Proceedings of the Informal DARE/ICAR Retreat to discuss India’s role and place in International Agricultural Research

28-29 December 2012

NDRI - Karnal

Executive Summary

India is a rapidly growing geo-political, economic and knowledge power at regional and global levels. With the second largest national agricultural research and innovation system in the world, it has made universally acknowledged progress in agricultural development using science and technology in the last 50 years. The country is also a hot spot of rural poverty, hunger and malnutrition and has complex challenges related to food and agriculture. It needs access to new technologies and knowledge from across the world to solve them. As a responsible member of the global community, it needs to share its knowledge, skills and technology, especially about its remarkable progress in agriculture with the rest of the world.

An informal Retreat of leading Indian agricultural scientists and innovators collectively explored what could be India’s role and place in International Agricultural Research (IAR) in the future by 2030, and how to achieve its true mark? In the process they revisited a possible vision, starting with the Indian Council of Agricultural Research (ICAR), the main public sector agricultural organization in India, ICAR Vision 2030 (ICAR,2012) for India’s future role and position in IAR and a strategy over time for the to reach it.

The retreat after considering India’s vision of its role and place in IAR set appropriate goals to be achieved with strategic options it has for achieving its desired future role and position by 2030. For the Indian agricultural research, the highest priority is to ensure adequate production to feed its population, improve productivity and incomes of all engaged in agriculture and related activities, which make more that 65 per cent of the population of India’s 1.2 billion people, to alleviate poverty.

For its role in IAR, India will optimize its agricultural research balancing with highest priority its own domestic needs with the need to do internationally more profiled research which brings prestige and recognition. India also believes that excelling in research that contributes to the country’s own development and progress is and continues to contribute significantly, if exposed appropriately, to International agricultural research for development as the challenges and solutions to the challenges in India and the solutions based on science and technology are similar and congruent to the needs of the developing world globally. In fact, technologically, solutions developed through Indian research and innovation are now finding greater suitability and adoption as they are more appropriate to farming systems and conditions in Africa, Central, South and South East Asia and the Small Island states as they are found to be adaptable, appropriate to the local small holder conditions, affordable, robust and resilient.

India’s vision for its role in IAR was summed as:

India, as a leading knowledge and technological hub, will be a responsible participant in International Agricultural Research appropriately sharing and exchanging information, knowledge, skills and technology that contributes to sustainable development that is fair and just to all globally.

The ICAR currently contributes and can contribute with a little more effort to agricultural research and technology generation globally:

• Capacities to generate Triple A’ technologies -- technologies that are adaptable, appropriate to the local smallholder conditions, affordable, robust and resilient. The technologies include:
• Crop, livestock, fishery and vegetable varieties
• Large, Medium and Small Irrigation technologies and management skills
• Water saving, effective use and augmenting technologies
• Tillage and planting methods
• Soil conservation and reclamation methods
• Fertilizers and nutrient management
• Small machinery for farm operations, food and feed processing
• Energy related technologies (for farm operations such as water pumping)
• Pest and disease control
• Livestock protection
• Small holder dairy successes
• Surveying - including remote sensing capabilities for soil, land use and biodiversity assessments
• Abilities/Institutional capacities to quickly roll out adaptive research in diverse ecological conditions
• Abilities to deploy advanced biotechnological and bioinformatics tools for improving yield and dealing with biotic and abiotic stresses, and introduce regulatory systems where necessary
• Abilities to use rainfall forecasts in crop planning and management
• Abilities to deal with adverse conditions like drought by developing contingency plans
• Experience of developing technologies for both adapting to and mitigating climate change.
• Introduce emerging technologies like nanotechnology, particularly in water purification and increasing input use efficiencies.
• Manpower development for agricultural research, education and extension in a cost-effective manner.
• Private sector capacities to build and scale up agricultural value chains
• Capacities in public, private and NGO sectors in leveraging ICTs, including Geographic Information Systems and mobile technologies for enhancing productivities and incomes and designing agri-supply chains.

The goals for ICAR’s further contribution to development through agricultural research by 2030 and in turn also contribute to IAR were set as:

I. **Goals that would contribute substantially through actions in agricultural scientific research and innovation, education, extension and research management and coordination that would generate information, experience, knowledge, skills and technologies to contribute to development and progress through agriculture.**

A. **Scientific Research**

1. Improving production, productivity and income generation of farmers and producers including livestock keepers, fisher-folk and those engaged in activities related to agriculture especially small and medium entrepreneurs in agribusiness.
2. Improve quality assurance of agricultural commodities and, especially, food safety through improved segregation, identity preservation and traceability and appropriate globally acceptable standards
3. Develop resilient agricultural systems
4. Conserve and effectively use India’s immense agricultural biodiversity of plants, animals, fish, insects and microbes
5. Manage the spread of and reduce the socio-economic impact of plant, animal and fish trans-boundary and zoonotic diseases through an integrated, trans-disciplinary approach
6. Strengthen research that contributes to India’s more effective participation in global agricultural commodities trade, including processed foods, as also technology and services markets.
7. Gain recognition in research through high impact publications and conducting research in basic and frontline/cutting edge areas

**B. Agricultural Extension**

1. Strengthen research in Agricultural Extension policy, strategy, organization, monitoring, evaluation and impact assessment
2. Establish Videsh Krishi Vigyan Kendras (Foreign Agricultural Science Centres) as outposts for India’s contribution to agricultural research and development and technology transfer globally

**C. Agricultural Education**

1. Develop 5 Agricultural Universities and Deemed Universities to be among the top 20 agriculture related universities in the world in academic excellence and infrastructure by providing academic autonomy and good governance, attracting the best faculty from within and outside the country, attracting foreign students through open entry and scholarships and adequate funding by 2025
2. Improve agricultural education through change in curriculum to attract students with inclusion of entrepreneurship skills and new disciplines related to biotechnology, nanotechnology, Information and Communications Technologies, Space sciences and Material sciences and capacity development through training of faculty in teaching methods, curriculum and syllabus development and in managing academic programs by 2017
3. Develop functional linkages between agricultural universities to exchange faculty and students by 2017
4. Establish quality assurance in University education through a University Grant Commission like Institution for Agricultural education by 2017
5. Mandate Agricultural Universities, Deemed Universities, ICAR Institutes and Centre’s of Excellence to provide and support informal learning in agricultural communities and continuing education to agricultural professionals by 2017

