Rethinking the Priorities for Indian Agricultural Research, Institutions and Policy: Learning from the Grassroots

Anil K Gupta

W.P. No. 2009-03-04
March 2009

INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD-380 015
INDIA

Rethinking the Priorities for Indian Agricultural Research, Institutions and Policy: Learning from the Grassroots

Anil K Gupta

Abstract

Sometimes having succeeded in a mission, we fail because we tend to persist with the same strategy even when times have changed. The success, thus, becomes the reason for failure. Indian agriculture research has been an outstanding success in terms of achieving food self-reliance and converting a perennially importing country to an exporting country. But, the trend in the last decade has been disappointing and reasons are not far to seek. I will take this opportunity to reflect on the three decades of my engagement with the agricultural research community so that some new pointers can be identified. I will also share the lessons learnt from the grassroots innovators and traditional knowledge holders through Honey Bee Network activities in the last two decades. It is possible that some of my views cause discomfort. But, it is with great respect that I submit these ideas. The agricultural research community has always considered me as an insider and therefore the liberty that they have allowed me to take with the ideas. The interface of science and society, which has become a bit weaker in recent years, was taken as a matter of deep concern and commitment. It is a privilege for me to share my views in Dr B P Pal's memory. I hope to help in triggering some thoughts towards revitalisation of our institutions, policy making approach and our relationship with the common people and their creativity.

Paper deals with mainly four issues, viz., (i) Managing genetic resources, (ii) Rethinking sustainability, (iii) Redesigning research organisations for sustainable, accessible and affordable outcomes and (iv) Ethical and institutional issues in agricultural research. The quality of education, development of entrepreneurial spirit, monitoring eco system health and developing longitudinal research facilities are some of the other important concerns in the Indian agricultural research system. When plant breeding got dominated by the practice of making selections in international nurseries and releasing varieties instead of painstaking seven to eight year breeding cycles of complex crossing programmes, the faster mortality of such rapidly released varieties was inevitable. The incentive systems for scientists unfortunately have not been upgraded and calibrated in a manner that social, professional and individual interests can converge. The organisational design does not let new forms of partnerships and networks to emerge. The current crisis in Indian agriculture is a consequence of the outdated policies and irrelevant organisational and institutional designs. There is no escape from major restructuring of agricultural research policy and institutions. I may be forgiven for being too critical at several places in my submission. Thousands of innovations and traditional knowledge identified from more than 500 districts have proved, if a proof was needed that Indian farmers, artisans, pastoralists and mechanics are extremely creative and engagement with them can not be avoided by institutional science for too long without inviting an unfortunate backlash.

Rethinking the Priorities for Indian Agricultural Research, Institutions and Policy: Learning from the Grassroots[1]

Anil K Gupta[2]

Sometimes having succeeded in a mission, we fail because we tend to persist with the same strategy even when times have changed. The success, thus, becomes the reason for failure. Indian agriculture research has been an outstanding success in terms of achieving food self-reliance and converting a perennially importing country to an exporting country. But the trend in the last decade has been disappointing and reasons are not far to seek. I will take this opportunity to reflect on the three decades of my engagement with the agricultural research community so that some new pointers can be identified. I will also share the lessons learnt from the grassroots innovators and traditional knowledge holders through Honey Bee Network activities in the last two decades. It is possible that some of my views cause discomfort. But, it is with great respect that I submit these ideas. The agricultural research communities have always considered me as an insider and therefore the liberty that they have allowed me to take with the ideas.

Dr. B.P. Pal was not only an outstanding scientist but also an extraordinary institution builder. He laid the foundation of an approach to research which was rigorous, responsive and respectful towards the local wisdom and the genius. Linking micro realities with macro policies was his forte. The time has come to revive the tradition which he created when the top policy makers listened to the agricultural scientists before deciding various policies. The interface of science and society, which has become a bit weaker in recent years, was taken as a matter of deep concern and commitment. It is a privilege for me to share my views in his memory today. I hope to help in triggering some thoughts towards revitalisation of our institutions, policy making approach and our relationship with the common people and their creativity.

I am planning to cover four issues, viz., (i) Managing genetic resources, (ii) Rethinking sustainability, (iii) Redesigning research organisations for sustainable, accessible and affordable outcomes and (iv) Ethical and institutional issues in agricultural research, which need further debate and reflection among the colleagues.

