



Brainstorming Session

on

Prospects of Producing 100 million tons of Wheat by 2015

and

Presentation of The Fifth Dr. M.S. Swaminathan Award

for

Leadership in Agriculture

PROCEEDINGS & HIGHLIGHTS

December 18, 2010
NASC Complex, Pusa, New Delhi



Trust for Advancement of Agricultural Sciences (TAAS), Pusa Campus, New Delhi
and
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Brainstorming Session on Prospects of Producing 100 million tons of Wheat by 2015

A Brainstorming Session on “Prospects of Producing 100 million tons of Wheat by 2015” was organized jointly by the Trust for Advancement of Agricultural Sciences (TAAS), New Delhi and Directorate of Wheat Research (ICAR), Karnal, on December 18, 2010 at NASC Complex, New Delhi, in which more than 200 delegates participated. The program is given in Annexure-I and the list of participants in Annexure-II.



The Session was chaired by **Dr. MS Swaminathan**, Chairman, MS Swaminathan Research Foundation and co-chaired by Dr. SK Dutta, Deputy Director General (Crop Science), ICAR. Among the dignitaries present was Dr. Sanjay Rajaram, former Director, Wheat Programme, CIMMYT, Mexico, and the recipient of the 5th Dr. MS Swaminathan Award for Leadership in Agriculture.

Dr. Swaminathan appreciated the theme of the meeting since he considered that wheat production is synonymous to Indian food security and we need to accelerate our efforts to compass the target of 100 million tons in next 5 years, which can only be possible when we make concerted efforts and ensure productivity enhancement in states yet below the national average. He also congratulated Dr. Paroda for having organized this very timely dialogue through TAAS.

At the outset, **Dr. RS Paroda**, Chairman, TAAS welcomed the dignitaries and the delegates. He also acknowledged the presence of eminent wheat scientists, namely, Dr. MS Swaminathan, Dr. PL Gautam, Dr. JP Tandon and Dr. S Nagarajan. While introducing the subject of the brainstorming, he emphasized the importance of increasing wheat production in the present context of ensuring food security. He highlighted the strength of the Indian wheat programme, built over several years, with the vision and initiatives of Dr. BP Pal, Dr. MS Swaminathan, Dr. AB Joshi, Dr. SP Kohli and others. Though India surpassed USA in wheat production 15 years ago to attain the world’s second position, it is still trailing behind China which produced 113



million tons with only 3.0 m ha more area under wheat. He indicated that Russia is making faster progress and has also surpassed USA in wheat production. Though we made great strides in genetic gains of almost 1%, there are challenges to be addressed like that of climate change, narrow genetic base, second generation effects of green revolution and high cost of inputs. There is a need to follow a twin pillar approach of genetic enhancement and natural resource management. Keeping this in view, three speakers, Dr. S Rajaram, Dr. Raj K Gupta and Dr. SS Singh were invited to flag issues on genetic enhancement, natural resource management and national wheat scenario. They opined that there is a good scope of moving forward with both horizontal and vertical growth coupled with strong national and international collaborations.



Dr. S Rajaram, former Director, Wheat Programme at CIMMYT and the recipient of 5th Dr. MS Swaminathan Award for the year 2010 gave a global perspective of wheat programme. He spoke about meeting the increasing demand of wheat due to increase in population. He indicated that there will not be easy solutions as this demand has to be met from the available area and lower genetic gains

