

Brainstorming Session
on
**MODELS OF PUBLIC-PRIVATE
PARTNERSHIP IN AGRICULTURAL
BIOTECHNOLOGY**

April 7, 2007
New Delhi



HIGHLIGHTS AND RECOMMENDATIONS

Organized by



Asia-Pacific Consortium on Agricultural Biotechnology
C/o ICRISAT, NASC Complex, Dev Prakash Shastri Marg, Pusa Campus
New Delhi 110 012, INDIA

Trust for Advancement of Agricultural Sciences
Avenue II, Pusa Campus, New Delhi 110 012, INDIA

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Foreword

During the past few years, crops raised through genetic modification technology have been gaining increasing acceptance in the developing countries. India experienced an unprecedented increase in Bt cotton acreage during 2006, increasing from 1.3 million hectares to 3.8 million hectares in one year. The success of Bt cotton has its foundation in partnerships comprising one company providing technology, another transferring the technology in Indian germplasm, and the third, the farming community that recognized the potential of insect resistant cotton and adopted the Bt hybrids with great enthusiasm. Over the past few years, similar partnerships for transferring the laboratory successes of biotechnology to farmers' fields have been developed among different sectors including public institutions, private companies, farmers' associations and NGOs. Golden Rice Humanitarian Board and ABSP II project on borer resistant brinjal are some of the prominent examples. However, it is also appreciated that more partnerships need to be built and impediments in the path of building partnerships overcome.

Recognizing the need to initiate a dialogue on public-private partnership involving all the concerned stakeholders, APCoAB organized a "Brainstorming Session on Public-Private Partnership in Agricultural Biotechnology" in March 2005. The Session was attended by experts on crop biotechnology, crop breeding, IPR, policy and planning, representing NARS, government science and technology departments, CGIAR Centers, private sector and NGOs. One of the recommendations of the Brainstorming Session was to define specific models of partnerships that could be considered by the policy makers for starting negotiations and taking decisions. The "Brainstorming Session on Models of Public-Private Partnership in Agricultural Biotechnology" held on 7 April 2007 is a follow-up of this recommendation. This publication is an outcome of the discussions held in the meeting which highlighted different models of public-private partnership in agricultural biotechnology presently in operation, identified constraints experienced while operating these models and made important recommendations on policy, infrastructure and operational modalities for developing successful partnerships.

We are thankful to the participants for making the meeting a success and look forward to progress in forging more intersectoral partnerships in agricultural biotechnology in the Asia-Pacific region. It is our hope that the recommendations of the meeting brought out in this publication will be useful to policy makers, research managers and researchers in all sectors to help build a strong public-private partnership for the benefit of farmers and other stakeholders in the region.



(Raj Paroda)
Executive Secretary
APAARI

Acronyms and Abbreviations

ABSP	Agricultural Biotechnology Support Project
AVRDC	Asian Vegetable Research and Development Center
ADG	Assistant Director General
APAARI	Asia-Pacific Association of Agricultural Research Institutions
APCoAB	Asia-Pacific Consortium on Agricultural Biotechnology
Bt	<i>Bacillus thuringiensis</i>
CASA	Centre for Advancement of Sustainable Agriculture
CGIAR	Consultative Group on International Agricultural Research
CIMBAA	Collaboration on Insect Management for Brassicas in Asia and Africa
CSIR	Council of Scientific and Industrial Research
DBT	Department of Biotechnology, Government of India
DST	Department of Science and Technology, Government of India
ELISA	enzyme linked immunosorbent assay
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuria
FAO	Food and Agricultural Organization of the United Nations
IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFSSA	Indian Foundation Seed and Services Association
IIT	Indian Institute of Technology
IIVR	Indian Institute of Vegetable Research

IPR	intellectual property rights
IVRI	Indian Veterinary Research Institute
Mahyco	Maharashtra Hybrid Seed Company
MARDI	Malaysian Agricultural Research and Development Institute
MTA	material transfer agreement
NAIP	National Agricultural Innovation Project
NARS	National Agricultural Research System
NATP	National Agricultural Technology Project
NBRI	National Botanical Research Institute
NCAP	National Centre for Agricultural Economics and Policy Research
NIPGR	National Institute for Plant Genome Research
NGO	non-government organization
NRCPB	National Research Centre on Plant Biotechnology
PPP	public-private partnership
PPV&FRA	The Protection of Plant Varieties and Farmers' Rights Act, 2001
R&D	research and development
SMTA	Standard Material Transfer Agreement
SWOT	Strength Weakness Opportunity Threat
TAAS	Trust for Advancement of Agricultural Sciences
UAS	University of Agricultural Sciences, Dharwar
UK	United Kingdom
UPOV	The International Union for the Protection of New Varieties of Plants
USA	United State of America

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MODELS OF PUBLIC-PRIVATE PARTNERSHIP IN AGRICULTURAL BIOTECHNOLOGY

1. Introduction

Developing countries have made substantial progress at improving food security, reducing poverty and improving human health. This has largely been achieved through growth in agriculture leading to increased food and feed production and improved farm incomes. However, lately there has been stagnation in agricultural growth giving rise to concerns about food and livelihood security of large sections of population who make their living out of agriculture and related enterprises. Developments over the last two decades indicate that biotechnology has the potential to enhance productivity, profitability and environmental sustainability of farming systems. The widespread adoption of Bt cotton in India and China and Bt maize in the Philippines are clear indicators that biotechnology is able to deliver appropriate solutions to the problems faced by farmers in the developing countries.