1. Managing genetic resources

1.1 Redefining Descriptors: The National Gene Bank (NBPGR) has the largest collection of local germplasm in the country. I have pursued this matter with IPGRI, NBPGR, Planning Commission and ICAR that the knowledge of people, particularly women about processing these landraces should be incorporated in the

[1] Dr. B.P. Pal Memorial Lecture delivered at Indian Agricultural Research Institute, New Delhi on 24th May 2008

[2] Professor, Indian Institute of Management, Ahmedabad and Executive Vice Chair, National Innovation Foundation, Ahmedabad, email: anilg@iimahd.ernet.in

descriptors. Later, in a campaign mode, this knowledge should be documented and incorporated in the Gene Bank Descriptors. It is known that as the income of the people increases in any society, the proportion of processed food also increases in the consumption basket. The food processing industry can be invited to look at the database and explore opportunities for exploiting their potential. It will generate incentives not only for conservation of agro biodiversity but also for adding value to the germplasm and its products. Despite availability of huge resources in the innovation project with ICAR, this gap continues to remain unbridged. The implication is that lot of knowledge is getting lost everyday both through erosion of diversity and the knowledge system. The rate of internal migration has never been so high as in the last decade, thanks to the economic growth. But, we have not woken up to this challenge. Can a programme be mounted in collaboration with various voluntary organisations as well as National Innovation Foundation (NIF) so that the knowledge gap can be bridged in a time bound manner. One way of bridging the gap can be to allocate at least ten days out of hundred days of employment provided under National Rural Employment Guarantee Programme for knowledge and resource mapping in the country. There is no reason why about 250 million people below poverty line should be given only menial tasks of breaking stones, or digging earth as at present. If India has to become a knowledge society, then there is no way millions of poor people cannot be engaged in knowledge based employment activity. Such a documentation will also unfold numerous opportunities for entrepreneurship and development.

1.2 Conservation through stimulating demand for traditional varieties:

During the Traditional Food Festivals (SATTVIK) organised by Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI) at IIMA during last four years, we tried to test the price elasticity of foods made of traditional varieties. It was very instructive to note that there exists a considerable unexploited urban demand for traditional varieties based food products for taste as well as neutriceuticals. The evidence is available about significantly lesser incidence of arthritis in villages in Africa where local varieties of maize were consumed compared to the regions where high yielding varieties were the main staple food. It was found out that Boron, which played an important role in strengthening the joints was available much more in local varieties. Studies in India also indicate need for attention on this issue.

1.3 Agro-Diversity, soil, plant and human health:

There are very few studies in the country where soil, plant, animal and human nutrition and health have been studied systematically over a period of time. One of the rare studies was pursued at Andhra Pradesh Agriculture University where the role of zinc in soil, paddy crop and human health was traced. Many local varieties may have comparative advantage in mobilising trace elements from soil more effectively. Despite low productivity, these crops can become source of functional

foods. But such research would require existence of food processing and characterisation facilities in agricultural research centres. This is an extraordinary neglect of the agricultural research system, which is very difficult to understand and appreciate. The result is that better economic opportunities are being denied to the conservators and growers of such crops, generally in dry regions whereas the big food processing companies are importing such grains from outside. Studies have shown that many minor millets have several times more nutrients than wheat, rice or maize. Not only that we do not study such things, we do not even include such issues in our curriculum, notwithstanding the rhetoric in favour of sustainability.

1.4 Linkage between farmers' selection criteria and that of the breeders:

Much of the focus in so-called participatory plant breeding is on letting farmers select the variations induced by institutional scientists, generally under well-managed conditions. Rarely if at all, the opportunity is given to farmer breeders to pursue their own breeding programmes through public support and with public facilities. Farmer breeders and innovators not only remain unrecognised but even their criteria are not paid attention. When Laxmidei Hantala, wanted to change the ratio of female to male flowers in spine gourd in Orissa, she was doing it with few plants in her backyard. A proper design based on her hypothesis would require much larger population. Similarly, when Dulabhai selected pink to red flower mutant in pigeon pea, he did not know that he had discovered a new way of avoiding pests. White flowered cardamom, dwarf arecanut, another new variety of cardamom which contributed significantly to Indian exports are just a few examples of outstanding breeding by farmers. A variety of paddy, HMT developed by Khobragade, a dalit farmer from Maharashtra diffused over a lac hectares in five states. This variety also became a standard for thinness by the Protection of Plant Variety and Farmers' Rights Authority (PPVFRA). And yet, the state agricultural university has hesitated in recognising his contribution to productivity. They released the variety merely by cleaning it without any genetic modification but by adding their own name to the same. This was neither ethical nor fair. The DNA finger print of the variety developed by the farmer and the one released by the university showed no difference on more than 12 markers (Sinha and Agarwal, 2007). The PPVFRA requires data, quite understandably for any variety to be registered. NIF has very limited resources to generate such data by paying agricultural universities. ICAR will not take it up on its own. The result is the delay and high cost of protecting the rights of farmer breeders. Why should not there be a dedicated programme exclusively for generating multi location data on farmers' varieties for protection as well as diffusion. The seed companies, which have made huge profits by selling PKV HMT and other variants of HMT, share not the slightest part of their income with the farmer breeder. Obviously, institutional incentives for farmer breeders are yet to be formalised. To the extent that such incentives would have spurred more innovations by farmers, society has been deprived of many potential breakthroughs. Many farmers have made selection in