due to technological fatigue. Though solutions are not easy but he firmly believed that the target of 100 million tons can be achieved. Speaking on the global scenario, he highlighted the fact that worldwide the area under wheat is 217 million ha producing 621 million tons with productivity of 2.9 t/ha, which is very low. The developing countries have a little more than half of the acreage with a little less productivity and production of 308 million tons. Wheat is very important in the daily consumption for countries like India and China as it provides 500 calories per capita per day which is nearly quarter of the daily requirement. This component alone will have large implication in wheat market chain at global level where on an average 100 million tons is traded annually in the international market. Fast adoption of improved varieties has occurred in India as compared to Latin America and China, while substantially lower in Middle East and Africa. He commented that during the first three decades starting from 1965, wheat production in India increased by 3% per year while from 1995 to 2005, the productivity growth remained sluggish at 1% per year. Hence, to meet the target, a substantial rise in the productivity growth rate in the range of 1.6 to 1.8 % per year is required. Declining international price of wheat will also have an implication on how the targets will be met. It is expected that by 2020, the requirement for wheat will be somewhere between 750 - 800 million tons against the current production of 620 million tons. This will be mainly due to the additional demand of wheat for animal

consumption and biofuel. It is expected that nearly 50% of this requirement will be met from Asia alone. He summarized that change in wheat area, adoption of modern varieties having high yield potential, pricing, government policies and international collaboration with CIMMYT facilitated the green revolution. He outlined the drivers of future revolution, which are summed up as follows:

The foremost technology that is going to be the driver of wheat research in future is the molecular marker assisted selection (MAS) and wheat transgenics. We need to have efficient markers for traits such as resistance to yellow rust, stem rust, grain quality, etc. Also the genetically modified wheat for heat and drought tolerance will deliver good returns. He also stressed that there is need of integrated germplasm enhancement policy. Emphasizing the use of synthetic wheats and other wild wheats, he pointed out the importance of such sources for mining new genes for grain yield as well as various biotic and abiotic stresses. The use of biotechnological approaches such as MAS can be helpful.

He also argued that we need to understand the impact of climate change on wheat crop. The temperatures may be higher and new threats to wheat production may arise such as leaf blast (prevalent in South American countries and can emerge in eastern plains of India), Fusarium head blight and Hessian fly. Also the leaf blight is becoming a major disease in North Western Plains Zone (NWPZ) of India. The major focus of the researchers should, however, be on maintaining the yields which have been stagnating for almost last one decade. There is a need to lay more emphasis on breeding for yellow rust resistance, which is potentially the biggest threat to wheat production. The constraints on production, however, may be managed by resource management while plant breeding is focussed on increasing yield potential of the varieties. New biological threats may not be of much importance now but we need to keep an eye on them. To overcome the constraints and increase yield potential, biotechnological approaches for developing hybrid wheat and marker assisted breeding can be seen as major options. We need to be prepared for the worst. Other than the above threats, the climate change is going to increase the risk of abiotic stresses such as terminal heat and drought. A number of measures have to be introduced for anticipated effects of climate change particularly in the terminal phase of wheat crop. The demand for more productivity growth and cereal based cropping systems in Indo-Gangetic Plains (IGP) will drain the soil of essential elements. Both crop improvement and management strategies have to be integrated to find better solutions.

The demand for agricultural inputs is also going to increase. The demand for fertilizer will remain strong but high energy costs may impair fertilizer production. The long-term yield growth of wheat will depend on improved nutrient use efficiency. Similarly, water

will remain a scarce commodity and for that the water use efficiency must improve. These issues can be tackled by crop improvement and crop management strategies in an integrated manner. There should be better access to data, information and knowledge. Three major threats including fresh water scarcity, marginal lands and soil degradation have to be tackled in a participatory mode involving public and private sectors. In future, competition in market value chain will have its own implications. 43 % of the global imports for food is wheat based and this demand will go up by 2.6% per year by 2020. If we add animal needs, this demand will further go up by 5% per year. India's consumer demand for improved quality wheats is going to increase and we will need to have more than one quality wheat in market. If this demand is adjusted for future demands for products like flour, pasta and bakery, the demand can still go up with different types of quality traits.

Given the scale of the task, it has become all the more important to develop partnerships between public and private sectors. We must also strengthen the old model of working together with Indian Agricultural Research System (IARS). This has to be done to meet the changing needs of technological advancement as it evolves. He highlighted that molecular breeding will keep delivering good outcomes through collaborative efforts and GM wheat has significant potential in coping up with global change through new innovations. Such initiative may be through public and private sector partnership and will lessen the risk of stresses like terminal heat or other issues related with biotic and abiotic stresses. Without sacrificing the yield potential, we need to promote work on drought, disease, and herbicide resistance and improvement in grain quality.

