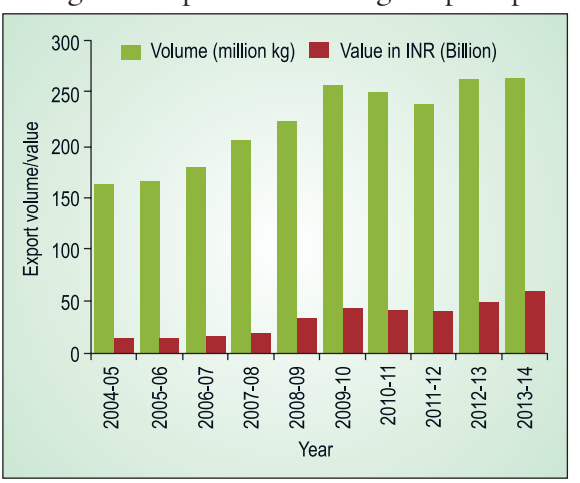


Fig.1 Indian Tobacco Exports-Trends

and tobacco exports showed continuous improvement over the last decade (Fig. 1). The bulk of the exports (>80%) continues to be FCV tobacco and the countries including UK, Germany, Belgium, Russia, South Korea and South Africa represent the major destinations for Indian tobacco (60%). The exports of scented *Bidis* and non-smoking products like, Hookah tobacco paste, scented chewing tobacco and *Zarda* are very substantial.

The Indian Central Tobacco Committee (ICTC), established in 1945 with its headquarters at Bombay (Mumbai) and later at Madras (Chennai). The main functions of the Committee were (1) to undertake and coordinate research on all aspects with the main idea of increasing the yield and improving the quality of various types of tobacco grown in the country (2) to undertake research on curing and re-drying, storing and other processes of tobacco before it is put to industrial use and (3) development of marketing, marketing intelligence, collection of statistics, etc. to improve the economic returns from tobacco. The ICTC 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.

The ICAR-CTRI is one of the premier research Institutes functioning under the Crop Sciences Division of the ICAR and mandated to conduct basic, strategic and applied research on different types of tobacco grown in India. It has a network of six Regional Research Stations situated at Guntur, Kandukur, Jeelugumilli (Andhra Pradesh), Vedasandur (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 their respective agro-climatic zones by developing improved varieties and crop production technologies.

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 that 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 released 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

Provide vibrant research back-up for Indian tobacco to be less harmful, remunerative and globally competitive in the changing milieu of national and international policy regimes.

Mission

Developing environmentally sustainable agro-technologies for production efficiency, product quality and diversified uses of tobacco.

Research Achievements

The ICAR-CTRI, in its earlier Vision documents (2020, 2025 and 2030) mainly focused on the development of high yielding varieties suitable for different agro-ecological situations and evolving viable crop production and protection technologies. Conservation of natural resources and production of pesticide-free tobacco was given due emphasis for increasing the exports. Also, thrust was given for identifying alternative crops/cropping systems that are next best 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, earlier vision documents focused on research initiatives for exploring tobacco for alternative uses.

Unrelenting research and developmental efforts made in tune with the earlier vision documents resulted in release of 94 varieties/ hybrids of different tobacco types for cultivation in various parts of the country. Developed and popularized soil, crop and input management technologies for improved production efficiency and product quality in

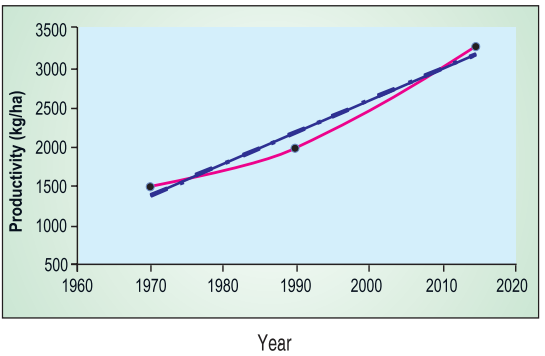


Fig. 2 Time line of the yield potential Improvement

major tobacco growing zones. The productivity potential of tobacco increased to 3.3 t/ha for FCV (Fig. 2) 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 a quantum jump in average productivity levels in FCV (1,600 kg/ha) and non-FCV tobacco (2,000 kg/ha).