the HMT itself and developed variations, which are liked by the farmers (Sinha, 2008). This kind of innovation in diffusion could become a major force for generating varieties by farmers.

1.5 Linking crop and animal breeding and incentives for *in-situ* conservation

Rarely do plant breeders screen crop varieties for the suitability of their fodder for the livestock. There are only a few countable programmes where advanced lines of sorghum were screened for suitability as livestock fodder. Despite the enormous increase in the demand of livestock products, the synergy between livestock and crop breeding programmes is yet to be achieved. This becomes even more important in high-risk environment where livestock plays a very important role in hedging the risk and ensuring survival. The management of livestock germplasm diversity in dry regions has not received adequate attention. The neglect of *in-situ* conservation of biodiversity of crops, livestock, trees and grasses is too serious an issue to be left to the scientists. I have tracked agro biodiversity situation in a few villages at an interval of ten years for more than two decades in eastern India. Situation is precarious. Unfortunately, by the time we wake up to the reality, it may be too late.

2 Rethinking sustainability

2.1 Farmers suicides and limitations of current public policy:

The factors which contribute to distress among farmers are not always same even if the consequences are similar. There is no mechanism to monitor the dependence on moneylenders among the farmers vis-à-vis institutional credit at village level. Actually there is no village level information system which can generate early warning signals of the impending distress. Department of Science and Technology has taken an initiative recently to develop and integrate Village Information System and Land Information System into Village Level Knowledge Management System. It would hopefully generate rapid and real time signals about distress in location specific manner so that targeting of alleviating measures can be precise, spatially focussed and time bound. Currently, the policy response is more of the same. Therefore, if chemical pesticides do not help in controlling the pests, then give credit to buy more of the same pesticides. Assumption is that probably little more chemical inputs would have alleviated the problem. Nothing could be farther from the truth. By now the entire programme of IPM (Integrated Pest Management), and bio control besides the research on herbal pesticides should have been focussed on suicide prone regions. There is no attempt to do that. In 43 districts where most suicides have taken place, my suspicion is that minimum experiments, trials and demonstrations on non-external input agriculture may have been taken up. The institutions which provide opportunity for articulating the problems of farmers are not being strengthened. The diversification of agriculture has been neglected and not backed up by adequate incentives. The situation with

regard to ground water extraction is equally unfavourable to the small farmers. Neither have the water conservation efforts been concentrated in such regions, nor have the public institutions tried to balance the interests of late entrants in water market with those who took the early advantage because of their better economic and political power. Water reforms, Dr.Minhas had warned way back early 70's would be more crucial than even land reforms. Today both water and land reforms are off the radar of public policy makers. Reducing cost of cultivation is not the primary goal of agricultural research any more. Hence the neglect of knowledge intensive approaches vis-à-vis the physical input intensive approaches. Studies had shown in late 70's that extension machinery ignored the technologies about non-purchased inputs. This neglect has become even more serious now. In the suicide prone regions, neglect of knowledge-based approaches becomes even more unacceptable than other regions. One would have expected a flurry of on-farm experiments in such regions to demonstrate, whether modern science and technology had anything specific to contribute to reduce the distress, if not mitigate it completely. But, this has also not happened. The resistance of pests, declining water table, increased input costs and stagnation of varietal choices are contributing to the sustainability crisis all over but much more so in distressed regions.