Agricultural biotechnology research and development are being carried out by several organizations including global private sector companies, public sector organizations in national research systems, Consultative Group on International Agricultural Research (CGIAR) centers and other national and international initiatives funded by various agencies. Despite the progress so far, it is being widely recognized that public and private sectors need to capitalize on mutual strengths to accelerate the process of development and field deployment of genetically modified crops so that the promised benefits reach the resource poor farmers. During the past few years, several partnerships have been developed within and between public and private sectors with the objective of achieving these goals. These partnerships include transfer of technology (genes for desired traits) made available under certain financial terms and conditions, outright donation of technology, knowledge sharing, and capacity building. While some of the public-private partnerships (PPPs) have been able to deliver the anticipated results in the form of improved varieties/hybrids with high farmers' acceptability, others are yet to achieve the desired goals. In fact, successful partnerships in agricultural biotechnology especially between public and private sectors are still rare because of several constraints, viz. different objectives of each sector, high transaction costs of operationalizing and coordinating the partnerships, mutual mistrust, and negative perceptions.

Appreciating the important synergistic role of PPP in delivering the required inputs and technologies to the farmers, Asia-Pacific Consortium on Agricultural Biotechnology (APCoAB) organized a “Brainstorming Session on Public-Private Partnership in Agricultural Biotechnology” in March 2005. One of the recommendations of the session was to define specific models of partnerships that could be considered by the policy makers for starting negotiations and taking decisions. The present “Brainstorming Session on Models of Public-Private Partnership in Agricultural Biotechnology” held on 7 April 2007 was a follow-up of this recommendation. The session was attended by 46 participants including policy planners and scientists from government departments, Indian Council of Agricultural Research (ICAR), private sector, CGIAR centres and non-government organizations (NGOs). The proceedings were organized in following four sessions:

- I. Inaugural session
- II. Existing Models of Public-Private Partnership
- III. Issues in Public-Private Partnership
- IV. The Way Ahead

2. Inaugural Session

The session was chaired by Dr. Raj Paroda, Executive Secretary, Asia-Pacific Association of Agricultural Research Institutions (APAARI) while Dr. S.A. Patil, Director, Indian Agricultural Research Institute (IARI) was the chief guest. Dr. J.L. Karihaloo, Coordinator, APCoAB welcomed the participants on behalf of APCoAB/APAARI and Trust for Advancement of Agricultural Sciences (TAAS) mentioning that this was second initiative taken by APCoAB to bring together policy planners, research managers and scientists from public and private sectors to deliberate on the important agenda of building partnerships in agricultural biotechnology. Dr. Mruthyunjaya, National Director, National Agricultural Innovation Project (NAIP) in his special remarks acknowledged the pioneering efforts of Dr. Paroda in initiating the concept of PPP and working towards it within the national agricultural research system. Dr. Mruthyunjaya mentioned that progress had been made particularly by way of formulation of intellectual property rights (IPR) policies by the ICAR, better appreciation of strengths of public and private sectors and creation of more favourable operating environment. However, much greater progress is expected in view of a number of emerging needs which will work as driving forces for PPP. Market forces will determine the future research agenda and, hence, organizations with market research and forecasting capabilities would need to be partnered. Global climate change, and soil and water scarcity are emerging as the major challenges to agricultural sustainability, for which multidisciplinary and multiinstitutional efforts would be required. Use of cutting edge technologies and forging partnerships across institutions and sectors is imperative to achieve the desired growth and bring about economic upliftment of farmers.



Welcoming the dignitaries in Inaugural Session. Participants attending the brainstorming session.

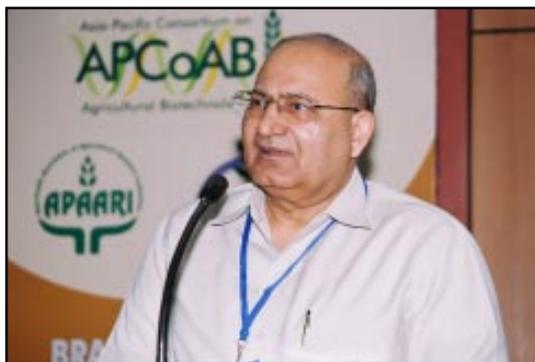
Dr. Wayne H. Freeman, Member, Board of Directors, Barwale Foundation expressed his appreciation of the choice of topic since partnership among different sectors, instead of competition, is need of the hour. He praised the enormous contribution of public sector organizations to agricultural research while mentioning that private sector has played a significant role in translating the research into products for farmers' use. Free exchange of technology and planting material was the key factor responsible for the success of green revolution. Biotechnology holds enormous potential but also poses new challenges to PPP with regulatory and IPR issues becoming crucial. Several models of IPR management are already available; ICAR has developed IPR management guidelines while Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA) and several American universities have IPR cells to resolve such issues and remain abreast of the evolving laws and regulations. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) model of germplasm development and sharing with private sector and other initiatives on PPP are working very satisfactorily and similar efforts are underway at the Barwale Foundation. Dr. Freeman felt that there is a need for wider dialogue to review the roles of public and private sector organizations, delineate responsibilities and create favorable environment for PPP to operate successfully and help in meeting the goal of food and nutritional security.

