



National Institute of Agricultural Economics and Policy Research (Indian Council of Agricultural Research) New Delhi 110 012

www.ncap.res.in

Printed : July 2015

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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 कोई 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।

CICUI HIEA An

( 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 multiinstitutional 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 ICAR-National Institute of Agricultural Economics and Policy Research (NIAP), New Delhi 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.

Indian Council of Agricultural Research

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

The Vision 2050 articulates a perspective plan for ICAR-National Institute of Agricultural Economics and Policy Research (NIAP), earlier known as National Centre for Agricultural Economics and Policy Research (NCAP), and elaborates on the role of research in agricultural economics and policy in achieving efficient, faster, sustainable and inclusive growth in agriculture. The Institute has succeeded in integrating social science research into agro-biological research, and through its creditable policy research and communication has come to the expectations of its sponsors and stakeholders.

Agriculture in the coming decades will face several new challenges and will also offer new opportunities. Understanding these changes will require greater role of agricultural economics and policy research. Indian population is rising and becoming more affluent, while natural resources are under greater stress to produce more. To meet the growing demand for agricultural products, by 2050 the country will have to triple its land productivity, double water- and energy-use efficiency and raise labour productivity five-times.

The Vision 2050 pronounces to develop capacity of the agricultural economists in the country to guide farmers in decision-making on issues like optimum resource-use planning; precision agriculture; marketing; and post-harvest value addition. Ex-post assessment of developed technologies and ex-ante assessment of potential and emerging technologies will require more attention. We need to have constant monitoring of local, national and global demand and supply forces, various undercurrents, new commerce, and institutional and market mechanisms and articulate their implications to help in preparedness of the country to adapt to these changes.

According to the Vision 2050, NIAP will strengthen itself as a policy think tank and will undertake futuristic and anticipatory research including visioning of agricultural science and technology, commodity outlook, and scenario building.

The Vision 2050 recognizes that future growth of agriculture will be driven by technology and its adoption at farm level and in postharvest value addition. However, this can be actualized only under conducive policy environment, appropriate institutional arrangements and supporting infrastructure. Therefore, it articulates the need for favourable interplay of policies, technologies, institutions and infrastructure in achieving the desired outcomes.

The recent methodological advances in economics have opened possibilities of analysing complex issues related to functioning of economy, markets, human behaviour and ethics, climate change, biodiversity, environment, property rights, and inter-generational equity. However, the social sciences in India have not been able to keep pace with these developments. This document specifies that NIAP will take responsibility of capacity building of agricultural economists in methodological advances.

New developments in science and policy innovations often become victims of apprehensions and misperceptions. The Vision 2050 pronounces the provision of credible empirical evidence for assessing the benefits of novel technological and policy innovations in agriculture and in shaping public opinion through effective communication and advocacy.

The strength of agricultural economics and policy research in the country is weakening because of decline of interest in agricultural issues in mainstream institutes and universities. The Vision 2050 specifies the filling of this gap by NIAP. The Institute will expand its role in state level policy analysis and advocacy. These responsibilities necessitate that NIAP has adequate number of professionals with orientation and penchant for policy research.

I am grateful to Dr S Ayyappan, Secretary, Department of Agricultural Research and Education (DARE), Government of India, & Director General, ICAR, and to Dr Arvind Kumar, Deputy Director General (Education), ICAR, for their suggestions. I thank Dr PS Birthal for his contributions in preparation of this document. My special thanks are due to Dr SS Acharya and Dr Mruthyunjaya for their valuable comments to improve the document.

This document represents our resolve to strengthen Indian agriculture through evidence based credible research and policy advocacy. It is open to suggestions and constructive criticisms by the public and peers.

> Ramesh Chand Director

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### Context

A griculture despite its shrinking share in gross domestic product, continues to be an important sector of Indian economy because of its strategic importance in food and nutritional security, employment generation and poverty reduction.

Recently, agriculture has attracted considerable attention because of high and volatile food prices, increasing cost of food production, emerging threats of climate change and its expanding role beyond providing food, feed and fibre security. The developments in science are creating opportunities for use of agricultural products in industry, pharmaceuticals, cosmetics and energy sectors. There are apprehensions that food production may not keep pace with demand in future.