**II. Goals that would support through necessary substructures of Institutions, Organization transformation, capacities and infrastructure to contribute to research, extension and education goals set above**

1. Conduct research for new approaches and processes for management of public sector agricultural research and innovation systems to improve efficiency and impact and to include new actors such as the private sector and the civil society especially farmer organization and non-government organizations in agricultural research and innovation through Challenge research, Corporate research, Venture Capital Research, Idea Banks, research, data matrix, information for policy research by 2017
2. Conduct research to further develop the Monitoring and Evaluation of Research, Extension and Education Programs with greater inclusiveness and participation of key stakeholder groups in entire program cycles from agenda setting to impact assessment by 2017. This will entail revisiting current accountability and reward systems including the ASRB scorecard and providing strong incentives for specialists to continue their specialist interests by 2015
3. Set up a research based support system for the national research and innovation system to participate effectively in international agricultural research through appropriate policies, strategies and coordination by 2017
4. Establish National Agricultural Forward Thinking Platform with Links to Global Forward Thinking Platform
5. Set up a research based support system for the national research and innovation system to participate effectively in international agricultural research through appropriate policies, strategies and coordination
6. Develop improved linkages, coordination and integration of research, extension and education systems with introduction of multi-disciplinary and trans-disciplinary programs and activities with focus on biotechnology, nanotechnology, information and communications technologies, space science and materials science

India needs from the International Community for its research, extension and education:

- Bioinformatics data and information for developing appropriate technologies to improve crop, plant and fish productivity, adapting to and mitigating effects of climate change and for managing agricultural biodiversity
- Research skills in value addition chain and innovation research
- Skills for analysis, modeling and simulation for genomic research
- Skills for managing, especially integrating, coordinating and setting up monitoring and evaluation for agricultural research and innovation systems
- Skills and technologies for plant, animal and fish disease surveillance, monitoring and rapid diagnosis and emergency management of outbreaks

India at the national level will judiciously partner with all multilateral global initiatives in IAR such as those led by CGIAR, UN/FAO, GFAR, G20, OIE, World Bank/IMF, IFAD, Multi-country arrangement such as of Brazil, Russia, India, China, South Africa (BRICS), India, Brazil, South Africa (IBSA), Africa Fund, Regional initiatives by Regional Organization in Asia and Africa including those SAARC, ASEAN and APAARI and bilaterally with individual countries.

At the Institute, University and Research Project level, India will enable based on its principles for participating in IAR, equitable partnerships, which share, exchange and jointly generate data, information, new knowledge, skills, technology.

India will pay special attention to contribute to building capacities in agricultural research, extension and education to countries in Sub-Saharan Africa, Central Asia and Small Island State.

There is a lot at stake if India misses its true mark. It may lose, as experience shows, not only in the highly competitive global agricultural commodities market but also in the emerging highly profitable agricultural technological and services market. If it is not able to benefit from global cooperation in harnessing advanced sciences and technologies, where apparently there still remain weaknesses in the Indian agricultural research system, its own agriculture and economy in the future may suffer affecting national growth as also its economic and geo-political position and influence.
Background

India is a rapidly growing geo-political, economic and knowledge power at regional and global levels. With the second largest national agricultural research and innovation system in the world, it has made universally acknowledged progress in agricultural development using science and technology in the last 50 years. Being among the leading producer and consumer of many agricultural commodities, it has a large trade as an exporter and importer in agricultural commodities. Yet, the country is also hot spot of rural poverty, hunger and malnutrition and has complex challenges related to food and agriculture. It needs access to new technologies and knowledge from across the world to solve them. And, as a responsible member of the global community, it needs to share its knowledge, skills and technology, especially about its remarkable progress in agriculture with the rest of the world.

Globally, agriculture and with it, agricultural research are transforming. New challenges in adapting to and mitigating the effects of climate change, the efficient and sustainable use of natural resources, especially water and land for agriculture, reducing environmental degradation and effecting its recovery, loss of biodiversity, spread of trans-boundary diseases and pests and effectively participating in highly competitive agricultural commodities, technology and services markets across the world are now the main driving forces for agricultural research and innovation. There is a huge potential of using advanced sciences and technologies such as biotechnology, especially genomics, nanotechnology, Information and Communications Technologies, Space Sciences and Material Sciences for progress in agriculture.

National strategies for development are also shifting. The fast growing economies with large capacities in agricultural research have now started realizing the role of supporting agricultural innovation and research systems both for their economic growth but also for “soft diplomacy”. All these affect India’s role and position in International Agricultural Research.
India now has to consider how it can benefit and also contribute to the flow and effective use of agricultural information, knowledge, skills and technology among countries the world over and participate commensurate to its world status in International Agricultural Research. With a rapidly transforming economic and knowledge landscape, including that related to agriculture, there is a need to relook at India’s vision and strategy of participating in International Agricultural Research. Today India has many bilateral and multilateral arrangements to cooperate in agricultural research. It has membership of the Consultative Group on International Agricultural Research (CGIAR), Food and Agricultural Organization (FAO), International Fund for Agricultural Development (IFAD), G20 Meeting of Agricultural Chief Scientists (MACS) etc. New international arrangements with focus on the sharing and exchange of data, information, knowledge and skills rather than germ-plasm, packaged technologies and technical knowhow are emerging. With 8 per cent of known plant and animal species spread over a wide range of biomes, India is a hotspot of genetic biodiversity which is and can influence further agriculture of the future globally. This agriculture will not be only about food and fiber production but about all aspect of manufacturing and industry. India can benefit significantly by carefully look at its current place in International Agricultural Research (IAR) and where it wants to be placed in the future for its influence as also by developing a strategy and implementing to be where it wants to be.