Dr. Raj Paroda in his address explained the genesis of APCoAB's initiative in organizing discussions on PPP in agricultural biotechnology. He mentioned that the first brainstorming session highlighted the need for partnership across various sectors while the present one would review the progress made in developing such partnerships over the last few years. It is being widely recognized that all the multifarious activities from research to marketing of finished products cannot be undertaken by public or private sector alone. However, developing partnerships needs policy support and enabling environment.

Dr. Paroda recalled some earlier initiatives of ICAR in developing PPP in hybrid seed and biotechnology. The success of hybrid rice had its foundation on the decision taken by ICAR to share the parental material with the private sector. Even the dialogue with Monsanto

for transfer of Bt cotton technology to India was initiated by ICAR and Department of Biotechnology, Government of India (DBT). Subsequently, Mahyco went into partnership with Monsanto, which finally resulted in the introduction of Bt cotton in India. Starting from 2002 when the first Bt hybrids were released, Bt cotton now occupies about 3.5 million hectares. Further, Bt technology has been sublicensed to several other private companies and more public-private partnerships have been initiated for development and deployment of insect resistance genes in cotton. There is a need for similar partnerships for exchange of germplasm and seed production with appropriate benefit sharing mechanisms and IPR protection. Food and Agricultural Organization of the United Nations (FAO) has already approved the Standard Material Transfer Agreement (SMTA) for sharing of germplasm with a benefit sharing mechanism that could serve as a model for entering into agreements with the private sector. Similar arrangement could be made for sharing of parental lines developed in public sector for hybrid seed production by private sector. For such partnerships, appropriate models need to be developed based on recognition of each other's strengths and mutual trust.

Dr. Paroda felt that since the process of development and release of biotech crops is expensive and time consuming, there is greater need for PPP in the agricultural biotechnology



Lectures being delivered by (clockwise) Dr. Raj Paroda, Executive Secretary APAARI; Dr. Wayne H. Freeman, Member Board of Directors, Barwale Foundation; Dr. Mruthyunjaya, National Director, NAIP and Dr. S.A. Patil, Director, IARI.

sector. While genes, appropriate germplasm and technological skills are available in the public sector, the process of field release involves extensive environmental and human safety testing. Collaborative efforts of public and private sectors would greatly expedite the process of development and regulatory testing of biotech crops which would ultimately benefit the farmers and other stakeholders. There is also a need for changing the mindset and inculcating corporate culture in the public sector. While the desired changes have already taken place in EMBRAPA and Malaysian Agricultural Research and Development Institute (MARDI), in the Indian agricultural research system, NAIP, IARI and National Centre for Agricultural Economics and Policy Research (NCAP) could initiate such a process.

In his inaugural address, Dr. S.A. Patil, emphasized that adoption of new technologies is imperative since agricultural production is stagnating and soil and water degradation are posing formidable challenges to planners and scientists. Biotechnology has already proved its potential as evidenced by the phenomenal success of Bt cotton in India. Dr. Patil informed that PPPs have been initiated at University of Agricultural Sciences, Dharwar (UAS) and IARI, New Delhi and these have resulted in substantially enhanced seed production of public bred varieties and their adoption by farmers. However, there is a need to develop appropriate models and guidelines for such partnerships which could serve as reference models for entering into future agreements and for negotiating terms of benefit sharing. In view of the time consuming and expensive testing required for release of biotech crops, Dr. Patil emphasized the need for establishing environmental testing facilities in the public sector. He also suggested that public sector scientists involved in biotech research should meet twice every year to exchange information, and develop networks and partnerships. He mentioned that the private sector would be interested in proven technologies and products and, hence, there is a need for their critical assessment before initiating PPP negotiations.

3. Technical Session I: Existing Models of Public-Private Partnership

The session was chaired by Dr. S.A. Patil. Five lectures were delivered during the session.

Dr. Arvind Kapur, Managing Director, Nunhems Pro-Agro Seeds listed the benefits of PPP in agribiotech, especially for the developing countries. These include, sharing of each other's competence and cost of product development, faster product development and facilitation of product acceptability by farmers and consumers. As an example, he gave details of the PPP project being undertaken in vegetable biotechnology under the aegis of Collaboration on Insect Management for Brassicas in Asia and Africa (CIMBAA). The project showcases the joint investment and collaborative research involving ICAR, India; Asian Vegetable Research and Development Center (AVRDC), Taiwan; University of

Melbourne, Australia; Natural Resources Institute, University of Greenwich, UK; University of Cornell, USA; and Nunhems, India.