2.2 Learning from the local best: Designing knowledge intensive approaches for sustainable agriculture:

Whether one has to manage to crop, livestock, trees or other related non-farm activities, the need for learning from the local best practices cannot be ignored. There is a lesson that Gandhiji taught us a long time ago. Once a group of young people went to Gandhiji to seek his advice for initiating a rural development project. He tried to avoid the subject because he had not lived in villages much. But, the people insisted that he advise them. After a while, he relented and offered a very interesting solution, which is relevant even today. He would like any change agent to first recognise that in every region, particularly rural areas, there existed lot of variability in almost in any facet of life. He suggested that those who wanted to work for rural development should decide in which area they wanted to begin. Let us assume that one wanted to work in livestock management. Gandhiji's advice was to identify such livestock keepers who were most efficient, or whose productivity was highest. Having documented from morning till evening all the operations done by the family of the farmers having highest productivity, one should then document the practices of the average producers. The gap between the best and the average, he said, would be his plan of work. This is an advice, which is relevant even today. The regret is that we do not have very many villages where such analysis has been done. The documentation of farmers' innovations by Honey Bee Network during last two decades is a small step in this direction.

2.3 Learning from Creative and Innovative Farmers: Lessons of Honey Bee Network

Despite all the discussion on participatory approaches for research and development, the public awareness about innovations by common people remains very low. We seldom provide an opportunity to a small farmer or artisan to present his or her innovation to the institutional scientist as a peer. A memorandum of understanding between NIF and CSIR as well as ICMR enables such a partnership to take place. In the collaboration with CSIR, a joint implementation committee (JIC) has been set up to review the proposals based on farmers' innovation from NIF in four areas viz., herbal technologies, mechanical, energy and food processing and nutraceuticals. Several very interesting discoveries have been made. A formulation of herbal pesticide developed by a farmer in Gujarat was taken up for a trial at IHBT, Palanpur. The scientists there found out a unique property of a plant mixed with neem in this formulation. When neem extract alone was exposed to ultraviolet rays (a proxy for light) for a duration of two to twenty minutes, the curve showed steep decline in the effectiveness of the active compounds. When combined with another plant, the degeneration of neem compounds completely stopped. A declining curve became a straight line. A new approach to make neem compound stable under light had been discovered, thanks to the farmers' innovations. Even that farmer did not know the science underlying the effectiveness of his formulation. But the science had progressed. In another case, a tribal practice about a vegetative technology of fruit ripening was taken up for validation at CFTRI, Mysore. The scientists found that the practice was not only valid but it achieved a result, which the chemical inducers of ripening did not. They noticed that apart from ripening, the composition of sugar triggered by the herbal agent was quite different from the composition triggered by chemical based fruit ripeners. The fruits ripened by the herbal agent were thus more tasteful. The tribal knowledge had made it possible for exploring the development of the first herbal fruit ripener. Likewise, several other studies in farm machinery and energy are going on. The blending of formal and informal science, pursued by Honey Bee Network and SRISTI for many years is finally showing results. The cooperation of NIF with ICMR is no less rewarding. Several herbal technologies are under validation trials at leading research institutes. Such a cooperation in the field of agricultural research is yet to materialise. May be there is a method in the madness.

In many cases of farmers' innovation, new ways of solving problems have been discovered. Thousands of herbal pesticide formulations, or veterinary medicines or other technologies to increase productivity without impairing ecological balance have been developed all over the country. When small farmers with minimum physical resources or financial assets have to try to improve productivity, they have limited choice. The only resource they can maximise is knowledge in which they are not poor. Therefore, sustainability is generally inherent in the small farmers' innovations. Lateral recharge in virdas (a traditional technology of conserving fresh water in saline soil with saline ground water) provides a new way of augmenting water resources in a very difficult ecological condition. Similarly, fusing two different plants of the same family having non-synchronous flowering and fruiting to try to augment nutrient

flows to both the plants at different times through each other is a new way of improving productivity. When we asked the farmers in a roadside meeting during the 20th Shodh yatra in West Bengal last December, Vijay Pramanik came out with this idea with much hesitation. Our culture, rich as it is, has not been able to generate as yet, an appreciative peer group among the local communities as well as institutional scientists. Perhaps there is a need to change the curriculum and organisational culture in the agricultural research system so that ability to listen to the voices from grassroots increases in the formal sector. At the same time, we have also to influence the community level social interactions by recognising the innovators through Shodh Yatras, Shodh Sankal (Workshops of innovators) and other such means so that people begin to appreciate each other's contributions. Recently, during a workshop organised to achieve just this result, the lead innovator Mansukhbhai who developed a motorcycle based ploughing machine (patented in India and US) and dozens of other imitators and improvisers were invited. In addition, scientists from CMERI, Durgapur were also invited to showcase the improved design of motorcyle Santi that they had developed at our suggestion. The users and other colleagues from Grassroots Innovation Augmentation Network (GIAN), SRISTI and NIF joined the discussions to give feedback to each other. There was such a positive and constructive spirit evident in the workshop that everybody learnt from each other.