Presently, India's agri-food policy faces twin challenges: enhancing food production in a cost-effective manner; and making agriculture attractive for the younger generation. Indian agriculture is dominated by smallholders; and deceleration in productivity growth, frequent occurrence of extreme climate events, rising cost of production, and incessant fragmentation of landholdings are rendering agriculture-based livelihoods untenable for them. Agricultural research has potential to improving economic viability of small farms. Thus, for efficient, sustainable and inclusive agricultural growth, it is essential to have a better understanding of the interface of technology with policies, institutions and infrastructure. The National Institute of Agricultural Economics and Policy Research through its credible and evidence-based policy research will continue to play an important role in guiding agricultural research policy to convert the challenges into opportunities.

Vision 2050 presents a roadmap for agricultural economics and policy research in the NARS for efficient, sustainable and inclusive agricultural growth.

## Challenges towards 2050

Indian economy is expected to grow faster over the next four decades. The population growth will decelerate but the country will become more urbanized and affluent. By 2050, on the assumption of a six percent economic growth, India's per capita income is expected to reach Rs four lakhs (at 2010-11 prices) – almost eight-times of the present level. The share of agriculture in gross domestic product will come down to around 7 per cent, but it will continue to engage 27 per cent of the country's workforce. These trends will induce changes in agrifood production systems requiring alignment of agricultural research with emerging changes.

### Balancing Food Supply with Demand will be an Uphill Task

By 2050, India's population will increase to 1.62 billion, and to feed this number, food demand will rise faster in quantity as well as quality than in the past. Nearly three-fourths of this change in demand will be driven by quantity and the rest by quality or consumer preferences.

The per capita consumption of cereals will be levelled off, while there will be a substantial increase in the consumption of high-value food commodities, such as vegetables, fruits, milk, meat, egg and fish. For agricultural research, the main challenge will be to develop technologies, practices, varieties and animal breeds that provide high-yield and are safe to human beings and environment.

#### Natural Resource base for Agriculture will be under a Greater Stress

Land, water and energy resources will be more severe constraints to agriculture. India's net cropped area now stagnates at around 140 million hectares, and there is a little scope to bring additional area under cultivation. Groundwater has already reached its limits of exploitation in many parts of the country. Agriculture will become more energyintensive. There will be a rise in competition for these resources from expanding urbanization and industrialization. The policy challenge is to facilitate technological innovations that improve resource-use efficiency and reduce cost of production.

### Climate Change will Emerge a Big Threat to Agricultural Development

Agriculture is highly vulnerable to climate change, and significant changes in climate will adversely affect agricultural production with a threat to livelihood of the farming community. To mitigate this threat, efforts will be required on developing climate smart agriculture by enhancing synergy across technologies, policies, institutions and infrastructure.

### Market Challenges will be Bigger

In recent years, food prices have increased significantly and have become more volatile than ever, and are likely to remain so in the years to come. On the other hand, consumers demand cheaper food, and producers want more returns from farming. Thus, to strike a balance between interests of the poor consumers and producers managing volatility in food prices will be a major policy challenge.

The domestic agri-food marketing systems are likely to undergo a transformation in terms of rise of supermarkets. This transformation will be accompanied by increased demand for food safety and hygiene. It will be a challenge to effectively integrate farmers on the demanddriven supply chain.

### Improving Viability of Small Farms will remain a Major Challenge

While the need to produce more food will remain as urgent as ever, the average farm-size will shrink further, and agriculture will be overwhelmingly dominated by tiny landholdings. Improving viability of smallholder production systems will remain a major challenge for research as well as policy.

### There will be an Increased Demand for Agricultural Services

Future agriculture will be more knowledge- and informationintensive. Farmers will demand heterogeneous services related to technologies, inputs, weather, information, markets, etc. While the returns on investment in agricultural research as well as extension are quite attractive, the outreach of public extension system has remained limited. In order to harness the potential gains from research, it will be imperative to develop effective and inclusive service delivery systems.