**Aims and Objectives of the Retreat**

What could be India’s role and place in International Agricultural Research in the future by 2030, and how to achieve its true mark? The informal Retreat of leading Indian agricultural scientists and innovators collectively explored and revisited a possible vision, starting with the Indian Council of Agricultural Research (ICAR), the main public sector agricultural organization in India, ICAR Vision 2030 (ICAR, 2012) for India’s future role and position in IAR and a strategy over time for the to reach it.

The retreat after reconsidering India’s vision of its role and place in IAR and setting appropriate goals to be achieved with strategic options it has for achieving its desired future role and position by 2030. There is a lot at stake if India misses its true mark. It may lose, as experience shows, not only in the highly competitive global agricultural commodities market but also in the emerging highly profitable agricultural technological and services market. If it is not able to benefit from global cooperation in harnessing advanced sciences and technologies, where apparently there still remain weaknesses in the Indian

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The interesting publication *"The New Harvest: Agricultural Innovation in Africa"* by Calestus Juma (Published by ‘The Oxford University Press’ – 2011) outlines some of the challenges to agricultural development in Africa and the inputs that the world community could provide. Two other publications by the McKinsey Global Institute: *"Africa at work – Job Creation and Inclusive Growth"* and *"Lions on the Move: The Progress and Potential of African Economies"* highlight some of the potentials of agricultural development in Africa. From some of these documents, it is clear that many of these developing countries are looking forward to having collaborative relationships with the rest of the world – especially with those countries which have tackled some of their agricultural development problems successfully. India and Indian experiences will be a natural choice.

*ICAR can contribute most effectively and immediately to the cause of global food security by catalyzing agricultural research and development in some of the developing countries notably Africa by drawing on its own research and institutional capacities built over the past five decades.*

- K.V. Raman, Ex-Director NAARM
agricultural research system, its own agriculture and economy in the future may suffer affecting national
growth as also its economic and geo-political position and influence.

The context of International Agricultural Research

IAR means developing internationally and globally useable agricultural information, knowledge, skills
and technology. IAR for development means developing internationally/globally useable agricultural
information, knowledge, skills and technology that contributes to “development” be it economic, social,
political, technological, environmental/ecological by contributing to:

- Reducing hunger and malnutrition
- Alleviating poverty
- Using natural resources sustainably
- Preventing environmental degradation and contributing to its recovery

India is and will be bound to aim to meet globally set development goals such as the Millennium
Development Goals and the Sustainable Development Goals after they are set by the United Nations.
Agricultural research in India will aim to contribute significantly wherever needed to these universal
goals that are congruent to its own development goals.

For the Indian agricultural research, the highest priority is to ensure adequate production to feed its
population, improve productivity and incomes of all engaged in agriculture and related activities, which
make more than 65 per cent of the population of India’s 1.2 billion people, to alleviate poverty. India will
optimize its agricultural research balancing with highest priority its own domestic needs with the need to
do internationally more profiled research which brings prestige and recognition. India also believes that
excelling in research that contributes to the country’s own development and progress is and continues to
contribute significantly, if exposed appropriately, to International agricultural research for development as
the challenges and solutions to the challenges in India and the solutions based on science and technology
are similar and congruent to the needs of the developing world globally. In fact, technologically, solutions
developed through Indian research and innovation are now finding greater suitability and adoption as they
are more appropriate to farming systems and conditions in Africa, Central, South and South East Asia and
the Small Island states as they are found to be adaptable, appropriate to the local small holder conditions,
affordable, robust and resilient.

The Indian agricultural research and innovation system has to do so in an environment where investment
in research, along with extension and education, though higher compared to many developing countries,
is considered inadequate with the total spending on agricultural R&D as a percentage of agricultural
output (AgGDP) by being only about 0.4 per cent of the agricultural GDP when it should be 1 per
cent. A major concern is in the significant fall in human capacities of almost 17 per cent between
2000 and 2009 in public sector agricultural research organizations combined with a significant
growth in public sector Research Institutes, Universities and employment opportunities for
scientists and technicians in the private sector. The Recent Key Trends facing India according to an
ASTI report (Pal et.al, 2012) is listed in the adjoining Box. As per this study, India faces
inadequate research funding and a shortage trained
human skills in research, extension and education.

The Indian agricultural research system, largely the Indian Council of Agricultural Research (ICAR) with its research Institutes and the State Agricultural Universities (SAUs), are public funded and generate technology, services and products that are largely public goods. There have been tentative steps to encourage commercialization of the technologies and products through public-private partnerships and technology transfer to the private sector for commercial purposes in recent years through programs such as the National Agricultural Technology and Innovation projects. The investment by the private sector in agricultural research has increased several folds in the past decade especially the seed sector. This development not only in seed but other areas such as in farm and food processing machinery and agricultural services such as finance, insurance and knowledge, will put a demand for India’s access to global agricultural technology and services markets.

Driving Forces, Values and Principles for India’s role in IAR

The Informal Retreat discussed:

1. What is the vision of India’s role and place in International Agricultural Research?
2. What is ICAR and the public Sector National Agricultural Research and Innovation System accountable (Goals) for when it pursue its vision? What will India contribute to the World Community? What does it expect from the World Community?
3. Whom does it involve with in pursuing its vision?
4. What tools, skills and behaviors does the national system need in successfully pursuing its vision?

Revisiting the Vision

The revisit of the vision for India’s role and position in international agricultural research was based on the ICAR Vision documents in the past two decades and more emphatically on the ICAR Vision 2030 (ICAR,2012).