The design critique by the peers generated such useful insights about gear ratios, multi functionality, spacing flexibility to suit different crops, turning radius, etc., that even the scientists acknowledged that they acquired new insights. Their design was critiqued by the innovators just as much as the scientists critiqued the designs of the innovators.

2.4 Institutional Innovation for Creating Technology Commons

One of the issues that Honey Bee Network has grappled with for last two decades is the cause of protecting intellectual property rights of the knowledge holders. Idea has never been to prevent or reduce the rate of peer learning. At the same time, it has been considered unfair that large scale commercial organisations should extract rent out of the grassroots innovations without any reciprocity. In the above workshop on motorcycle ploughing machine, the idea of creating technology commons was also discussed. The innovators agreed that they should not have any reservation about fellow artisans or farmers learning from each other and fabricating modified designs. However, no large firm should be allowed to copy their designs without proper licence. One of them went to the extent of proposing that no imitator should have the right to license the improvement or the original technology to a company without the consent of other improvisers. The concept of 'technology commons' thus evolves as an effort to keep the right to copy, improve, innovate around a base, technology common among all concerned. Once they join the 'technology commons', they will have collective responsibility to share their improvements with each other and licence the technology collectively, or through the lead innovator or through the mediating institutions, in this case the Honey Bee Network. In practice, Honey Bee Network

has propagated thousands of technologies as open source ideas for learning across the world. Hardly 150 patents have been filed though many more will be filed in the near future. The point is clear. The intellectual property rights of the people deserve to be protected so long as these rights don't come in the way of the societal learning and creativity.

2.5 Scientific platforms, labs and workshops becoming arena of experimentation by creative people:

Sustainability requires blend between formal and informal science and also between universal and local concepts, applications and contexts. ICAR has created a vast network of KVKs all around the country in large number of districts. But these research stations have not become the hub for grassroots innovations to be tested, demonstrated, improvised and disseminated by the people. There is no reason why the research plans of the scientists and the local creative communities and individuals should not be allowed to compete and thus prioritised together for utilising the facility in a fair and just manner. After all scientists would learn from such people and vice versa. Despite millions being spent on so-called innovation promoting initiatives, we are not creating basic cultural changes in our mindset to promote partnerships between the creative people and the institutional scientists. Much is talked about public-private partnership which is a euphemism for letting private sector companies use public facilities for private good, eventually for commercialisation. I have nothing against it. My only regret is that individual farmers and local communities also are members of private sector and in that sense all the privileges that are being provided to large corporations should be accessible, in fact, at much more concessionary terms to the local creative people. The irony is that research institutions expect grassroots innovators to pay the same testing charges as they levy on the large corporations. Thus, the equipment testing institute at Budni charges same fees to Bhanjbhai and expects him to bear the cost of the documentation of more than 500 pages for getting his three and four wheel mini tractor tested as it would charge a large multinational or national corporation. Whether it is testing of a herbal pesticide, or veterinary medicine, exceptions apart most institutions don't seem to discriminate in favour of farmer innovators. In fact, by now, there should have been a national fund to test, validate, generate data and disseminate the innovations by farmers. When varietal claims have to be submitted to PPVFRA, the same problem is faced. There is no institutional accountability to fulfil the data requirements of the Authority by a designated institution. NIF with its meagre budget can hardly play a significant role in this regard unless we realise the injustice being done to the creative people of our country for such a long time. Sustainable solutions are facing so many barriers for testing, validation and value addition and dissemination, that the tragedy of farmers distress becomes even more striking. Farmers Commission unfortunately did not engage itself with the large scale restructuring of the culture and the organisational design of agricultural research system.

3 Redesigning research organisations for sustainable, accessible and affordable outcomes:

3.1 In most research organisations, a young scholar has to wait for at least a decade before he/she would be made a programme director for a specific research field. Once the passion is lost, the scholar has learnt to compromise and adjust with inefficiency, he/she seems to get qualified for leading the research teams for further investigations. One of the youngest countries in the world having 54 per cent people below 25 years and 70 per cent below 35 years deserves to be led differently. Younger people might take to the new ideas with greater alacrity and thus might make even the institutions more permeable to the feedback and ideas from outside including common people. IARI should itself create exceptions. The Director of IARI, Dr. Patil had pioneered a very unusual experiments at agricultural university, Dharvad when he encouraged young biotech innovators to avail of the university facilities at a very concessionary term. The idea was that the entrepreneur would bring new knowledge and market understanding while the university had lot of equipments and facilities not always optimally utilised. In the process, young students would get the advantage of working with entrepreneurs and at the same time, fulfil their educational requirements. This has influenced the design of BIRAC (Biotechnology Industry Research Assistance Council) being set up by Department of Biotechnology for creating entrepreneurial culture among the scientists and enabling them to fulfil their dreams. More such experiments are warranted in agricultural sector.