The severity of loss in cauliflower and cabbage due to diamond back moth infestation and the use of large quantities of pesticides leaving residues in the edible product, prompted the international institutions, national research organizations and the private seed company to join hands in resolving the problem. CIMBAA model is in a way unique as there existed no previous PPP model in vegetable research or marketing. The model, therefore, relied on the public sector for socio-economic and ethical evaluation of the project, facilitating regulatory approval within the established norms and infrastructure facilities, and management of stewardship training in taking the product to the public. The role of private establishments was in sourcing of technology (a stacked gene product for durable insect resistance), conducting field trials and stewardship till the product initiation stage, from where it is to be carried forward to product development stage by the public institutions. It was suggested by Dr. Kapur that these partnerships would acquaint both the partners to each other's capacities without conflicts of interest, enable appropriate use of basic research for applied and strategic investment, introduce contract research system for end-to-end development, explore farmers' and users' capacities in implementing new developments with assured safety parameters, and evolve new modalities of producing and marketing biotechnology products at commercial level and within rural environments.

Dr. Vinod Kumar, Syngenta India cited two examples of Syngenta partnerships to highlight the successes that could be achieved with mutual benefits to public as well as private partners. The first model referred to the development of a collaborative project on Anthracnose resistance in hot pepper where the project was carried out by Syngenta Seeds Korea and two other private companies with Seoul National University. The resistance was discovered by Seoul National University and the university used the funding provided under the project to generate new breeding materials for exchange with the partner companies who are using them in their respective breeding programs. The second model comprised the development of molecular marker for the TY 2 gene, conferring leaf curl virus resistance in tomato, by AVRDC, Taiwan, through a joint funding by several seeds companies including Syngenta. The molecular marker is helping the companies to select for leaf curl virus resistance at seedling stage, thus significantly improving breeding efficiency and speedy delivery of products to market. These are just two examples of how the relative strengths of the public and private sectors can be complemented to deliver valuable products for the grower, while furthering knowledge that is available for everyone to learn from.

Mr. Raju Barwale, Managing Director, Mahyco described a model that partnered NGOs with public and private sectors to popularize Bt cotton in India. The company realizes the importance of involving both public partners and NGOs in ensuring delivery of the product to the farmers and help the consumers to make an informed choice. Mr. Barwale felt that trust on the product among the farmers and consumers can be better developed through an all sector involvement where the company's sole interests do not get overemphasized

and the technology's worth can demonstrated independently. This not only lends support to the technology developing agencies, whether in public or private sector, but also develops their confidence to invest in appropriate research and development (R&D) in biotechnology.

Mr. Barwale suggested that even basic research projects could be executed in public-private partnership mode as exemplified by the Mahyco-DBT partnership on plant genomics. More such collaborations could be developed whereby the outputs of high investment agricultural biotechnology research could be quickly translated into farm-use products making agricultural production economically rewarding. A partnership similar to Agricultural Biotechnology Support Project (ABSP) II, involving several government and non-government agencies could be taken as a model for PPP in upstream research areas targeted at product development.

Indian Foundation Seed and Services Association (IFSSA)-IARI Model presented by Dr. Gowri Sankara Rao of IFSSA, a non-profit organization, highlighted the benefits of partnering a private agency in seed production of hybrids developed in public sector. Such partnerships could overcome the limitations faced by seed production system in the public sector particularly for production of hybrid seed.

The model presented by Dr. Gowri Sankara Rao links the R&D units involved in initial development of the product with the seed industry or an exclusive seed promoting intermediary responsible for maintaining the parental lines of the hybrid. The partnership ensures that the innovator institution is able to generate revenue while also ensuring that sufficient quality material of the parental lines is available to meet the seed industry demands. This model also introduced the concept of an intermediary private agency or NGO as the "sponsored breeder" representing the initial breeder's variety or hybrid.

From the IARI side, Dr. Hari Prasad elaborated upon the effectiveness of this partnership in popularizing a hybrid developed at IARI and expanding its coverage among the farmers. He also detailed the role of such linkages in encouraging the innovating institutions to expand their program by focusing mainly on nucleus seed production of the parental lines and initiating further advancement in yield and quality improvement. The significant revenue gains made by IARI through such partnerships were also detailed in this presentation.

Dr. Mathura Rai, Director, Indian Institute of Vegetable Research, Varanasi (IIVR) highlighted the ABSP II model in which Mahyco; IIVR; UAS, Dharwar; and Tamil Nadu Agricultural University, Coimbatore are involved in development of transgenic brinjal varieties resistant to fruit and shoot borer. In this project, ABSP provided the funding, DBT the regulatory support, Mahyco provided the *cry* gene and IIVR has the responsibility to develop the resistant varieties. Emphasizing the importance of borer resistance in brinjal, Dr. Rai mentioned that insecticide sprays account for 36% of the cost of cultivation in brinjal. Initial results indicate that transgenic lines show less than 1% borer infestation compared to 20%

infestation in non-transgenic lines. The increase in marketable yield of brinjal fruit is up to 48% which is a substantial gain for the farmer.