Values

The ICAR Vision expresses the values of the Indian Agricultural Research and Innovation System. These Values are indicated as:

Prominent values (beliefs) expressed in the ICAR Vision for India’s role in International Agricultural Research

Some of ICAR’s stated values for participating in IAR:

• Consider persistent hunger and poverty unethical
• Strive for inclusiveness especially of women and youth in agricultural research and development
• Equity in action and in sharing of research outcomes for all stakeholders
• Aid and support through sharing to the deprived and weak across the world
• Long tradition of peaceful co-existence
The Key Driving Forces for India’s Agricultural Research

The Key Driving Forces (Factors that propel/direct action) for India’s agricultural research are:

- External or those forces that are not directly manageable by ICAR were identified as:

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<tr>
<th>Driving Forces that are not manageable by ICAR</th>
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<tr>
<td>• Persistent global hunger and extreme poverty – India has 350 million hungry and poor people of the 1 billion in the world. Many of these people are also malnourished especially the girl child and women.</td>
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<td>• Emergence of highly competitive global agricultural markets for commodities, technology and services</td>
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<tr>
<td>• Climate change, desertification, loss of biodiversity, trans boundary spread of diseases and pests</td>
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<tr>
<td>• Recognition by the global community of India as a Scientific/knowledge power commensurate with the size of its population and strength of its scientific and technical capacities – India has the second largest national agricultural research system in the world but produces only 3 per cent of scientific publications</td>
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<td>• India’s global economic and political influence and being a responsible member of the global community – Participating in IAR is only a very small component of India’s foreign policy based on peaceful coexistence with all.</td>
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- Internal forces or those forces that could be controlled/owned by an organization were identified as:
Principles for India’s participation in IAR

- The principles (Rules that need to be followed for ICAR’s role in International Agricultural Research) are identified as:

  **Driving Forces that could be controlled wholly or partially by ICAR**

  - **Elimination of hunger and malnutrition in India** – All poor (350 million) are hungry with large calorie and protein gaps, Child nutrition appalling in India.
  - **Reduction of extreme poverty in India** – Almost 350 Million poor living less than the nationally established poverty line, most in rural areas
  - **Accelerate national economic development** – Economic growth essential to reduce poverty and hunger as they are intertwined
  - **Fulfilling demand for quality, wholesome and nutritious food** – Major issue for urban populations and with India rapidly urbanizing,
  - **Reduction of losses and waste of agricultural commodities, especially food** – which is the same as growing more with the same resources
  - **More effective market participation** locally and nationally
  - **Effective natural resources management** - Soil/Land, Water, Air, pollution, Energy, Biodiversity
  - **Intellectual pursuit and recognition of scientific capabilities** within India

  **Key principles followed by ICAR for participating in IAR**

  - Should be within overall Indian foreign policy and contribute to strengthen it
  - Should not contradict stated national objectives or damage national interests
  - Should be legal and ethical
  - Should be in area of ICAR/DARE (including State Agricultural Universities) competence or a need expressed by ICAR/DARE
  - Should share and exchange data, information, resources, knowledge, skills and technology equitably
  - Preference to frontline/cutting edge science and technology area important to India
Developing a possible Vision for India’s role and function in International Agricultural Research by 2030

After considering ICAR’s values that can be expressed through research, considering the various driving forces and principles that would guide ICAR in participating in IAR, the participants in the retreat considered:

- “What do we do and need to do?”
- “For whom do we do it?”
- “How do we excel/do the best we can?”

India’s vision for agricultural research is to contribute substantially to elimination of hunger and malnutrition, reduction of extreme poverty, provide technologies for wholesome foods, participate equitably and effectively in global markets, safeguard agricultural biodiversity, use its natural resources for agriculture sustainably and be a recognized influence for the world of its perspectives and needs for agricultural development and progress. Its vision for its role in IAR is:

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Vision Statement for ICAR’s role in IAR

India, as a leading knowledge and technological hub, will be a responsible participant in International Agricultural Research appropriately sharing and exchanging information, knowledge, skills and technology that contributes to sustainable development that is fair and just to all globally.
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Current areas where ICAR contributes or can contribute to IAR

The ICAR currently contributes and can contribute with a little more effort to agricultural research and technology generation globally:

- Capacities to generate Triple A’ technologies -- technologies that are adaptable, appropriate to the local smallholder conditions, affordable, robust and resilient. The technologies include:
  - Crop, livestock, fishery and vegetable varieties
  - Large, Medium and Small Irrigation technologies and management skills
  - Water saving, effective use and augmenting technologies
  - Tillage and planting methods
  - Soil conservation and reclamation methods
  - Fertilizers and nutrient management
  - Small machinery for farm operations, food and feed processing
  - Energy related technologies (for farm operations such as water pumping)
  - Pest and disease control
  - Livestock protection
  - Small holder dairy successes
  - Surveying - including remote sensing capabilities for soil, land use and biodiversity assessments
  - Abilities/Institutional capacities to quickly roll out adaptive research in diverse ecological conditions
• Abilities to deploy advanced biotechnological and bioinformatics tools for improving yield and dealing with biotic and abiotic stresses, and introduce regulatory systems where necessary
• Abilities to use rainfall forecasts in crop planning and management
• Abilities to deal with adverse conditions like drought by developing contingency plans
• Experience of developing technologies for both adapting to and mitigating climate change.
• Introduce emerging technologies like nanotechnology, particularly in water purification and increasing input use efficiencies.
• Manpower development for agricultural research, education and extension in a cost-effective manner.
• Private sector capacities to build and scale up agricultural value chains
• Capacities in public, private and NGO sectors in leveraging ICTs, including Geographic Information Systems and mobile technologies for enhancing productivities and incomes and designing agri-supply chains.

**Goals for India’s agricultural research and its participation in IAR**

The retreat considered the most imperative goals India can itself now set in agricultural research so that it can contribute substantially both to national and, consequently also international needs in the future by 2030 as also how they can be reached. The goals set were SMARTER: Specific, Measurable, Attainable, Relevant, Time bound, Ethical, Rewarding. The retreat also considered how progress on reaching these goals could be monitored through indicators and milestones and how the outcomes and impact could be evaluated and assessed

Two types of goals were set. The first set of the goals were those that would contribute substantially through actions in agricultural scientific research and innovation, education, extension and research management and coordination that would generate information, experience, knowledge, skills and technologies for India’s vision (see above) for research to contribute to agricultural development and progress. The second set of goals were those that would support through necessary substructures of Institutions, Organization transformation, capacities and infrastructure reaching the first set of goals efficiently, effectively, economically and in the shortest period of time.