Some years ago, I was invited to discuss ideas on education and entrepreneurship in the conference of vice chancellors at HAU, Hissar. I feel privileged when research community reposes so much faith in an 'outsider'. But I feel a little disappointed when I find that most scientists and students have not had any structured exposure to the entrepreneurship development processes during their education or early career. We need a revolution in regard to diluting or dissolving the boundaries of research organisations when it comes to encouragement, inducement, and incorporation of the energy that start ups provide.

And not only economic entrepreneurs but also the social entrepreneurs should be provided welcome facilities at all public research organisations so that risk taking, forward looking and path breaking innovations emerge within the formal systems. India is poised for such a revolution. While there are so many venture capital funds to promote technology start ups (although not many are as easily accessible to start ups as to the existing companies) there is hardly any dedicated fund for promoting micro or macro enterprises around agricultural technologies. This is an area where research system must take bold initiatives, invite the alumni and the central government must set up such funds through SIDBI or otherwise for this sector. Such funds should be managed by young scholars, entrepreneurs and other professionals instead of senior people with good intentions and weak hearts.

People who have never taken risks in their life, can hardly promote other people who take risks. The social venture funds are required to encourage entrepreneurs to disseminate through local adaptation, such technologies for which the unit cost may be low but the transaction costs of dissemination and local adaptation may be very high. In this age of excessive reliance on market forces, the social conscience is getting subdued if not in some cases, disappear. This is a problem that we should address upfront.

The classical approach to extension has outlived its utility. There is a need to remember what Shri. K.M.Munshi had advised way back in 50's when the term, 'extension' was being popularised by certain international aid agencies. He had warned that extension might mean enlargement. He wanted the society to use the term, 'land transformation (bhu parivartan)'. It was in 1952, that the first unit of Land Army comprising students of Delhi University was constituted to clean the Chhatarpur drain. In a far sighted framework enunciated in a lecture entitled, "The Gospel of Dirty Hand" and others in the series, delivered to the Governing Council of ICAR, he had anticipated the sustainability crisis much before anyone else in the country or around had done so. It is tragic that our students do not get an opportunity to read these lectures in their Agronomy 101 course. Shri Munshi had drawn three circles. One representing nutrient cycle, the second reflecting hydrological cycle and the third village community. His contention was that every village will have to synergise the three circles. He was conscious that drainage would often get blocked around the houses of the poorest people. To him, the health of the drainage system reflected the health of the eco system. His vision was that youth of the country would be organised in the units of Land Army and they would take up the projects for strengthening land, water, sanitation, composting, etc., at community level. Subsequent thinkers and planners of agricultural research had no use for Shri. Munshi's, Gandhian ideas. But, the time has come when the soil, crop and water systems are not in sync to revitalise the basic foundation of agriculture. I hope that young students of IARI would take initiative to start a 'march to the basics' and learn from people, benchmark the current crisis of sustainability and create pressures on the teachers to redesign the curriculum and the content to reflect future needs of our society.

3.2 The research on hand tools, small machinery and non-purchased technologies. Agricultural engineering is one discipline in which there is a much stronger case for strengthening the connection with the grassroots. Just as we organise farmers fair, every university and research institute should organise blacksmiths and farm mechanic fairs. These fairs will provide a regular opportunity for tool and implement makers to show their innovations and scientists to share theirs. The best would hopefully survive. But there will not be only one best solution. Depending upon variability in soil, crop, climate and other factors, location specific adaptations will have to be made. If engineers focussed on transferring science and basic techniques, then the rural blacksmiths and mechanics can work with better imagination. We should have mobile fab labs for mechanics to test, calibrate and

improvise their equipments. If the right depth of placement of seed and other inputs is crucial for increasing productivity, then role of implements does not have to be highlighted. The labourers are under tremendous stress due to price rise and heavy mechanisation. The polytechnics and ITIs are not taken into account when we develop agricultural research policies. There will hardly be much overlap between the mechanical and electronic requirement of the agricultural sector and the curriculum and workshop facilities of ITIs and polytechnics. Why should not such a linkage be forged urgently. Government has been considering revitalising the vocational education system. What are skill requirements for production, processing and service sector which need to be incorporated in the design of vocational education. We have not perhaps done homework to analyse such missing links. It would be useful if the students of agricultural engineering take up country wide benchmarking exercise in the villages selected from different agro climatic zones and prepare a state of skill and technique gaps in the country. Such a report may be revised every two to three years. It would have a significant impact on the nature of projects that students and their guides might take up. Today, may be not even one per cent of students' projects go farther than the workshops. This will automatically change when the feed forward from the field will guide the choice of projects.