Improvement in physical and chemical leaf quality attributes of the tobacco including lower levels of harmful constituents like tar and TSNA has made the place of Indian tobacco secure in the international



FCV VARIETY: SIRI



FCV VARIETY: KANCHAN



MOTIHARI VARIETY: DHARLA



CHEWING VARIETY: ABIRAMI

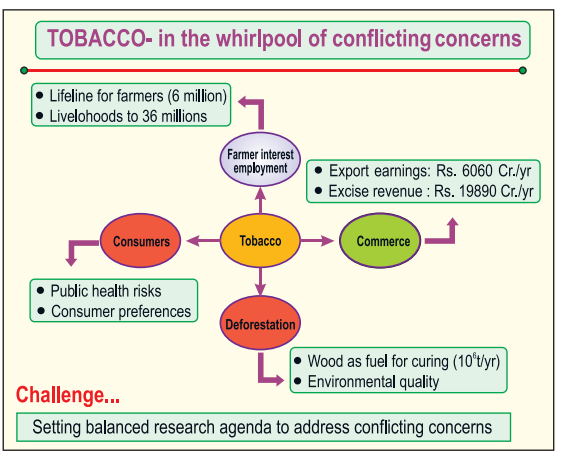
Popular tobacco varieties

market as a 'quality filler'. One high yielding FCV tobacco line, JS-117 yielding relatively low tar content was identified for release.

Refined site-specific fertilizer management practices developed and propagated by the institute include: integrated and balanced nutrient management, soil test based fertilizer prescriptions for different soil domains, nutrient supply strategies and nutrient supplementation through non-chemical sources to enhance nutrient use efficiency etc. The research efforts also contributed to improve the water-use-efficiency through irrigation by IW/CPE ratio, alternate furrow irrigation, micro-irrigation systems and watershed management technologies. 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. Energy conservation and fuel saving (40-50%) techniques were developed for tobacco curing to reduce dependency on forest fuel wood. Curing with agri-byproduct and its briquettes has been advocated as alternative fuel to coal/wood. Energy and labour saving devices like stubble remover and bale pressing machine were developed. Tobacco genotypes rich in useful phytochemicals and seed oil have been identified. 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 alternative crops/cropping systems next best to tobacco in different tobacco growing zones.

Emerging conflicting concerns on tobacco

Now is the crucial time for the ICAR-CTRI as it stands poised between the glorious past with proven track record of research service to the farming community, and the future that is fraught with uncertainties about its mandated crop. These uncertainties stem primarily from emergence of diametrically opposing



WHO-FCTC (2005)

The WHO-Framework Convention on Tobacco Control (WHO-FCTC) came into force on 27th February, 2005. With 180 parties including India, the FCTC is widely embraced treaty. The main objective of the convention is to protect present and future generations from the devastating health, social, environmental and economic consequences of tobacco consumption and exposure to tobacco smoke by providing a framework for tobacco control measures.

- Asserts the importance of demand reduction strategies as well as supply issues.
- Aims at eliminating all forms of illicit trade in tobacco products.
- Prohibits the sale of tobacco products to or by the minors.
- Provides for price, non-price and tax measures to reduce demand.
- Provides for supporting economically viable options alternative to tobacco.

concerns about the livelihood security of millions of those who produce tobacco on one hand and the serious health risks for those who consume it on the other. Another issue having far reaching environmental implications is the deforestation caused by consumption of large quantities of wood fuel in the flue-curing of tobacco. The WHO - Framework Convention on Tobacco Control (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, is under obligation to support the measures for reduction of supply and demand for tobacco. Addressing whirlpool of conflicting concerns about tobacco requires ICAR-CTRI to evolve, enrich and expand a strategic research framework commensurate with changing national and international tobacco-related policy regimes. It is against this backdrop that the long-term vision document "ICAR-CTRI VISION-2050" is prepared.