### Improving Quality of Human Resources

The demand for NIAP's input in research and capacity building will increase, requiring capacity building of the agricultural economists in advanced quantitative techniques and modelling. Agricultural research managers will demand more support from social sciences in monitoring, impact assessment and priority setting. Thus, NIAP will be required to contribute significantly toward improving quality of teaching and research.

## **Operating** Environment

In the wake of increasing commercialization and modernization of agriculture, the technology--growth--policy interface will become prominent but complex also. It will require a deeper understanding of the developments in science and technology across the world and the scope for collaboration and cooperation. With increasing entry of the private sector in agricultural research, IPR regimes will be stricter, limiting the scope for technological spill-overs and knowledge flow from developed to developing countries. Under such an environment, developing countries including India may face a situation of technology orphanage. Such a scenario calls for self-reliance through developing indigenous research capacities. The focus of agricultural development policy will have to be shifted from growth to efficient, sustainable and inclusive growth.

In the shifting paradigm of R&D, agricultural economics and policy research will play a crucial role. The process of R&D involves discovery and innovation, which is incomplete without adaptation, adoption and diffusion of new technologies. It will, therefore, be crucial to complement agro-biological sciences with social sciences. The social science research will be required to increasingly contribute to refining of research agenda, taking into consideration emerging trends, besides providing evidence-based inputs for policy decisions. Social science research will also encompass newer lines of research such as capacity building with respect to intellectual property rights, impact assessment, and climate change. Farmers will face greater risks of price volatility, weather aberrations and outbreaks of newer pests and diseases. Managing such risks requires an effective mix of technological solutions and policy instruments.

Research on productivity growth and its impact on farmers' welfare is another area that will continue to attract considerable attention. Hence, the emerging scenario will require a deeper exploration and understanding of the policy issues impinging upon agricultural technology, resource use, production, marketing, and food and nutritional security.

While the challenges are formidable, public funding for agricultural R&D is likely to face severe crunch. At the same time, there will be a pressure to justify public investments in agricultural R&D. This

will require a strong emphasis on research prioritization and impact assessment of investments in agricultural research. Further, unlike in the past, scientific achievements—innovations and products—will not be taken at their face value, and will be increasingly subjected to public scrutiny, as is being observed in case of transgenic crops. Social scientists will have to undertake objective assessment, ex ante in many cases, encompassing economic, social, environmental, and ethical aspects of newer technologies.

Under the operating environment by 2050, social sciences will have to understand that "business as usual" approach will not work and strategies have to be adopted to prevent marginalization of agricultural R&D institutions. Social scientists will be required to suggest innovative and efficient ways for technology dissemination, and identify niche areas for public-private partnerships to strengthen the public sector for competitive marketing of technology and other knowledge products.

### New Opportunities

Commercialization is creating new opportunities in agro-processing and value chain developments. Dietary patterns are shifting towards high-value and processed foods. There is a growing concern for safe and quality food, and a realization about the connect between agriculture and human health. Besides, food demand is likely to face increasing competition from new sources like bio-energy, industrial uses, biomedicines, bio-cosmetics, etc. These changes will give rise to a range of new issues for social science research.

Given the emerging challenges and opportunities, it is important to identify the future sources of agricultural growth and to suggest technological, institutional, investment and policy options for efficient and sustainable growth of agriculture.

To provide solutions to the contemporary and foreseeable challenges, agricultural research agenda will expand. This will create space for social sciences to undertake an objective assessment of the likely requirement of research resources and their allocation across commodities, programmes and regions. Agricultural research will by and large remain in the public domain, and investment therein will have to be justified in terms of its impacts. This is an opportunity for the agricultural economists to take a lead in developing and refining methodologies for objective impact assessments.

Climate change is throwing a number of researchable issues before agricultural economists, such as its impact on agricultural productivity, resource-use efficiency, prices, consumption pattern and poverty. New and innovative approaches will have to be evolved to manage natural resources for sustainable intensification of agriculture. Emphasis will have to be on the development of water saving technologies, renewable energy sources, and crop planning.