3.3 Are postgraduate students addressing the problems of future:

There is no doubt that a lot of research being done by the postgraduate students is very relevant and futuristic. However, in a study of postgraduate research, more than 20 years ago, based on 26 universities and colleges, I found that in agronomy ¾ of the thesis dealt with fertilisers and 90 per cent of these were concerned with only chemical fertilisers. The sustainability agenda of conjunctive use of chemical and organic fertiliser was not being studied. Those students today are directors of the institutes or head of the division. Would not the acts of commission and omission at that time by the leaders of the research system affect the choices of our people today. And if so, would not our actions today affect the choices in future. Do we take up such reviews every five years? Does ICAR not have funds to take up such systematic reviews so that needs of future can be aligned with the concerns of the present? Dr.Y.P.Singh and Dr.Jamtani had analysed the pattern in postgraduate research in extension and pointed out important gaps. Such stripe reviews were recommended by ICAR review committee also. When we undertook the restructuring of ICAR headquarters way back in 1990, similar suggestion was made therein. Obviously, seeking patterns in our behaviour may make us more accountable. Would not it be useful if we could have a portal displaying thesis summaries of all postgraduate students in the country. This will promote originality and at the same time, encourage students to build upon each other's ideas. Analysis of these abstracts will also give feedback to the policy makers about the correspondence between the skills and perspectives being developed and the emerging needs of the society.

3.4 Blending open source with IP protected technologies:

The major stress of public agricultural research system so far has been creation of public goods. Almost every technology developed in agricultural universities and research institutes was available for so long to anyone who wanted to use them for individual or collective purpose through commercial or non-commercial channels. Private seed and input companies used the materials developed by public system, generated huge profits and shared practically nothing with the public research system. Of late, the stress on protection of intellectual property right has begun to be made. But, the progress is very slow and uneven. We have not developed licensing schemes like technology commons mentioned earlier to blend open source technologies for common people and proprietary restrictions for firms. The need for research system to generate revenue from the companies which benefit from the public R&D cannot be over emphasised. And yet, the process of technology licensing has progressed very slowly.

3.5 Tracking IP in Indian commodities:

I have looked at all the patents on uses of several commercial crops exported by India such as psyllium, castor, fennel, cumin, coriander, etc. Out of 320 patents during 1976 to 2008 on uses of psyllium in US Patent and Trademark Office (USPTO) only two were granted to Indians. This is the situation in a crop where India is a major global exporter. The implication is that our farmers must continue to produce only raw material and the value would be added in the importing countries. Can we pay our farmers better price under such circumstances? Can we export value added products to generate more returns for farmers as well as entrepreneurs? In castor, out of 198 patents (1996 –2008), only four were by Indians. This again is an important export crop of India. Some of the patents are so obvious that we should have opposed them long ago. For instance, patents on making snack bar containing psyllium or patent on optimal mesh size for maximising adsorption in human body. None of these US patents have involved any sophisticated R&D. Who is tracking these trends and what policy measures are being taken to arrest this trend is difficult to understand. Because since 2001, I have been sharing this kind of information with hardly any impact on the policy or the institutions. The research organisations must be having perverse incentives for protecting IP, otherwise, it is difficult to understand such an apathy towards value addition to get better returns to farmers. The Farmers Commission failed to share such trends and thus recommend corrective action.

4 Ethical and institutional issues in agricultural research

4.1 To the extent research is done based on farmers' knowledge and wisdom, seldom are the findings shared with the people who provided the data. The knowledge providers are neither attributed nor reciprocated. There are large number of varieties in pulses and oil seeds which are purification of farmers varieties and yet, the communities conserving those varieties have never been given any credit. The ethical responsibility towards knowledge providers must be enunciated in the guidelines for granting degrees or sponsoring research projects. A knowledge economy without proper balance in the rights of various knowledge contributors is unlikely to flourish in the long term.

4.2 Longitudinal research:

It is well known that theory building requires long term research, particularly, in tropical countries where variations over time and space are very high. And yet, some of the old experimental sites under study for soil fertility changes and other such factors have been closed down. Much is talked about climate change and yet no systematic study of coping strategies of local communities in different kinds of high risk environment has been taken up. Unless we take up longitudinal research, in close cooperation with the people in different parts of the country, situation would not improve even in future.