Dr. S. Mauria, Assistant Director General (ADG) (IPR & Policy), ICAR detailed the reforms undertaken by ICAR for facilitating PPP in the seed sector. NAIP has a strong component of partnership with private sector as well as seed associations and NGOs. There is also a good private sector and farmers' organization representation in various management committees at ICAR headquarters and in its institutes. The IPR guidelines of ICAR provide statutory autonomy to the institutes to enter into partnerships with private sector. However, while appreciating the need for PPPs, ICAR has the responsibility to address productivity constraints in 140 million hectares of difficult ecologies. There is a need for private sector to also work with public sector in ameliorating the agricultural productivity constraints of these areas using conventional and biotechnological approaches.

Dr. A.K. Srivastava, Head, Biochemistry Division, IVRI elaborated upon the progress made by the institute towards development and commercialization of animal biotechnology products. IVRI has developed animal vaccines, drugs for animal therapeutic purposes, diagnostic kits and processes for manipulation of animal rumen for better digestibility. A number of the technologies have been commercialized, some in collaboration with private sector, which have resulted in appreciable revenue generation. Vaccines using recombinant technology, enzyme linked immunosorbent assay (ELISA) testing kits for disease detection, gene silencing, stem cell and gene therapy are some of the frontline areas of biotechnology research and development at IVRI. Dr. Srivastava welcomed private sector participation in quality control of conventional and new generation vaccines.

During the discussion that followed individual presentations, Dr. Mruthyunjaya opined that it may not be appropriate to suggest any one model as the best PPP model since each is unique and has a well defined understanding among the partners regarding the working relations and outputs. Some other models could involve a public-public partnership till a certain stage of product development after which a private partner could enter, or vice-versa, depending upon who is providing the innovative technology. In each model, there should be clarity on sharing of fund investment, research and development components and business operations. He suggested that there should be a more aggressive public sector policy to sustain revenue generation on a dynamic scale.

Dr. Mauria was of the opinion that possible impact of biotechnology products on biodiversity needs to be taken into consideration so that no unexpected risk or loss occurs.

Dr. S.K. Vasal felt that PPP was crucial for addressing complex problems like abiotic stresses, which need special attention. He also emphasized that in these partnerships, public sector should take the responsibility of conserving and maintaining the biodiversity.

Dr. Rakesh Tuli, Director, National Botanical Research Institute (NBRI) emphasized the consortium mode of PPP with partners of comparable strengths constituting the consortium. A consortium involving unequal partners may not yield a viable partnership.

Dr. P. Ananda Kumar, Project Director, National Research Centre on Plant Biotechnology (NRCPB), New Delhi was of the view that the PPP networks need to expand among the entire National Agricultural Research System (NARS), comprising ICAR institutes, agricultural universities, and other public sector institutions. Further, the models should take into their ambit the whole chain from innovation, product development to marketing. The different operating systems existing within public and private sectors need to be recognized and attempts made to create harmonious working relations between the two.

Dr. S.R. Rao, Advisor, DBT expressed the need to review the progress made and lessons learnt since the first brainstorming session on this topics held by APCoAB two years back. He opined that considerable progress in building PPPs has been made but compared to developments in the pharmaceutical and space technology sectors much needs to be done in the agriculture sector. Also, considering the revenue generated by Indian Institute of Technology (IIT), the value of technology-led PPPs needs to be high in agricultural sector too. He, however, acknowledged that agricultural biotechnology is a highly complex enterprise with respect to developing workable partnerships. The partnership models have to be need-based, case-based and should achieve through teamwork goals above individual capabilities.

Dr. K.C. Bansal, Professor of Biotechnology, NRCPB reminded that affordability of biotechnology products and other interests of small farmers need to be kept under consideration while commercializing biotech products.

Dr. I.P. Abrol from CASA mentioned that the partners need to clearly understand their individual roles and responsibilities in the partnership. A new culture of cooperative working has to evolve that must overcome the diverse work cultures in the public and private systems.

Dr. Gopikrishna Warriar, Communication Officer, ICRISAT felt that consortium mode is the most appropriate approach especially for projects that are aimed at broad clientele. He apprised the participants about the efforts of ICRISAT in building consortia on biotechnology, biopesticides and bioethanol. In such consortia, the public and private systems work as equal partners.

The Chairman, Dr. S.A. Patil summed up the first session and made the following recommendations:

- Several PPP models are now in operation in the agricultural biotechnology sector. These need to be analysed and reviewed to suggest appropriate modifications in ongoing PPPs and develop guidelines for entering into future partnerships.

- A nodal agency such as APCoAB needs to develop modalities for identifying potential partners in a PPP from product development to marketing stages.
- A permanent network is required to be set up with ICAR; DBT; Department of Science and Technology, Government of India (DST); IITs, basic science universities and state agricultural universities participation to review at regular intervals the technological developments in the public sector and identify the ones fit for commercialization in partnership with public or private sector.
- Agriculture biotechnology scientists should meet every six months to exchange information and develop collaborative programs to benefit from each other's experiences and avoid duplications.