Dr. SS Singh, Project Director, Directorate of Wheat Research, Karnal, in his presentation, gave the national scenario of wheat production and productivity. He highlighted the achievements of the Indian wheat programme and showed how successive strategies improved wheat productivity over the years resulting in record production during last three years. He enumerated that nearly 371 wheat varieties have been developed since 1965 and lauded the efforts of breeders and pathologists in keeping the rust disease at



bay for more than three and a half decades. He highlighted the role of the Directorate as a nodal centre coordinating wheat research in the country and contributing towards germplasm enrichment through sharing of improved materials. While addressing the issue of wheat target of 100 million tons by 2015, he delineated various issues that need to be tackled for achieving the targeted

wheat production. He laid emphasis on bridging the gaps in productivity in different wheat producing zones of the country through available technologies which can give additional production of nearly 21.8 million tons. He laid stress on broadening of genetic base through pre-breeding, exploitation of heterosis, changing plant architecture and biotechnological interventions. While highlighting the constraints in wheat production, he addressed the issue of climate change and the need to work on heat and drought tolerance. Pest and disease dynamics are changing due to environmental fluctuations and as such it is important that these issues are well tackled. He opined that besides keeping a watch on the new race of stem rust Ug99, it is of paramount importance to keep yellow rust at bay. He also advocated the concept of integrated management of wheat productivity scenario and use of conservation agriculture (CA) base to evolve new wheat varieties. He strongly believed that varieties should be developed to suit the new management techniques including conservation agriculture. Integrated nutrient and water management will play an important role in conserving resources and increasing profitability of the farmers. Balanced use of fertilizer and correcting micro-nutrient deficiencies will be a part of this integrated approach. His special recommendations were phasing out of old varieties, improving storage facilities and incentives for profitable crop production. At the end he enumerated the various steps being taken by the Directorate in collaboration with the Central and State Government to boost wheat production in the country. In this regard, a series of meetings and deliberations were held at Karnal and Kanpur, the representatives of the two mega-environments of wheat production.



Dr. Raj Gupta while speaking on the 'Role of natural resource management in improving the wheat production of the country' emphasized that the issue was very pertinent and timely. To achieve additional production, we require land, water, additional inputs, right policies and the will to invest in natural resource management technologies. He informed that during 1970-

2000, the production gains were 1.6 million tons per year which subsequently reduced to almost half, close to 0.8 million tons per year. The rate of increase of total rabi food production was 1.97 million tons per year during 1960-1995 which decreased to 0.41 million tons per year, afterwards. This explains the contribution of enhanced wheat production to the national food security of the country, which is very crucial. For increased rabi production, we need good aquifer recharge, since the irrigation water supplies depends on ground water. In addition, availability of quality

seed of appropriate cultivars, fertilizer nutrients and appropriate management practices are a must to boost the wheat production. Large area in the country depends on ground water while the underground water in many areas is of poor quality. As the crop water demand in many states depends on ground water, there is substantial decrease in water table leading to unsustainable situations in the north western Indo-Gangetic plains. Even, the latest National Aeronautics and Space Administration (NASA) report says that these regions are mining water to the tune of 13 km³ per year which will never return. The consequence of this mining of ground water is the decline in underground water levels which will pose a greater challenge in the years ahead to meet the crop water demands.