The excessive employment pressure on agriculture and declining farm size imply a need for creating income-generating opportunities for farm households in the non-farm sector. This will require studies on exploring opportunities for farm households in agro-based industries and services, and non-farm labour markets; and to identify physical, financial and skill barriers to their entry into rural non-farm sector.

Globalization of agri-food systems will require more efforts in monitoring of the domestic and global market trends, assessment of their impacts on agricultural production, prices, trade and rural livelihoods. The research will have to come out with feasible options to strengthen international competitiveness of agricultural value chains.

The NIAP will focus on mainstreaming policies related to food production, procurement and distribution. Evidence-based policy advocacy for a better management of natural resources will be another focus. The Institute will undertake rigorous analysis of costs and benefits of institutional innovations such as contract farming, producers' associations and cooperatives; and will suggest ways and means to improve their efficiency.

## Goals and Targets

Between the past and the future agricultural growth a major difference will be in terms of quantity and quality of resources for farming. The production environment is expected to be more stressed in future than in the past. A growing economy needs more land and water, and there is very high probability of diversion of these resources for nonagricultural uses. By 2050, the resource scenario will be as follows:

Land: At the most India can bring 2 million hectares of additional land under cultivation, and that too by shifting from the ecological sector comprising culturable wastes, pastures, and barren and fallow lands.

Water: Agriculture will have access to 6 per cent more water than it received in 2000. Nonetheless, groundwater resources will be under acute stress.

**Energy:** Energy demand for pumping water for irrigation will increase at the rate of 1.8 per cent per annum.

**Manpower:** Labour availability for agricultural activities will decline, from 244 million workers at present to 177 million workers by 2050.

This scenario suggests that by 2050 the availability of resources for agriculture will increase but at a slower rate compared to that for food demand. This underlines the importance of improving use-efficiency of available resources, and technological breakthroughs. In order to strike a balance between the future demand and supply of agricultural products under resource constraints, the Vision 2050 suggests to target a (i) three fold increase in land productivity, (ii) two-fold increase in water productivity, (iii) doubling of energy-use efficiency, and (iv) five times increase in labour productivity.

The required improvements in resource-use efficiency will not come from R&D alone, policies will be equally important for efficient and sustainable agricultural growth. Economists will need to suggest policy and institutional options to bring in the required improvements. NIAP will focus on designing efficient and inclusive R&D strategies and policies; and capacity building in agricultural economics and policy research.

# Way Forward: NIAP to 2050

N IAP has been contributing to the growth of agricultural economics and policy research within NARS, besides providing inputs to ICAR on prioritization of research. Based on its academic progress the Quinquennial Review Team (2006-2010) has remarked that, "Despite several constraints, the NCAP (now NIAP) has performed exceedingly well. It has contributed immensely in generating research-based policy outputs and enhanced the participation of ICAR in agricultural policy related discussions."

The Institute will continue to provide economic and policy inputs based on sound empirical analysis to convert challenges into opportunities. The focus will be on designing efficient and inclusive R&D strategies and policies; and enhancing capacity in agricultural economics and policy research in the NARS. It will keep track of the changes in domestic and global markets and come up with future scenarios and outlook for agriculture so as to help the country in its preparedness to adjust to the emerging changes. It will proactively engage in futuristic and strategic research and develop innovative solutions to address the upcoming challenges and harness the opportunities.

#### Vision

Leveraging innovations for attaining efficient, inclusive and ecofriendly agricultural growth through agricultural economics and policy research.

### Mission

To strengthen agricultural economics research for providing economically-viable, socially-acceptable and environment-friendly policy options for science-led agricultural growth.

#### Focus

To realize the vision of `leveraging the potential of technologies for an accelerated, inclusive growth through policy-oriented research', the Institute will strive to accomplish its mission by focusing on the following key areas:

Technology Policies for Sustainable Intensification of Agriculture: The Institute will concentrate its research on supply side constraints, welfare impacts of emerging technologies, technology forecasting and foresight, research prioritization, internalization of consumer preferences in technology generation process, intellectual property regimes, and public-private partnerships in agricultural research; linkages across technology, environment and trade; technological, institutional and policy options for climate smart agriculture; resource-use efficiency, regional crop planning; valuation of non-market services including biodiversity and ecosystem services.