4. Technical Session II: Issues in Public-Private Partnership

The session was chaired by Prof. Asis Datta, Director, National Institute for Plant Genome Research (NCPGR) while Dr. Dev Raj Arya, Dr. Malathi Laxmikumar, Dr. S.R. Rao, Dr. Gopikrishna Warriar and Dr. P. Ananda Kumar made presentations.

Dr. Dev Raj Arya, Manager Regulatory Affairs, Monsanto India detailed the high cost involved in development and field release of transgenic crops. An investment of Rs. 250 to 500 crores over a period of 8-10 years is required to develop a transgenic crop from gene discovery phase to completion of regulatory requirements. With such high stakes involved, it is necessary to do a proper Strength Weakness Opportunity Threat (SWOT) analysis of the entire value chain before taking decisions about entering into partnerships. He further opined that the multinational private companies should be treated on par with Indian private companies for entering into partnerships with public sector. Dr. Arya gave some suggestions for strengthening PPPs: clarity in material transfer agreements (MTAs) and bilateral agreements for technology development, well-defined modalities for royalty sharing, mutual human resource development, and empowerment of partnership managers to take the required administrative decisions.

Dr. Malathi Laxmikumar, a leading IPR expert in biotechnology detailed the complex IPR issues involved in technology application for transgenic crop development. These include IPRs on genes, promoters, terminator sequences, marker genes, and gene transfer and testing protocols. Dr. Laxmikumar emphasized the importance of undertaking Freedom to Operate analysis for all the proposed technology-based activities before venturing into projects aimed at product commercialization. Further, The Protection of Plant Varieties and Farmers Rights Act (2001) of India (PPV&FRA) confers researchers' and farmers' rights, which are at some variance with The International Union for the Protection of New Varieties of Plants (UPOV) guidelines. There is a need to harmonize the IPR and benefit sharing provisions so that the PPPs with Indian and International organizations can operate with clear understanding and transparency among the partners.

Dr. S.R. Rao enumerated other IPR issues that impact PPP in agricultural biotechnology. These concern issues of germplasm transfer and environmental protection, including liability. Dr. Rao cited the example of Golden Rice project to emphasize the complexity of issues involved in transfer of technology related to development and field cultivation of transgenic crops. However, PPP offers opportunities for achieving objectives beyond the capacities of individual partners through asset complementarities including those of infrastructure, germplasm, technical know how and market experience. Depending upon project requirements there could be several types of PPPs involving different partners and partnership arrangements. Indian government has opened avenues for PPP by giving incentives to private sector, particularly small and medium sized companies. However, these companies need to have adequate capacity to implement new technologies and undertake regulatory testing. There is also a need for private sector to invest in improvement of true breeding varieties and orphan crops using biotechnological tools. Further, along with improving efficiency in management of PPPs there is a need to improve the institutional intellectual property management skills and information database on available technologies in the public sector.

Dr. Gopikrishna Warriar gave details of the ICRISAT's partnership based research with media as one of the partners. The latter serves an important role of communicating factual scientific information to the general public and policy makers and acts as a bridge between them. Media need to be properly informed not only about the pros and cons of biotechnology but also about the technology itself. ICRISAT has organized a number of media workshops in which besides media, farmers, seed suppliers, fertilizer dealers and extension workers participated. These evoked considerable interest that prompted ICRISAT to organize laboratory visits for journalists giving them opportunity to experience the technology first hand and interact with bench-level scientists. The feedback from these interactions led to publication of a source book on agricultural biotechnology and formation of an email discussion group. The latter has a current membership of 150 hailing from Senegal to Bangladesh.

Dr. P. Ananda Kumar in his presentation mentioned that applied biotechnology has its roots in the research carried out in public sector institutions. In India too, scientists in public institutions like ICAR, Council of Scientific and Industrial Research (CSIR) and universities have contributed new technologies, some of which are under commercialization while many more are held up in laboratories or glasshouses due to regulatory and IPR bottlenecks. Private sector is better equipped for product testing, commercial release and marketing; PPPs should capitalize on these strengths of private sector. Technology transfer modalities are already enshrined in ICAR guidelines which can form the basis for facilitating access to foreign technology. Further, there is a need for exchange of scientists and students between public and private sectors and encourage scientist entrepreneurship programs.

In his concluding remarks, Prof. Asis Dutta mentioned that there has been progress since his past attempts to patent new genes in the USA and India. The number of collaborations in agricultural biotechnology has increased, but there are still many bottlenecks, and implications of IPRs on technology transfer and commercialization need to be properly understood. There is also a need to create an interface between inventor, technology user and farmer. Proper selection of partners and their harmonious interaction is very important for the success of a partnership. Prof. Dutta further mentioned that there is considerable lack of public awareness about biotechnology; hence, creating awareness based on scientific facts is essential for generating desired public opinion.