Challenges

The tobacco, being an important commercial but non-food crop, is facing many challenges that demand short, medium and long-term vision for research. Unlike other crops, the demand for tobacco is depends on changes in national and international tobacco policies and consumer preference. Hence, it is difficult to project the target for tobacco production.

Some of the major challenges faced by tobacco crop are low productivity, lack of flavourful tobacco for export, increased cost of production, labour shortage, depletion of soil fertility, low input use efficiency, non availability of coal and wood for tobacco curing, weather vagaries/ climate change, increasing biotic and abiotic stresses, residues of crop protection agents (CPAs) etc. Further, growing public health consciousness, increasing recognition of potential health risks alleged to be associated with tobacco consumption and changing national and international tobacco related policy regimes may all restrict tobacco production in future. 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 depends, *inter alia*, 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 challenges for researchers. Exploiting tobacco for production of phytochemicals having

Research Challenges

- Production of tobacco with reduced levels of harmful constituents.
- Enhancing farm returns through innovative interventions for sustainable resource use and production efficiency.
- Exploring and effective use of alternative energy sources for tobacco curing to reduce dependency on forest fuel wood.
- Exploiting tobacco for diversified uses (phytochemicals and value added products).

pharmaceutical and industrial value would be the long-term strategy. Also, identification and popularisation of economically viable and next best crop options is another challenge. The research approaches for addressing the challenges faced by tobacco are given below:

S. No.	Challenges	Research Approaches/ Thrust Areas
1.	Production of tobacco with reduced levels of harmful constituents.	• Developing varieties with low levels of TSNA, Tar and Nicotine • Reducing pesticide residues and HMs • Flavor / semi-flavorful flue cured tobacco • Organically grown tobacco in selected pockets
2.	Enhancing farm returns through innovative interventions for sustainable resource use and production efficiency	• High yield varieties with tolerance to biotic & abiotic stresses • Polyhouse tray-nursery technique for healthy seedling • Efficient soil and crop management techniques • Farm mechanization to reduce cost of cultivation
3.	Exploring and effective use of alternative energy sources for tobacco curing to reduce dependency on forest fuel wood.	• Solar energy for tobacco curing • Briquettes made of agro-wastes/saw dust • Coffee/coconut husk, maize rinds, etc. • On-farm energy plantations for generating fuel wood
4.	Exploiting tobacco for diversified uses (phytochemicals and value added products)	• Phytochemical profiling • Genotypes rich in phyto-chemicals • Tobacco seed oil for human consumption / industrial uses • Stem biomass and seed cake as adsorbent/ soil amendment

Issues relating to emerging strict regulatory mechanisms on smoke constituents, pesticide residue and heavy metal levels are also equally important and need to be taken in to account while drawing the future research framework for tobacco.

A new dimension for tobacco could be its use for production of ethanol from sugars and biodiesel from oil through biotechnological approach. As the tobacco is a high biomass crop it can be modified to produce bio-fuel. If the tobacco is used for bio-fuels instead of cigarettes and other tobacco products, farmers can grow tobacco in greater quantities than ever before. Environment-friendly tobacco dust can be an effective "molluscicide" against snails and other fishpond pests without any residue in fish harvests which will boost the aquaculture.