4.3 Public awareness about hazards of various chemical technologies:

One could travel from Delhi to western UP, Haryana or Punjab. While one can find thousands of bill boards advertising chemical pesticides, one cannot find one or two bill boards communicating the precautions workers should take while using chemical pesticides. Despite considerable awareness about the hazardous consequences of several pesticides, they continue to be sold in India. Whose responsibility it is to educate the workers and provide them safety gears for preventing exposure to hazardous substances.

4.4 Monitoring post release effects of biotechnology:

There is no argument about the need for pre-release scrutiny of any technology including biotechnology. While in other technologies markets can deal with the consequences to some extent, in chemical and biotechnological inputs, the markets may not be able to monitor consequences for environment, biodiversity, human and non-human life forms. The result is that wider public does not get authenticated information about say, the consequence of Bt cotton on soil microbial diversity, pest resistance and migration to other crops, effect on human and livestock health, etc. A great deal of anecdotal information is going around on the web but scientific studies on the subject are not available to the wider public to make informed judgments. In certain cases, if one has to make a trade off in favour of

technological choices that affect workers adversely, vis-à-vis the ones which do not, one should ordinarily prefer the safer choices. Some of the biotechnological choices may stand their ground on this issue. National Biotechnology Regulatory Authority is likely to set up soon to bridge the gap among societal confidence, scientific rigour and ethical responsibility.

Summing up

There are a large number of areas where wisdom of common people can help in revitalising Indian agriculture. One of the biggest participatory research took place in Gujarat during last six years when cotton production went up by more than three times, pesticides consumption came down largely through hundreds of varieties developed by farmers. Many of these farmer breeders provided performance guarantee and charged the seed price after the crop performed as expected. It is true that environmental consequences of such widespread use of Bt gene have not been monitored adequately. At the same time, some indications are becoming available that pests are getting resistant or are moving to other crops. More than 90 per cent area under irrigated cotton has been taken over by Bt cotton. Thanks to thousands of micro irrigation projects, the diffusion of farmer-bred varieties has over taken significantly the seeds marketed by large multi national corporations. There has obviously not been any farmer suicide in Gujarat on this account. Why have lessons not been learnt from a state having 10 per cent agricultural growth with primarily people's own efforts when national average is less than two percent.

The quality of education, development of entrepreneurial spirit, monitoring eco system health and developing longitudinal research facilities are some of the other important concerns in the Indian agricultural research system. When plant breeding got dominated by the practice of making selections in international nurseries and releasing varieties instead of painstaking seven to eight year breeding cycles of complex crossing programmes, the faster mortality of such rapidly released varieties was inevitable. The incentive systems for scientists unfortunately have not been upgraded and calibrated in a manner that social, professional and individual interests can converge. The organisational design does not let new forms of partnerships and networks to emerge. The public policy has become so populist that government can provide tens of thousand crores for waiving loans. But public investment in participatory research on sustainable agriculture building upon farmers innovation and wisdom would not get allocation of even 10 crores. The current crisis in Indian agriculture is a consequence of the outdated policies and irrelevant organisational and institutional designs. There is no escape from major restructuring of agricultural research policy and institutions. I may be forgiven for being too critical at several places in my submission. I am aware of the respect and affection that colleagues scientists have for our work over last few decades in highlighting the genius of unsung heroes and heroines of our society. Thousands of innovations and traditional knowledge identified from more than 500 districts has proved, if a proof was needed that Indian farmers, artisans, pastoralists and mechanics are extremely creative. If a Rs.5000/= wind mill developed by Mushtaq and Mehter Hussain

in Assam does not surprise policy makers and induce them to overcome their indifference towards the creative potential of small farmers, nothing will. Even if I tell you that this windmill has reduced the energy cost of salt farmers and workers in Gujarat, thought at slightly higher unit cost, you may still not feel surprised. Dr. Y.P.Singh had drawn attention to the need for recognising indigenous knowledge way back in 1967-68. He failed. Honey Bee Network has been trying for last two decades. We have succeeded in industrial and medical research. Why should agricultural research leaders show so much resistance to learning from innovators and inventors at grassroots?

I have not shared many examples of farmers' innovations because most of you might have seen them at www.nifindia.org or at www.sristi.org. I have instead focussed more on realigning agricultural research policies by learning from grassroots. If even a few ideas can get empathetic shoulders to walk on, my purpose would have been served. After all, a tail can indeed wag the dog.