I. **Goals that would contribute substantially through actions in agricultural scientific research and innovation, education, extension and research management and coordination that**

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1 India went through the same situation now faced in Sub-Saharan Africa in the middle of the last decade and established the Agricultural Universities which made a dramatic improvement in trained manpower. The contributions that these Universities have made to teaching, research and frontline extension are now history. India’s major contributions could be in this area which will be performed in association with the SAUs. **India can significantly contribute to the capacity building of local scientists, farmers, including farm women, and students through training and higher education cost effectively. ICAR can do this in both formal and informal modes through contact and distance learning.**
would generate information, experience, knowledge, skills and technologies to contribute to development and progress through agriculture.

A. Scientific Research

1. Improving production, productivity and income generation of farmers and producers including livestock keepers, fisher-folk and those engaged in activities related to agriculture especially small and medium entrepreneurs in agribusiness is the overarching, primary goal of the public sector Indian Agricultural Research and Innovation System.

Development targets to be achieved by meeting this goal:

- Contribute to reduction of hunger and malnutrition by 50 percent of current status by 2020
- Increase productivity by 40 percent by 2020 specifically by small holder farmers
- Increase incomes to contribute to reduction of poverty of 20 per cent of households dependent on agriculture related livelihoods, as measured by increased number of households above poverty line by 2020.

Reaching this goal is the most important and of highest priority of ICAR’s research efforts. There are several key areas and sub-goals for reaching this overarching goal which are listed below.

The reaching of this goal has to be within the constraints of reduced access to agricultural resources, especially land, water, energy and fossil fuels such as petroleum and coal that contribute to production of fertilizers and the need to conserve and sustainably use all natural resources. There is significant transfer of fertile land to urbanization, roads and industry. There is massive soil degradation and ground water depletion across the country. The effects of climate change are beginning to be felt with greater severity of droughts and floods.

A dominant feature of Indian agriculture is that it is largely smallholder farmer and producer based and much of the new technologies and knowledge needs to be developed through research and innovation for use of this category of farmers and producers. This is both a constraint, as use of available knowledge and technologies from outside India is curtailed by farm size, as also an opportunity for developing new, adopting and adapting available technologies to be more small holder farmer useable.

The research goal will focus on the production of food, especially cereal, pulse and oil seed crops though there is a call for a shift to more higher value crops research. The primary reason is to ensure national food sovereignty as also contribute to stability of food prices in the national and global markets. As India embarks on national programs to ensure household food security, which will increase demand on staples, this research would also be central to ICAR’s research strategy. However, this does not mean that research on fruits, vegetable, livestock production and fisheries will not be emphasized. The key shift for this research would be to improve production, productivity, incomes and quality of products by improving farming and production systems through integration at various levels and enabling more efficient and equitable marketing along food chains to ensure high quality and wholesome foods to consumers. This is also recognition of the fact that Indian agricultural is increasingly becoming more market driven.

Research needed to reach this goal includes:
• Enhancing efficiency of use of resources such as land, water, fertilizers, pesticides, labor etc. in an integrated way at various levels to increase cropping intensity of 180 percent by 2020 from the present 120 percent using the same resources now available.
• Reduce production costs for small and marginal farmers by 10 per cent by 2017 and 30 per cent by 2025
• Enhance farm and individual animal production and productivity of livestock and fisheries with emphasis on integrated farming and production systems and linkages with efficient marketing by 20 per cent by 2020
• Enabling more rapid multiplication of superior germ-plasm of rice, wheat, maize, soya, sorghum, pearl millet, cows, buffaloes, (Fish?) by leveraging Biotechnology and Nanotechnology tools and enabling their more easy and ready access by 2020
• Intensifying isolation of at least 100 genes for traits with economic importance for agricultural production and increasing productivity by 2020
• Development of new farming systems with good agricultural practices through precision agriculture (employing Geo-spatial and information technologies extensively) for small holder farming systems by 2020
• Reclaim and Recover 50 per cent of lands that have gone out of production back to production by 2030
• Establish, enhance and bring efficiency to area specific production to consumption systems across India by 2020
• Development of technologies for end to end use of 5 major indigenous bio-resources for agriculture by 2017
• Consolidation of research on Coastal and Marine Aquatic Systems by 2017
• Sustainable Utilization of Aquatic resources (Fossil fuels, sea drugs etc.) with a focus on enhancing livelihood security of dependent households by 20 per cent by 2020
• Enhance and improvement of facilities and infrastructure for export and import trade and marketing facilities of agricultural commodities through water ways and sea transport facilities such as navigation, port and docking facilities by 2030
• Reduction of environmental footprint by 20 per cent by 2020 by use of green technologies in agricultural production and marketing chains
• Improve efficiency and reduce drudgery of human labor, especially of women, through mechanization of farm operations
• Bring adaptation to and mitigation of effects of climate change with special reference to agriculture and agricultural production
• Reduce post-harvest losses of major crops, fruits and vegetables, milk, meat, eggs and fish by 50 percent by 2020 by developing non shattering crop varieties, automated, mechanical harvesting, modifying Crop geometries, Zero Energy Chilling/Cold Storage for perishable commodities, processing and mass storage in modified storage systems etc.
• Strengthen socio-economic research in agriculture and rural development with emphasis on reduction of hunger, malnutrition and poverty through agricultural knowledge services, technological interventions and development of value addition chains by 2017 with at least 10 per cent of research by ICAR Institutes should be on socio-economics related to agriculture.

2. Improve quality assurance of agricultural commodities and, especially, food safety through improved segregation, identity preservation and traceability and appropriate globally acceptable standards

Research needed to reach this goal includes:
• Improving value chain addition management and marketing in the context of small holder farming by 2017 through use of Information and communications technologies for creating effective linkages, enabling quality and food safety assurance and effective and efficient farmer and producer aggregation through Producer Companies, Cooperatives, Contract farming etc.,
• Improving technologies for segregation, identity preservation and traceability as also labeling of agricultural commodities such as those produced through use of Genetically Modified Organisms, animal products, fruits and vegetables.

3. Develop resilient agricultural systems

Research needed to reach this goal includes:

• Implement research programs in resilient agriculture through mitigation and adaptation strategies to climate change, carbon sequestration in soil and vegetation through woody perennial based systems, Crop varieties CVS tolerant to abiotic and biotic stresses, modification of agronomic practices taking into consideration threat perception, disease and pest management, forecasting etc by 2017.
• Socio-economic and Management related research on small holder farming and production to contribute to resilient agriculture such as in financial and knowledge services, weather information, agricultural input access, insurance, risk aversion and mitigation etc. by 2017.