In Punjab and Haryana, which are the major wheat growing states, the yield gap is 14 – 17 % whereas in the eastern Gangetic plains, the yield levels are just half of the attainable yield with a yield gap of 47-48 %. If we can bridge this gap, I think, we can address the question posed by Dr. Raj Paroda to produce additional 20 million tons of wheat, thus, the projected production targets of 100 million tons seems to be achievable. I consider that in the next couple of years, there will be no major gains in the release of high yielding varieties because the last variety released is DBW 17 and recently a joint release by Directorate of Wheat Research (DWR), Karnal and Punjab Agricultural University (PAU), Ludhiana is in the pipeline. These varieties are going to stay in the field for the next 4 – 5 years. Hence, the yield gains are to be made mainly through natural resource management to bridge the management gaps in wheat productivity. The management gaps which need to be addressed are: late planting of wheat, weed competition, low fertility related soil degradation, seed quality and inappropriate choice of cultivars. In addition, we need to address the issue of terminal heat which substantially reduced the yields in the north western India. To bridge the yield gaps, we need to have appropriate technological intervention, address the socio-economic issues coupled with policy support from the Government. The added challenge is that the temperatures are rising and for each degree rise in temperature, we need 2% additional irrigation. The projections are that the current favourable wheat growing areas will reduce by half by the year 2050. Moreover, the ground water supplies are unsustainable and we need to develop practices to recharge the underground water resources and use them appropriately. The question arises as to where the additional gain will come from? The projections are that rice-wheat system which covers 10.6 million hectare can produce additional 5 million tons, rainfed mixed cover around 16 million hectare can produce additional 5.4 million tons and other areas around 0.3 million tons which make it to 10.7 million tons by bridging management gaps. Then, can we have additional area? The 2001 estimates show 11.6 million hectare as the rice fallows in Bihar, Madhya Pradesh, West Bengal, UP and Assam which can be

effectively used to produce substantial quantities of wheat by adopting surface seeding and other appropriate technologies. Moreover, additional wheat can be produced by intercropping wheat with sugarcane and relay cropping of wheat in cotton, growing extra short duration pigeonpea in pigeonpea-wheat sequence. We can produce about 13.4 million tons additional food if we are ready to invest in rice fallow and intercropping options.

Earlier Dr. SS Singh and Dr. S Rajaram have pointed out that conservation agriculture (CA) practices can help increase the productivity and reduce the cost of production. So, the major emphasis is going to be on zero tillage, raised bed planting, residue management and surface seeding. The crop establishment and residue management practices will determine the subsequent agronomic practices. The CA practices are site specific, divisible, flexible in application and can be used in diverse situations. It was further emphasized that the need of adopting water saving technologies like laser land levelling which saves on an average around 12 cm water in rice and 6 cm in wheat with higher system productivity by about half a ton with 2 – 3 quintals in wheat. In order to achieve high productivity, choice of cropping system specific cultivars is a must. We also must replace old varieties like UP 262, HUW 432, PBW 343 and Lok 1. Late planting is an issue especially in the eastern Gangetic plains. Timely planting can give up to 12 t/ha productivity from rice-wheat system when rice is planted by June which helps in timely planting of wheat also. Delay in rice planting affects the wheat sowing and zero tillage can help timely planting leading to higher productivity. To address the terminal heat, we can follow sugarcane –wheat intercropping, wheat + mint and even relay planting of mung bean with wheat or wheat with cotton. Another opportunity is the growing of dual purpose wheat with berseem which gives green fodder as well as fairly good wheat yields. This can help reducing area under pure green fodder and more area can be brought under wheat. The better quality of wheat + berseem straw can also help increase the productivity of the cattle. Another issue which is very close to us is that without much thought we have introduced tillage equipments like rotavators which compress the soils in about four years leading to ill effects on wheat causing temporary water logging, chlorosis at first irrigation, increased incidence of Phalaris minor and additional use of N and P fertilizers. This is required to be looked into more closely and we must provide an alternative which is environment and farmer friendly.