Markets, Trade and Institutions: The thrust will be on understanding changes in dietary patterns, demand projections; transformation of markets, value chains, institutional innovations, food safety and quality standards, food processing; role of incentives and taxes in sustainable agricultural intensification; price stabilization policies, market intelligence; food procurement and distribution systems; international trade, market integration and price transmission; domestic and global trade policies; land, labour and water markets; delivery systems for inputs, services and information; centre-state relations in agriculture; role of governance in agricultural development; agrarian relations; gender issues.

Agricultural Growth and Development: Agricultural growth being the outcome of the inter-play of technologies, institutions and policies, NIAP research portfolio will comprise scenario analysis of structural changes in agriculture and their impacts; prospects of an evergreen revolution; regional disparities in agricultural growth; pathways and drivers of agricultural growth, public and private investments, infrastructure and human resources; rural diversification and farm and non-farm linkages. The Institute will continue to undertake studies on short-term and medium-term outlook for agriculture.

**Capacity building:** NIAP will continue to play a key role in curricula development for graduate and post-graduate levels in agricultural economics and policy analysis by focusing on technology assessment, institutional economics, climate change impacts and adaptation and mitigation strategies, risk management and growth models. It will also forge linkages with advanced research institutions in India and abroad for capacity strengthening of its own faculty.

### Strategy and Framework

NIAP is required to meet the growing demand for evidence-based policy inputs for a faster, efficient, sustainable and inclusive agricultural growth. With socio-economic issues in agricultural R&D becoming prominent, Institute's engagement in formulation of plan and designing of development programmes has started growing rapidly from different quarters, including central ministries and state governments. With agricultural research agenda enlarging, the socio-economic research will become more important. Therefore, there will be a need to further strengthen NIAP to come to the expectations of its stakeholders. NIAP will follow a multi-pronged strategy to contribute toward improving research agenda in the NARS and enhance participation of ICAR in agricultural policy dialogues.

### Networking

While NIAP may remain small in size, its research agenda will expand. To fulfil the expectations of its sponsors and stakeholders, it will emphasize on research in network mode by involving agricultural economists, social scientists and biological scientists. It will take a leading role in capacity building in methodological advances in policy analysis. Besides, it will continue to promote collaborative and multidisciplinary research.

#### Partnership

NIAP believes in partnership. It will nurture research partnerships with national and international institutions, and will foster functional linkages with them. The existing partnerships will be further strengthened; and new collaborations will be developed to work on complex policy issues.

#### **Policy Communication and Advocacy**

NIAP disseminates its policy research findings through various means such as policy papers and policy briefs, policy dialogues, and media. The Institute has a history of publishing regularly on contemporary policy issues. Its publications serve as a medium for knowledge dissemination, constructive criticism, and sensitization of people representatives and policymakers, and therefore their outreach will have to be enlarged. NIAP will continue to contribute to the process of policy formulation through its research and participation in policy dialogues and debates.

### **Data Bases and Indices**

A number of institutions and agencies are engaged in compilation of data on various aspects of agricultural and rural economy. Yet, real time information for decision-making and strategic planning is not readily available in the form in which it can be directly used by the policymakers. NIAP will strengthen and expand development of digital data bases pertaining to important variables from district to global levels.

### **Organisational Structure**

NIAP has a sanctioned strength of 30 scientists; mostly agricultural economists. The research activities will be organized under three divisions: Division of Technology Policy and Sustainable Agriculture; Division of Markets, Trade and Institutions; and Division of Growth and Development Strategy. Each Division will be headed by a senior agricultural economist.

NOTES

Laser typeset at M/s Print-O-World, 2568, Shadipur, New Delhi 110008 and printed at M/s Royal Offset Printers, A-89/1, Naraina Industrial Area, Phase-I, New Delhi 110 028.