4. Conserve and effectively use India’s immense agricultural biodiversity of plants, animals, fish, insects and microbes

Research needed to reach this goal includes:

• Initiate inventory and catalogue of genes and traits with genomic and phenomic databases mapped geo-spatially and linked to retrospective weather and other environmental data by 2015 and complete 50 per cent of inventory by 2020.
• Strengthen bioinformatics research with appropriate infrastructure for data analysis including “supercomputers,” high speed computer networks linking Research Institutes, Universities and Centers of Excellence in Science and Technology by 2017. The ICAR has to include research institutions and organizations, facilities and capacities outside the public sector agricultural research system.

5. Manage the spread of and reduce the socio-economic impact of plant, animal and fish trans-boundary and zoonotic diseases through an integrated, trans-disciplinary approach

Research needed to reach this goal includes:

• Identifying important Trans-Boundary and Zoonotic Diseases (TBDs) threatening South Asia and India by 2014
• Establish detailed disease intelligence and epidemiological studies for identified important TBDs and Zoonoses by 2017
• Establish capacities for rapid diagnostics and further develop diagnostics for important TBDs by 2017
• Establish effective nation plant, animal and fish disease surveillance and monitoring systems by 2017
• Create public and farmer awareness about all important TBDs and their management and control by 2017 so that public reporting of suspected TBDs occur in all outbreaks
• Establish Emergency Control Mechanisms for TBDs of high economic importance by 2020
• Establish Climatology research in relation to TBDs
• Establish Socio-Economic research on effects of TBDs on communities, farmers and producers

6. **Strengthen research that contributes to India’s more effective participation in global agricultural commodities trade, including processed foods, as also technology and services markets.**
   - Establish market research and intelligence programs for agricultural commodities, technology and services markets with forecasting and forward looking capacities
   - Contribute to Indian policy and strategy development related to agricultural trade in commodities, technologies and services including contract research
   - Establish a trade enquiries unit in ICAR as a single window service which responds in time and with appropriate information on trade related enquiries.

7. **Gain recognition in research through high impact publications and conducting research in basic and frontline/cutting edge areas**

   India’s research in agriculture and related areas remains low in global impact as measured by number of publications and their citation indices compared to its scientific manpower strength. This has many causes including lack of high profile Indian scientific journals, research done to meet national development needs which are not mainstream research in western science, poor scientific communication skills etc. India has to do research that is basic and frontline/cutting edge to build its capacities for the future, encourage its researchers and gain recognition as a country with significant scientific and technical strengths capable of contributing to the universal goals for advancement of science and technology. The frontline/cutting edge research areas for Indian contribution are bioinformatics, genome sequencing and mapping, gene discovery, biological nitrogen fixation, C3-C4 photosynthesis, managing natural disasters, agricultural applications of new information and communications technologies such as for modeling, simulation and knowledge based systems and map based services, precision agriculture for smallholder farmers, materials for agriculture and farming, use of geo-spatial data for crop, farm and production monitoring and for environmental research. It may also be noted that many of these areas will be mainstream research by 2020.
   - Increase and improve impact of its research publications through supporting current and establishing new journals which have high profile, capacity building in scientific publications and encouraging publication of research in research areas that are relevant at the global levels. India should be in the top 5 publishing countries in agriculture and related sciences by 2020

I.B. **Agricultural Extension**

Agricultural extension and rural advisory services in India today faces a challenge of rapid transformation. Extension and advisory services now need to cater to needs of an agriculture that is rapidly becoming more market oriented. Individual farmers and agricultural communities need customized knowledge and skills enhancement services. Advisory services now need to offer not only
advise but advise with a basket of options in the solutions the farmer, producer, processor or market intermediaries and consumers face.

New actors, including the private and civil society/community sectors and philanthropies, now offer rural and agricultural advisory services. The Indian agricultural research and innovation system has now to also perform as a knowledge, skills and technology feeder service for these actors in addition to supporting technology and skills transfer and innovation directly through Krishi Vigyan Kendras (KVKs).

New information and communications technologies have great potential for the entire national agricultural research and innovation system to offer advisory services as also knowledge feeder services as an integrated, coherent system.

Research needed to reach this goal includes:

3. **Research in Agricultural Extension policy, strategy, organization, monitoring, evaluation and impact assessment**

   - Basic, Strategic, Adaptive and Frontier Research in Extension by creation of State of Art infrastructure by 2017, Quality Human resource by 2020 with adequate funding, enabling research environment and effective monitoring and evaluation system
   - Research to strengthen further Krishi Vigyan Kendra Networks to provide single window information, new knowledge, skills and technology and advisory services appropriate to needs of individual farmers and farming communities with extensive use of new information and communication technologies and integrate with ATMA centers
   - Research in Extension and Rural Advisory policy and strategy with identification of missing links in extension policy including that at National, State and Local levels, development of technology adoption Indices and validation, HRD Index etc. by 2017

4. **Establish Videsh Krishi Vigyan Kendras (Foreign Agricultural Science Centres) as outposts for India’s contribution to agricultural research and development and technology transfer globally**

   - Share India’s experience, knowledge, skills and technology in agricultural development offer research, education and advisory services through a single window approach by Videsh Krishi Vigyan Kendras (Foreign Agricultural Science Centers) established in different countries which will include development of database to identify where VKVKs are needed and what roles they can have, initiating Pilots and Replicating success stories of Indian KVKs and Socio-economic Impact analysis. At least 8 Videsh Krishi Vigyan Kendras established in Sub Saharan Africa, Central and South East Asia established by 2017.
   - Promote and support farmer and agribusiness entrepreneur exchanges between India and other countries
   - Develop Agricultural Technology and Services Parks and Incubators at State levels and around agricultural commodities and products

**I.C. Agricultural Education**

Agricultural education in India fulfills the capacity needs of its agriculture by providing new knowledge and skills. Agricultural education, like research and extension, also needs to undergo a transformation in
the country as it strives to become a knowledge based society with agriculture and agribusiness becoming even more knowledge based and demanding rapid innovation in agricultural production, value addition and market chains. Agricultural education now needs to open new avenues in both formal education as in schools, colleges and Universities and in informal learning in agricultural communities.