It is also important to know as to how to address the climate change and water issues? Surface retained crop residues help in buffering the soil temperature, thereby, increasing the comfort zone of the crop. Canopy temperature during grain filling remains lower

leading to higher productivity. We have substantial area under saline and sodic soils. Under such conditions, we need to change the planting technique. Putting wheat on beds in sodic or semi-reclaimed sodic soil and in furrows in saline soil can help increase the productivity. To meet the target, we need to take all these technologies to the farmers. For this, we need almost 100,000 multi-crop planters in which farmers also have to invest. We need region-specific seed systems and service centres, government funding and we need to improve the reach of the farmers to agricultural knowledge through dedicated TV and radio channels, interactive SMS services with sharply focused technical contents. The key message is that the innovations in technology development, dissemination and use can help produce 100 million tons of wheat for which all that is required is the strong will.

General Discussion:

Following the presentations, intensive discussion took place where various participants flagged important issues that could help in enhancing wheat production in the country. Some important interventions were:

Dr. Swapan K Datta drew attention of the house to the fact that nearly 30 years ago, Rht gene had made remarkable gain in wheat production during green revolution era. He further said that now integration of system biology, genetic resources, system management, NRM, biotechnology could take us to achieve 100 million tons of wheat in next 5-7 years, provided concerted efforts were made by all concerned.

Dr. S Nagarajan remarked that there were many genes that could still be mined for productivity enhancement. He opined that there was a need to explore the “stay green” system, stiff straw, possibilities of increasing photosynthesis, readjusting balance between source and sink. Leaf temperature management by plant is an important mechanism to avoid heat stress. There is lot of variability for such traits in the cultivated species and related genera. This calls for a concerted effort of integrating a physiology group with breeding activities. Another issue that needs examination is the possibility of enhancing maturity period in cooler regions by a few days (as we know that 50 kg per day extra yield can be achieved). He also showed his concern for the stripe rust as it was the major disease in the highly productive North Western plains for which Punjab should not be looked in isolation but should be linked with West and Central Asia. He also said that stem rust in India is not likely to cause an epidemic. He also showed his concern for head scab due to which the grain becomes unfit for animal and human feed. The head scab assumes more importance in the event of climate change leading to more rains in the terai region. He

also spoke about the low spread of zero tillage due to lack of service package for proper maintenance. He pointed out the micronutrient and multiple nutrient deficiencies and need for balanced fertilizers. Storage of extra wheat was a major concern and UP and Bihar need to have a good mandi concept. Dr. Nagarajan concluded stating that India could achieve expected target of 100 million tons provided all issues are addressed as a package and in a missionary zeal.

Dr. RK Malik pointed out about the need of replacing diesel based irrigation with electricity based irrigation in eastern Indo-Gangetic Plains as the former is very costly. He also showed concern for the late harvest and delayed procurement of rice resulting in late sown wheat. There is a lack of medium duration (120 days) rice for uplands. He opined that short hybrid rice can make a big dent on system productivity in upland irrigated systems owing to timely harvest of rice and timely planting of wheat. . Low productivity in eastern India is also due to low nitrogen use. Hence, when productivity constraints such as these are addressed, we can enhance wheat productivity in eastern India to achieve the target.

Dr. Ashutosh Serkar while speaking on yield gap in north eastern region voiced his concern about farmers being unaware of the new technologies. He emphasised the need of training and capacity building of farmers of Eastern India. He also addressed the importance of including pulses for diversification of rice-wheat system.

Dr. IP Abrol stressed upon the need to study the elements that led to growth in productivity during past three years and devise comprehensive strategy for accelerating wheat production in the country.

Dr. JP Tandon showed his concern about the low realization of yield from improved varieties though these had a high potential. He was confident that the existing varieties with appropriate management practices can bridge this gap. Late sowing in eastern India is a major concern. Zero tillage facilitates timely planting if farmers have timely availability of water. In such a case, he opined that dry seeding followed by irrigation was a good option for timely planting. We need to promote wheat production through efficient mechanization.

Dr. BR Barwale mentioned that the quantity of hybrid wheat produced was meagre and is not sufficient to meet the demand. Hybrid wheat technology needs to be rationalized to make it competitive as far as its cost is concerned. He also showed his concern about poor quality of seed as there was no regular monitoring of seed at farmers' field. He also mentioned that low replacement rate is a reason for low production. **Dr. Kaushik** also emphasized on increasing investments on hybrid wheat research.