Changes in policy on growing of tobacco in India are going to shape the future research agenda of the Institute. Different policy scenarios expected are status quo of policy on tobacco, gradual phase out of tobacco and complete withdrawal of tobacco. If status quo of policy on tobacco is maintained, safe tobacco (less harmful) for consumers, enhanced farm returns to farmers, environment-smart energy sources

for curing and diversified uses of tobacco will be the research priorities. In case of gradual phase out of tobacco, the Institute needs to put increased focus on tobacco for export, exploring alternative livelihood security options, rechristening the Institute and broadening its mandate by inclusion of important commercial food crops. Rechristening the Institute and recasting its mandate is a must in the event of a policy scenario forcing complete withdrawal of tobacco from cultivation.

Resource base

CTRI - Core Strengths

- Large collection of tobacco germplasm.
- Experienced Scientists.
- Well equipped laboratory facilities.
- Trained technical manpower.
- Accumulated scientific knowledge on tobacco crop.

The Institute has large collection of germplasm of myriad tobacco types grown in India. This provides us with an opportunity to bring about continuous improvements in terms of crop productivity, quality and stress resistance. Scientists of the Institute are well trained and competent for pursuing high quality research aimed at enhancing productivity and quality of Indian tobacco so as to make it less harmful, more remunerative and globally competitive. The Institute has well equipped laboratories with sophisticated equipment to meet the requirements of research programmes. However, 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.

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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. This is evident from the growing global market demand for Karnataka light soil grown FCV tobacco. Also, there is an opportunity for export of Indian cigarette brands.

Favourable features

- Diverse climatic conditions favouring production of different FCV tobacco styles.
- Price competitiveness and positive features (low TSNA, low CPAs).
- Growing global market demand for Karnataka tobacco.

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 future, the consumer preference is likely to grow in favour of smokeless tobacco products. The stringent policy measures such as COTPA, WHO-FCTC etc. at national and international level on regulation of tobacco demand and supply will have a definite bearing on tobacco sector in India. Further, the increasing health consciousness on one side and the public awareness about the tobacco related health risks on the other may work against tobacco in future.

Unfavourable features

- Changing consumer perceptions and preferences
- Increased health consciousness
- Stringent national policies on tobacco control (e.g. COTPA 2003)
- WHO-FCTC : Seeking for demand and supply reduction measures (USA – not ratified FCTC and may take advantage of export market)

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 many phytochemicals some of which are known for their medicinal value (eg. Solanesol). There was growing perception in the past about this crop being used for alternative purposes other than traditional uses as smoke and non-smoke products. But the research work at CTRI and elsewhere have not yielded any tangible results in support of much talked about possible alternative uses including seed oil, leaf protein, phytochemicals, organic acids etc. The advancement in the pharma industry particularly in the field of preparation of synthetic compounds that mimic the properties of natural chemicals has undoubtedly undermined the possible exploitation of these phytochemicals. It is, therefore, believed that the use of this crop for alternative purposes is going to be neither lucrative nor pragmatic proposition.

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COTPA - 2003 (GOI)

The COTPA (Cigarettes and Other Tobacco products Act), 2003 is an important law made by Govt. of India on prohibition of advertisement and regulation of trade and commerce, production, supply and distribution of tobacco.

- Prohibits smoking of tobacco in public places, except in special smoking zones Advertisement of tobacco products including cigarettes is prohibited.
- Tobacco products cannot be sold to person below the age of 18 years, and in places within 100 metres radius from the outer boundary of an institution of education.
- Tobacco products must be sold, supplied or distributed in a package which shall contain an appropriate pictorial warning, its nicotine and tar contents.
- Cigarette packets are required to carry pictorial warnings of a skull or scorpion or certain prescribed pictorial warnings along with the text SMOKING KILLS and TOBACCO CAUSES MOUTH CANCER in both Hindi and English.

Opportunities

Cultivated tobacco *(Nicotiana tabacum L.)* has a large genome size with approximately 4.5 billion base pairs (~ 1.5 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.