5. Plenary Session: The Way Ahead

The session was chaired by Dr. Raj Paroda while Dr. R.P. Sharma, Dr. Rakesh Tuli, Dr. Mruthyunjaya, Dr. Wayne H. Freeman and Dr. T.V. Ramanaiah spoke as panelists. Dr. K.C. Bansal and Dr. Malathi Lakshmikumaran were the other participants who actively participated in the discussion.

Dr. R.P. Sharma stressed that PPP is the only viable option through which biotechnology research would lead to product delivery. There are, however, several impediments to effective partnership building: different priorities of the partners; general lack of corporate culture in the public sector; lack of desired infrastructure for biosafety and contamination testing; and limited resources with majority of the private sector partners. He made the following suggestions as the way ahead:

- Creation of comprehensive infrastructural facilities for biosafety and transgene testing in the public sector.
- Besides identification of novel genes and promoters, research on modifying quantitative trait loci, molecular mechanisms of transgressive segregation, minimizing genotype X environment interaction, needs to be taken up on priority.
- The PPPs of future will be long-term partnerships on development of new and novel genotypes and designer crops using molecular genetics and bioinformatics approaches.
- Besides public sector, the private sector also needs to invest in biotechnology research. Collaborative projects in which private sector participates from project inception stage itself need to be developed.

Dr. Rakesh Tuli made the following suggestions for building effective PPPs:

- The private sector partners should have sound financial strength to invest in adoption and commercialization of the technology.
- The models of participation and benefit sharing would differ depending upon whether the technology concepts come from the industry or from public sector institutes.

- The public sector scientists and other researchers should be provided adequate incentives to drive the partnership towards achieving the desired goals.

Dr. Mruthyunjaya gave details of the organizational structure and functioning of NAIP while mentioning that the project represents a scale-up of the earlier efforts of ICAR under National Agricultural Technology Project (NATP) towards building PPPs. Under the NAIP, it is proposed to partner, besides ICAR and other public sector organizations, private sector, NGOs, CGIAR centers and farmers' organizations. While there are some apprehensions about the success of these partnerships, with sufficient monitoring and accountability these consortia would lead to significant improvements in the farmers' incomes and sustainability of agriculture as an enterprise.

Dr. Wayne H. Freeman opined that public sector would continue to lead in basic and strategic research. But, there is a need to rethink about its role in seed production where seed associations which could play an important role, need to be partnered.

Dr. T.V. Ramanaiah gave a number of suggestions for building successful PPPs:

- Respect the work culture, ethics and goals of the participating organizations.
- Confidence building in a partnership is essential for which understanding and appreciation of mutual strengths and weaknesses is required.
- There should be appropriate authentication, validation and valuation of the technology before it is offered for commercialization. The partners should be adequately conversant with benefit sharing and IPR issues.
- Adequate flexibility should exist within the broad framework of operating rules and regulations to address the concerns of each partner.
- Each partner should act faithfully and legitimately to implement the partnership.
- The partners should actively work towards making the partnership successful rather than terminating it for one or the other reason.

Dr. Raj Paroda in his concluding remarks mentioned that a number of partnership models have developed since the last two years when the first brainstorming session on PPP in agricultural biotechnology was held by APCoAB. Essentially, these partnerships should be built on mutual trust, understanding, dedication and sharing of benefits. There is also a need for enabling environment, transparency and efficiency in making these partnerships successful. While there is considerable strength in the national public sector, there is a need for greater coordination and harnessing of mutual strengths for the ultimate good of farmers and consumers. Appropriate policy support by the concerned ministries, a system of incentives and rewards which can inculcate a competitive spirit, and better regulatory and IPR management systems would be required. Legal implications of IPR and Standard Material Transfer Agreement (SMTA) must be properly understood, for which human resource development programs need to be initiated.

6. Recommendations

The following recommendations were made and adopted for further follow-up:

There was general consensus that PPP is the most effective mechanism for translating the potential of biotechnology into products that will help in enhancing agricultural productivity and improving the economic condition of farming community. While a number of successful partnerships have emerged during the last few years, more needs to be done to build new partnerships and strengthen the existing ones.

Models of PPP

- In view of the highly diverse nature of agricultural biotechnology projects operating successfully in partnership mode, there is no single model that can be recommended as the most appropriate one. However, some basic requirements are essential for making a PPP successful:
 - The partnership should be based on common goals of the partners to achieve objectives of mutual interest that are also aimed at addressing national challenges in agricultural growth and farmers' incomes.
 - The partners should have matching resources which also complement mutual strengths.
 - The partnership should be built on mutual trust and commitment to create a dynamic and result oriented working environment.
 - Ultimately, the output of the partnership should be more than the potential of individual partners.
- The existing PPP models should be analyzed to develop appropriate guidelines for entering into future partnerships and for negotiating terms of benefit sharing.
- PPPs need to consider partnering seed industry, including seed associations, to enable expeditious multiplication and distribution of the seed to farmers.
- All projects should be analyzed for Freedom to Operate from IPR perspective before they are operationalized.