Dr. VP Singh emphasized that there was need of good quality and quantity of wheat straw in future strategy for wheat improvement.

Dr. KS Khokhar pointed out the importance of timely availability of inputs and the required coordination between research and extension agencies, aiming at increasing productivity of wheat in Haryana.

Dr. PK Joshi proposed two kinds of strategies: the first being the research strategy where emphasis is given on genotype x environment x management and second being the developmental strategy where there is need to increase yield and area. Yield can be increased in low yielding areas while area can be increased in rice fallow system by making availability of irrigation. This can be done by investments in power generation and other infrastructure.

Dr. Ramesh Chand pointed out the positive, as well as, negative factors affecting wheat productivity. The negative being keeping wheat area intact in view of emerging challenges such as: competitiveness with hybrid maize and boro rice. Wheat is losing its relative profitability compared to winter maize and boro rice. The positive trend is possible due to food security bill in which government is planning for yet better procurement policy for wheat.

In his concluding remarks, **Dr. MS Swaminathan** complimented the presentations and contributions made by other participants on various issues that might help in meeting the wheat productivity target of 100 million tons by 2015. He said achieving this target was critical to achieve the Millennium Development Goal to eradicate extreme poverty and hunger by 2015. He specially complimented TAAS and DWR for choosing this topic for this Brainstorming. He pointed out that India was still lagging behind in achieving the first goal of reducing hunger to half by 2015. Though poverty is being reduced, hunger is taking more time. He hoped that “important steps” will be taken to implement the recommendations emerging from this session. He maintained that it was still possible to boost wheat productivity from existing technologies provided research and extension agencies work together and integrate all schemes. There are gaps between the potential yields that new technologies offer and the yield that our farmers get, new schemes like Rashtriya Krishi Vikas Yojana (RKVY) should be effectively integrated with new technologies so that the benefits of existing technologies can be harnessed effectively. The MNREGA designed especially for rural poor has given us an opportunity to develop an interface between labour and technologies (labour x technology). This can be easily integrated

into the programs like water-shed management. Benefits will be more if existing labour is better utilised for the accelerated adoption of new technologies.

Dr. RS Paroda, while thanking Dr. Swaminathan, all speakers and participants, emphasized that for required national food security, production trend in wheat will be the most crucial deciding factor. India has potential to be number one in the world provided we make all out efforts to increase productivity through resistance in wheat production system.

Recommendations:

The brainstorming was mainly focused on the ways and means to achieve a target of 100 million tons of wheat production by the year 2015. The following are the main recommendations emerging out of the discussions:

- i. Food security in India is synonymous to wheat production. Hence, consistent efforts would be necessary to increase wheat production to meet our ever increasing demand despite numerous challenges such as: factor productivity decline, high cost of inputs, poor soil health, low quantity and quality of water, and adverse impacts of climate change.
- ii. Almost a decade ago, India had become number two in wheat production by surpassing the USA with almost same acreage. It must now aim to be number one by achieving higher production than China (currently 112 million tons). In this context, there is no room for complacency. Concerted efforts would be needed under national food security mission to coordinate AR4D initiatives, especially to accelerate wheat production efforts in eastern India, and in those States whose average wheat productivity is still lower than the national average.
- iii. Nutrient application in the form of fertilizers and pesticide use will become more expensive due to high energy costs. Similarly, water scarcity will be a major challenge. Hence, it is important to develop varieties that are both water and nutrient use efficient. This can be achieved through appropriate crop improvement and crop management strategies in an integrated manner. It would require intensified crop improvement efforts and more extensive use of germplasm, synthetic wheat breeding and use of biotechnology. In this context, wheat breeding efforts in the country must immediately be strengthened and capable human resource employed.
- iv. The major focus of the researchers should now be on enhancing the yield, which has been stagnating for almost a decade. To overcome specifically this challenge,

both breeding and biotechnological approaches for developing hybrid wheat appears to be a viable option. To address this, public-private partnership should be encouraged through much needed policy environment and support, especially to ensure quantum jump in wheat productivity.