Opportunities

- Availability of tobacco nuclear/ chloroplast/ mitochondrial genomes sequences and discovery of candidate genes (metabolic and regulatory processes).
- Suitability of tobacco for molecular farming of several recombinant proteins, pharmaceuticals, industrial enzymes and antibodies.
- Climate resilient and eco-smart techniques for efficient and sustainable resource management.
- Nanotechnology assisted nutrient/pesticide delivery systems for precision input application.
- Host plant driven bio-degradation of pesticide residues

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.

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Goals/Targets

The Vision-2050 envisages following goals for tobacco research and highlights research output targets:

- Developing high yielding tobacco varieties with superior quality, pest and disease resistance, low harmful substances and high input-use-efficiency
- Genetic resource management for harnessing the diversity mediated possibilities for crop improvement
- Climate resilient interventions for management of biotic and abiotic stresses
- Managing resource constraints for production efficiency and product quality
- Increased use of new generation techniques in the emerging fields viz., omics, nano science, bioinformatics, ICT, etc. for production, protection and processing of tobacco
- Farm mechanization to reduce cost of production
- Exploiting the alternative sources of energy for tobacco curing

The envisaged out-put targets include:

- Vertical increase in productivity (4.0 tonnes/ha in FCV and 6.0 tonnes/ha in non-FCV)
- Development of consumer-friendly cultivars with reduced levels of harmful substances and climate-resilient genotypes for enhanced tolerance to biotic and abiotic stresses and improved resource use efficiency
- High precision production and protection technologies for reduced cost of cultivation, increased farm incomes and environmental quality
- Increased tobacco exports through production of high quality and flavourful tobacco with acceptable levels of CPAs and HMs
- Reduction in the labour requirement and drudgery through innovative farm mechanization
- Increased use of alternative sources of energy (solar and bio) to reduce dependency on forest based wood fuel

Way Forward

The production and market dynamics in the tobacco sector are profoundly influenced by trade requirements, consumer preferences and statutory regulations besides environmental and socio-economic considerations. Notwithstanding the income and employment generating potential of the crop, the emerging changes in the national and international policies particularly in public health, commerce and environment sectors will have a direct bearing on the future of the tobacco sector as a whole in India. The future research framework for tobacco needs to be dynamic in nature so as to fit into all possible policy scenarios. In the *status quo* scenario of the government policy on tobacco, the development of economically viable and eco-friendly agro-technologies for enhancing productivity and quality, increasing the farm returns, reducing harmful substances to make the tobacco consumption relatively less harmful, developing value added products for diversified use of tobacco are the key issues requiring innovative scientific interventions, for promoting exports, generating revenue and employment on a sustainable basis.

Dynamic Research Roadmap in the Changing Policy Environment

Scenario 1: Status quo of policy on tobacco

- Safe tobacco (less harmful) for consumers.
- Enhanced farm returns to farmers.
- Environment-smart energy sources for curing.
- Diversified uses of tobacco.

Scenario 2: Gradual phase out of tobacco

- Increased focus on 'tobacco for export'.
- Exploring alternative livelihood security options.
- Rechristening the Institute and broadening its mandate to include other commercial crops.

Scenario 3: Complete withdrawal of tobacco

- Rechristening the Institute and recasting its mandate.

Research on exploring and exploitation of alternative sources of energy and fuel saving technologies for curing of tobacco receives increasing attention in the years to come to address the environmental concerns relating to tobacco production. As the livelihood security of millions continuous to depend on the crop, the possibilities for diversified uses and value added products of tobacco need to be explored.

If the tobacco cultivation is to be gradually phased out / reduced in response to policy changes, the research focus will be on increasing tobacco for exports, exploring alternative livelihood security options along with rechristening and broadening Institute mandate. Rechristening the Institute and recasting its mandate is a must in the event of a policy decision to completely withdraw tobacco from cultivation. It is expected and wished that the innovative approaches and new concepts presented in the ICAR-CTRI Vision-2050 document will provide a road-map and guidance for tobacco researchers.