Indian has 63 agricultural Universities producing 24000 agricultural and veterinary graduates. However, its human capacities in research have reduced by 17 per cent in the past decade and there remains a severe shortage of veterinarians and graduate field extension personnel. A large number of agricultural graduates are employed in banking, insurance and other non-agriculture related occupations. Postgraduate veterinarians are mostly absorbed into the private sector especially the pharmaceutical industry. Agricultural education in the country is not now perceived as of very high standards.

There is very little offered in terms of informal learning to agricultural communities. Even a dedicated TV channel for agriculture is not in operation in spite of TVs spread across the country. The radio channels established during the green revolution have slowly decayed instead of being strengthen and Community radio has not been very well exploited for agricultural learning and information dissemination. A large number of ICT based agricultural information platform have been established but these have had problems of being scaled up and out and in being sustainable in content and financially.

There is an urgent need to revamp formal agricultural education and bring informal learning in India. This needs to be done through consolidation of Institutions, strengthening linkages between Institutions, change in University statutes to include off campus education especially continuing education, organizational setup to include new disciplines and areas of learning, curriculum changes, quality assurance, training of faculty and academic managers etc.,

The key goals to improve agricultural education in the short and medium term by 2025 are:

1. **Develop 5 Agricultural Universities and Deemed Universities to be among the top 20 agriculture related universities in the world in academic excellence and infrastructure by providing academic autonomy and good governance, attracting the best faculty from within and outside the country, attracting foreign students through open entry and scholarships and adequate funding by 2025**

2. **Improve agricultural education through change in curriculum to attract students with inclusion of entrepreneurship skills and new disciplines related to biotechnology, nanotechnology, Information and Communications Technologies, Space sciences and Material sciences and capacity development through training of faculty in teaching methods, curriculum and syllabus development and in managing academic programs by 2017**

3. **Develop functional linkages between agricultural universities to exchange faculty and students by 2017**

4. **Establish quality assurance in University education through a University Grant Commission like Institution for Agricultural education by 2017**

5. **Mandate Agricultural Universities, Deemed Universities, ICAR Institutes and Centre’s of Excellence to provide and support informal learning in agricultural communities and continuing education to agricultural professionals by 2017**

**II. Goals that would support through necessary substructures of Institutions, Organization transformation, capacities and infrastructure to contribute to research, extension and education goals set above**

For India to further develop excellence in its agricultural research and innovation system, attention now needs to be paid in its research management and Institutional development to bring greater efficiency and
impact of its agricultural research and innovation. The key issues are of coherence, integration, consolidation and coordination within, between and across the entire national agricultural research and innovation especially the ICAR Institutes and State Agricultural Universities who are and will continue to have dominant presence in agricultural research in India for the foreseeable future.

A. Research Management and Institutional Development

The Indian research system has a unique Institution in the National Academy of Agricultural Research Management (NAARM). NAARM is a world-class research and training academy in the area of ‘Agricultural Research Management which includes education and extension systems management also. This potential has to be now exploited by strengthening and further utilizing it to train a cadre of ‘System Managers” for agricultural research who will be responsible to bring the transformation of the Indian agricultural research and innovation system. This will also require strengthening of research in managing research, education and extension and of issues relating to technology development, dissemination and effective use.

The research needed to improve agricultural research management and Institutional development includes:

1. Research for new approaches and processes for management of public sector agricultural research and innovation systems to improve efficiency and impact and to include new actors such as the private sector and the civil society especially farmer organization and non-government organizations in agricultural research and innovation through Challenge research, Corporate research, Venture Capital Research, Idea Banks, research, data matrix, information for policy research by 2017
2. Research to further develop the Monitoring and Evaluation of Research, Extension and Education Programs with greater inclusiveness and participation of key stakeholder groups in entire program cycles from agenda setting to impact assessment by 2017. This will entail revisiting current accountability and reward systems including the ASRB scorecard and providing strong incentives for specialists to continue their specialist interests by 2015
3. Setting up of a research based support system for the national research and innovation system to participate effectively in international agricultural research through appropriate policies, strategies and coordination by 2017
4. Establish National Agricultural Forward Thinking Platform with Links to Global Forward Thinking Platform
5. Set up a research based support system for the national research and innovation system to participate effectively in international agricultural research through appropriate policies, strategies and coordination

B. Institutional and Organizational Transformation Goals

1. Develop improved linkages, coordination and integration of research, extension and education systems with introduction of multi-disciplinary and trans-disciplinary programs and activities with focus on biotechnology, nanotechnology, information and communications technologies, space science and materials science by

   • Enhancing Investment in agricultural research and innovation to 1 percent of Agricultural GDP by 2017 reducing inefficiencies by Identification of inefficient resource sinks 2015 and tapping non-public investment 2016.
• Consolidate the public sector National Agricultural Research and Innovation System Revisiting NARS (For Optional Resource Utilization) 2017 by re-mandating the Role of ICAR and SAUs, enabling policies for strengthening Centre-State relationships related to agricultural research, commiserating ICARs role similar to University Grants Commission in case of agricultural education through an act of Parliament by 2017
• Integrate Information Flows across the public sector National Agricultural Research and Innovation System by revitalizing Agricultural Research Information System which is mandated to manage information at Institute and University level with a duly trained, professional cadre of information managers

How can ICAR excel in IAR?