- v. Marker assisted wheat breeding will have a pivotal role and there is need to develop efficient markers for traits such as yellow rust, stem rust, grain quality, etc. Transgenics in wheat should be developed, especially for abiotic stresses, like terminal heat, drought and other traits like herbicide resistance, grain quality improvement, tolerance to micronutrient deficiency etc.
- vi. Research on quality improvement has to be further strengthened as the country's consumer demand for improved quality wheat is increasing, since, there is a need now for various end uses like flour, pasta, bakery, etc. Also, wheat quality will be a critical factor in case of future exports, if any.
- vii. There is a need to lay more emphasis on breeding for yellow rust resistance which potentially will be the biggest threat to wheat production in near future. Keeping in view the impact of climate change, constant vigil and preparedness is required to deal with new threats like leaf blast, Fusarium head blight and Hessian fly. Similarly, incidence of leaf blight is now spreading in NWPZ, which needs to be addressed as a new threat.
- viii. There is an urgent need to integrate both crop improvement and management strategies, especially to find solutions to improve soil health that has been constantly drained due to intensive rice-wheat cropping system in the Indo-Gangetic Plains. Organic matter content in the soil has to be improved and need based application of nutrients to be applied in future.
- ix. Burning of crop residues is leading to environmental pollution, in addition to the loss of valuable organic matter needed to maintain soil health. We must promote surface retention or incorporation of crop residues for better soil health, which is so crucial for increasing productivity and profitability.
- x. In the scenario of decreasing availability of good quality irrigation water, there is an urgent need to adopt and promote water use efficient technologies like laser land levelling, raised bed planting, wheat sowing using zero till drill etc. for higher productivity and profitability to the farmers.

- x. Unfortunately, considerable area is under late planting, especially in the eastern Gangetic plains. Through an aggressive campaign, timely sowing of wheat for higher productivity has to be ensured, following the examples of Punjab and Haryana in the recent past.
- xii. Substantial area in the eastern Gangetic plains is under rice-fallow. There is an urgent need to promote adoption of surface seeding and/or zero tillage to convert the single cropped area to double cropping for increased production of wheat. This option has to be pursued aggressively, to both, increase area under wheat and cropping intensity in eastern India.
- xiii. Wheat can be grown as an intercrop with sugarcane by adopting bed planting technique or relay cropping with cotton. Therefore, future efforts be addressed towards farming system's research. Also for increased system productivity, profitability and sustainability, summer mung in north western Gangetic plains must be promoted, since, excellent short duration, disease-resistant varieties of mung bean are now available.
- xiv. Region-specific seed systems should be developed for ensured supply of quality seed of varieties suitable for different regions for achieving increased productivity. It was also felt that predominant variety PB343 must be phased out soon, since, it has shown increased susceptibility to brown rust, whereas new resistant varieties are now available to replace it. This requires priority time bound action.

**Presentation
of the
Fifth Dr. MS Swaminathan Award
for
Leadership in Agriculture**



Dr. MS Swaminathan Award for Leadership in Agriculture

The Trust for Advancement of Agricultural Sciences (TAAS) has instituted an Award in honour of the renowned agricultural scientist, Dr. MS Swaminathan, whose pioneering contributions to Indian Agriculture, led to the Green Revolution in late 1960s, resulting in food self-sufficiency in India and neighbouring countries.

The Award is given annually to a person for his/her outstanding leadership in agriculture, as demonstrated by significant contributions made towards overall agricultural growth in the developing world, especially India.