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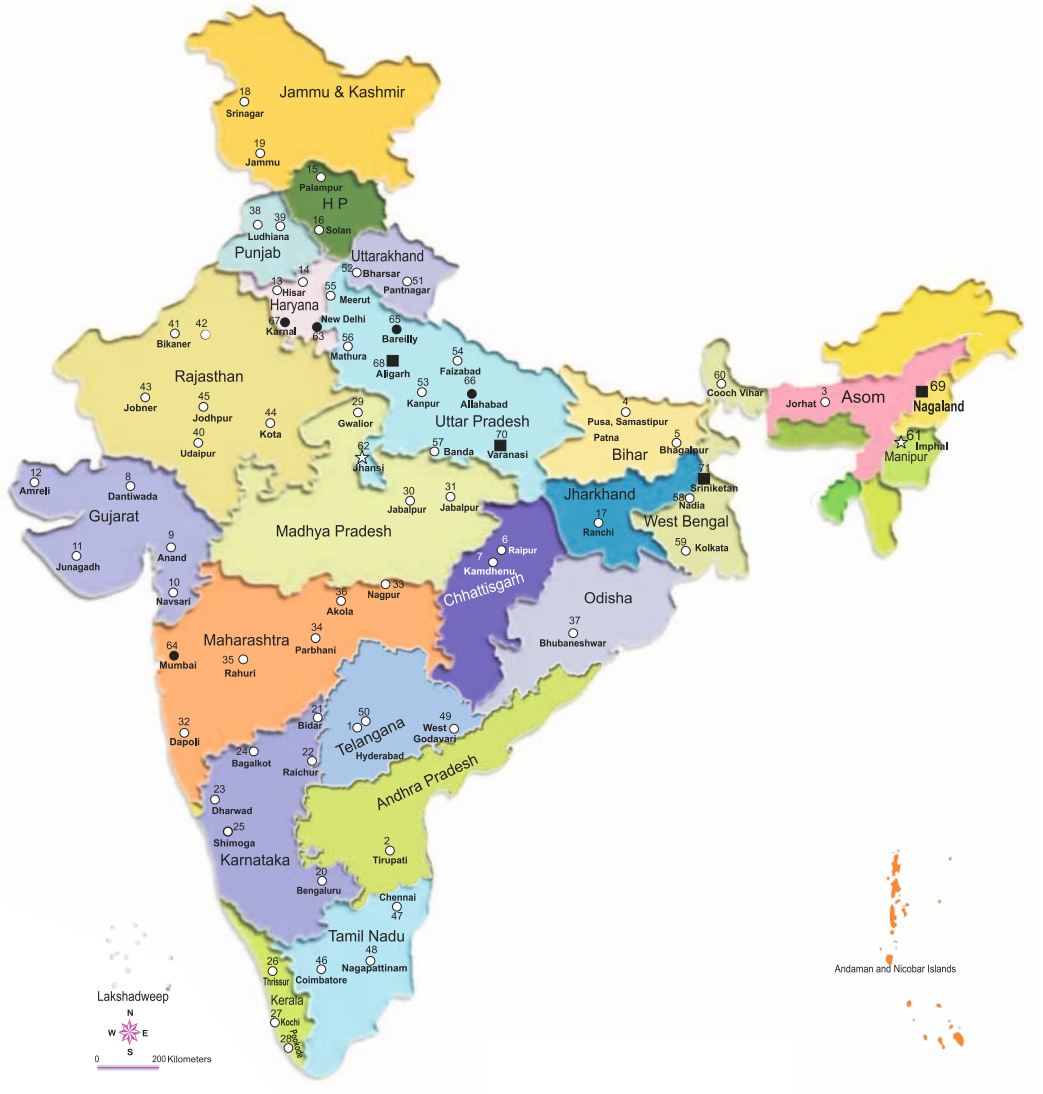
INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Agricultural Universities



LEGENDS

State Agricultural Universities	○
Central Universities with Agricultural faculties	■
Central Agricultural Universities	☆
Deemed Universities	●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