Some suggestions for ICAR participating more effectively and excelling in IAR are:

<table>
<thead>
<tr>
<th>Some suggestion about how we can excel in participating and contributing effectively to IAR</th>
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<tbody>
<tr>
<td>• Doing cutting edge/frontline research</td>
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<td>• Coordinating our research</td>
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<td>• Publishing our research, knowledge, skills, technology modestly and inspiring trust</td>
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<td>• Participating with a firm voice and in a decisive manner in forums and organizations related to International Agricultural Research at global, international and regional levels</td>
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<tr>
<td>• Assuming leadership roles in forums and organizations related to IAR at global, international and regional levels</td>
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<td>• Building negotiation and partnership skills</td>
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<td>• Offering our knowledge, skills and technology fairly even in competitive markets</td>
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<td>• Creating trust among partners</td>
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<td>• Training foreign scientists/teachers at research facilities and providing University education in agriculture</td>
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<td>• Collaborate in bilateral and multilateral Research Programs and develop joint research program and join relevant International research programs where India can contribute usefully</td>
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<tr>
<td>• Build an International Agricultural Research Unit with skilled manpower and Intelligence gathering about International Agricultural Research</td>
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<td>• Build International Agricultural Research Outposts such as being done by Brazil</td>
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<td>• Develop Laboratories and Field Stations in Foreign Countries</td>
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<td>• Share and exchange technology, seeds, plant, animal, microbial germ-plasm and related information with Foreign Countries</td>
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<tr>
<td>• Train manpower in managing International Agricultural Research</td>
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<tr>
<td>• Support quality assurance in research, education and technology generation</td>
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What India needs from the International Community for its research, extension and education?

India needs:

- Bioinformatics data and information for developing appropriate technologies to improve crop, plant and fish productivity, adapting to and mitigating effects of climate change and for managing agricultural biodiversity
- Research skills in value addition chain and innovation research
- Skills for analysis, modeling and simulation for genomic research
- Skills for managing, especially integrating, coordinating and setting up monitoring and evaluation for agricultural research and innovation systems
- Skills and technologies for plant, animal and fish disease surveillance, monitoring and rapid diagnosis and emergency management of outbreaks

Who will India partner with in IAR?

India at the national level will judiciously partner with all multilateral global initiatives in IAR such as those led by CGIAR, UN/FAO, GFAR, G20, OIE, World Bank/IMF, IFAD, Multi-country arrangement such as of Brazil, Russia, India, China, South Africa (BRICS), India, Brazil, South Africa (IBSA), Africa Fund, Regional initiatives by Regional Organization in Asia and Africa including those SAARC, ASEAN and APAARI and bilaterally with individual countries.

At the Institute, University and Research Project level, India will enable based on its principles for participating in IAR, equitable partnerships, which share, exchange and jointly generate data, information, new knowledge, skills, technology.

India will pay special attention to contribute to building capacities in agricultural research, extension and education to countries in Sub-Saharan Africa, Central Asia and Small Island States.

Conclusion

India is a rapidly growing geo-political, economic and knowledge power at regional and global levels. With the second largest national agricultural research and innovation system in the world, it has made universally acknowledged progress in agricultural development using science and technology in the last 50 years. Globally, agriculture and with it, agricultural research are transforming. New challenges in adapting to and mitigating the effects of climate change, the efficient and sustainable use of natural resources, especially water and land for agriculture, reducing environmental degradation and effecting its recovery, loss of biodiversity, spread of trans-boundary diseases and pests and effectively participating in highly competitive agricultural commodities, technology and services markets across the world are now the main driving forces for agricultural research and innovation. National strategies for development are also shifting. The fast growing economies with large capacities in agricultural research have now started realizing the role of supporting agricultural innovation and research systems not only for their economic growth but also for “soft diplomacy”. All these affect India’s role and position in International Agricultural Research.

For the Indian agricultural research, the highest priority is to ensure adequate production to feed its population, improve productivity and incomes of all engaged in agriculture and related activities, which make more than 65 per cent of the population of India’s 1.2 billion people, to alleviate poverty. India will
optimize its agricultural research balancing with highest priority its own domestic needs with the need to do internationally more profiled research which brings prestige and recognition. India also believes that excelling in research that contributes to the country’s own development and progress is and continues to contribute significantly, if exposed appropriately, to International agricultural research for development as the challenges and solutions to the challenges in India and the solutions based on science and technology are similar and congruent to the needs of the developing world globally. In fact, technologically, solutions developed through Indian research and innovation are now finding greater suitability and adoption as they are more appropriate to farming systems and conditions in Africa, Central, South and South East Asia and the Small Island states as they are found to be adaptable, appropriate to the local small holder conditions, affordable, robust and resilient.

The Informal retreat discussed in detail what is India’s vision and where it needs to focus in the future to improve its contributions by identifying SMARTER goals for research, extension, education and research management and what transformational changes the ICAR needs in its Institution, Organization, Structures, Work processes to deliver the vision and the goals set thereof. The retreat has also identified how ICAR can excel in contributing to and participating in IAR and who it can work with.

References:


Annexure

1. Program

<table>
<thead>
<tr>
<th>Day and Time</th>
<th>Agenda</th>
<th>Facilitator</th>
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<tbody>
<tr>
<td>Tuesday, 28/12/2012</td>
<td>Welcome to Participants and Introduction to the Retreat by Dr. S. Ayyappan DDG, ICAR and Secretary, DARE</td>
<td>Dr. S. Ayyappan</td>
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<tr>
<td>9:00</td>
<td>Introduction by Participants</td>
<td>Participants</td>
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<tr>
<td>9:15</td>
<td>Setting the norms for the Retreat</td>
<td>Facilitated by Ajit Maru</td>
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<tr>
<td>9:30 – 12:30</td>
<td>Session 1: India’s Vision about its role in International Agricultural Research</td>
<td>Group Work by Participants</td>
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<td>12:30-14:00</td>
<td>Lunch</td>
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<tr>
<td>14:00 – 17:00</td>
<td>Session 2: Setting Goals for 2015, 2020 and 2030 to achieve India’s vision in International Agricultural Research</td>
<td>Group Work by Participants</td>
</tr>
<tr>
<td>Wednesday, 29/12/2012</td>
<td>Session 3: Developing a Strategy to achieve the goals for India’s vision for International Agricultural Research</td>
<td>Group Work by Participants</td>
</tr>
<tr>
<td>9:00 – 12:00</td>
<td>Wrap up and Closure of the Retreat</td>
<td>Dr. S. Ayyappan</td>
</tr>
<tr>
<td>12:00-12:30</td>
<td>Lunch</td>
<td></td>
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</table>

- Tea/Coffee will be available during the Group Work Session.

2. List of Participants (Please add)