Policy

- A Senior Level Working Group comprising ICAR/DBT/DST/IITs/universities to be constituted to frequently review the technological developments in the public sector and identify the appropriate ones which are fit to be commercialized in a partnership mode. APCoAB could facilitate identification of potential partners in a network.
- All partners must ensure that the project at any stage does not adversely impact ecology and biodiversity.
- With changing perceptions of partnership in a globalized world, multinational companies may be considered at the same level as Indian national companies for entering into partnerships with public sector.

- Private sector needs to make long-term investment in basic and strategic research in molecular aided selection, genomics and bioinformatics, and enter into partnerships with public sector right from project inception stage.

Capacity Building

- There is a need for building comprehensive infrastructure and human resources in public sector for biosafety and transgene testing.
- Human resource development in public sector institutions on technical and legal aspects of IPRs and MTAs is essential to build capacities for negotiating partnerships.

Brainstorming Session Models of Public-Private Partnership in Agricultural Biotechnology

PROGRAM

Date: 7 April 2007

Venue: ICAR Lecture Hall, National Agricultural Science Centre Complex,
Pusa, New Delhi-110 012

09:00-09:30 **Registration**

09:30-10:30 **Inaugural Session**

09:30-09:35	Welcome	J.L. Karihaloo
09:35-09:45	Special remarks	Wayne H. Freeman
09:45-09:55	Special remarks	Mruthyunjaya
09:55-10:05	Special remarks	Raj Paroda
10:05-10:25	Inaugural address	S.A. Patil
10:25-10:30	Vote of thanks	K.V. Prabhu

10:30-11:00 **Tea break and group photograph**

11:00-13:00 **Session I: Existing Models of Public-Private Partnership**

Chairman: **S.A. Patil**

Rapporteur: **K.V. Prabhu**

11:05-11:20	Bayer-Nunhems	Arvind Kapur
11:20-11:35	Syngenta	Vinod Kumar
11:35-11:50	Mahyco	Raju Barwale
11:50-12:05	IFSA-IARI	Gowri Sankara Rao & Hari Prasad
12:05-12:20	ABSP II-IIVR	Mathura Rai

12:20-12:35	PPP – ICAR’s perspective	S. Mauria
12:35-12:50	Animal biotechnology	A.K. Srivastava
12:50-13:15	General discussion and summary	
13:15-14:00	Lunch	
14:00-16:00	Session II: Issues in Public-Private Partnership	
	<i>Chairman: Asis Datta</i>	
	<i>Rapporteur: N.K. Singh</i>	
14:05-14:20	Regulatory costs	Rajan Kapoor & Dev Raj Arya
14:20-14:35	IPR – Implications on biotechnology research and development	Malathi Lakshmikumaran
14:35-14:50	IPR – Implications on PPP	S.R. Rao
14:50-15:05	Public awareness	Gopikrishna Warriar
15:05-15:20	A scientist’s perspective	P. Ananda Kumar
15:20-16:00	General discussion and summary	
16:00-16:30	Tea	
16:30-18:00	Session III: The Way Ahead	
	<i>Chairman: Raj Paroda</i>	
	<i>Rapporteur: J.L. Karihaloo</i>	
	Panel Discussion and recommendations	R.P. Sharma Rakesh Tuli Mruthyunjaya Wayne H. Freeman T.V. Ramanaiah
	Concluding remarks	Raj Paroda

Brainstorming Session Models of Public-Private Partnership in Agricultural Biotechnology

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Asia-Pacific Consortium on Agricultural Biotechnology

The Asia-Pacific Consortium on Agricultural Biotechnology (APCoAB), was established in 2003 under the umbrella of the Asia-Pacific Association of Agricultural Research Institutions (APAARI) – an initiative of Food and Agriculture Organization that has been promoting appropriate use of emerging agri-technologies and tools in the region.

MISSION

APCoAB's mission is "To harness the benefits of agricultural biotechnology for human and animal welfare through the application of latest scientific technologies while safeguarding the environment for the advancement of society in the Asia-Pacific Region".

OBJECTIVES

- To serve as a neutral forum for the key partners engaged in research, development, commercialization and education/learning of agricultural biotechnology as well as environmental safety in the Asia-Pacific region.
- To facilitate and promote the process of greater public awareness and understanding relating to important issues of IPR's *sui generis* systems, biosafety, risk assessment, harmonization of regulatory procedures, and benefit sharing in order to address various concerns relating to adoption of agricultural biotechnology.
- To facilitate human resource development for meaningful application of agricultural biotechnologies to enhance sustainable agricultural productivity, as well as product quality, for the welfare of both farmers and consumers.



TRUST FOR ADVANCEMENT OF AGRICULTURAL SCIENCES

GOAL

An accelerated movement for harnessing agricultural sciences for the welfare of the people.

MISSION

To promote growth and advancement of agriculture through scientific interactions and partnerships.

OBJECTIVES

- Sponsoring seminars and special lectures on emerging issues and new developments in agricultural sciences in different regions of India.
- Facilitating partnerships with non-resident Indian agricultural scientists visiting India on sabbatical or short leave.
- Instituting awards for outstanding contributions to Indian agriculture by the scientists of Indian origin abroad.
- To act as think tank on key policy issues relating to agricultural research and development (ARD).