First Award

The first Award was given to Dr. Norman E Borlaug, the only agricultural scientist to have been honoured with the Nobel Peace Prize. His work in wheat at CIMMYT, Mexico resulted in development of high yielding wheat varieties which revolutionized wheat production in India and other developing countries suffering from food scarcity. This Award was given to him by the then President of India, Hon'ble Dr. APJ Abdul Kalam on March 15, 2005 at Vigyan Bhawan, New Delhi.



Second Award

The Second Award was conferred upon another distinguished scientist, Dr. GS Khush, by the Hon'ble Prime Minister, Dr. Manmohan Singh, during the International Rice Congress, held in New Delhi on October 9, 2006 at Vigyan Bhawan. Dr. Khush, working at the International Rice Research Institute, Manila, was associated with the development of more than 300 high yielding varieties of rice which gave a tremendous boost to the productivity of rice in rice growing countries. In recognition of his contributions, he was awarded the World Food Prize in 1996. He has been honoured with a number of awards by National and International organizations.



Third Award

The third Award was presented to Dr. SK Vasal, an accomplished Maize Breeder, by Prof. MGK Menon on May 3, 2008 at NASC Complex. The Award function was preceded by a National Symposium on “Quality Protein Maize for Human Nutritional Security and



Development of Poultry Sector in India”. Dr. Vasal’s work at CIMMYT on maize led to the development of Quality Protein Maize (QPM). For this work, he alongwith his colleague Dr. Evangelina Villegas received the World Food Prize for the year 2000. Quality Protein Maize developed by Dr. Vasal helped in improving nutritional status of millions of people depending on maize as their staple. Dr. Vasal has developed useful methodologies and

released a number of inbred lines which are being used by various institutions worldwide. He has been honoured by a number of institutions for his valuable contributions.

Fourth Award

The fourth Award in the series was given to Prof. Rattan Lal, an eminent soil scientist, for his outstanding contributions in the field of sustainable management of natural resources. His work had a great impact on food production among resource-poor farmers in developing countries. This Award was presented to Prof. Rattan Lal by Dr. Montek Singh Ahluwalia, Deputy Chairman, Planning Commission on August 11, 2009 at IARI Auditorium.



Fifth Award

The fifth Award was presented to Dr. Sanjay Rajaram, a distinguished Wheat Breeder, by Hon’ble Dr. APJ Abdul Kalam, former President of India. Other dignitaries present were: Dr. KV Thomas, Dr. MS Swaminathan, Dr. S Ayyappan and Dr. BR Barwale. The Award Ceremony was held at AP Shinde Symposium Hall, NASC Complex, Pusa and attended by a large audience of senior research managers, wheat scientists, faculty and students of IARI and other Institutes. Copy of the program of the Award Function is given at Annexure-III.

Dr. Sanjay Rajaram is one of the most distinguished wheat breeders, known for his valuable contributions globally. He led CIMMYT's wheat breeding programme for over two decades. Under his leadership, the CIMMYT programme made tremendous impact on global wheat production. Dr. Rajaram has been associated with the development of as many as 480 wheat varieties which have been released in 51 countries, and are grown on an estimated 58 million hectares worldwide. Twenty five of his varieties have so far been released in India. For this contribution, he has been honoured with a number of national and international honours and awards.



The Award presentation function began with the Welcome Address by **Dr. S Nagarajan**, Vice-Chairman, TAAS. He lauded the contributions of Dr. Sanjay Rajaram. He said that the rejuvenated second phase of the wheat revolution came as a result of scientific efforts of Dr. S Rajaram, while he was at CIMMYT. Wheat lines like Veery, Seri, Bacanora, Baviacora, Attila, Myna, Chiriya and several others, that he evolved since 1980s, sustained the genetic gain as they were all superior to Kalyan Sona and Sonalika in yield and disease resistance. His concept of wheat growing mega environment of the world, involving Russian, Chinese and Argentinean wheat in crosses, shuttle breeding for generation advancement are a landmark in global wheat research. He welcomed Hon'ble Dr. Abdul Kalam to this Award Function as Chief Guest and Prof. KV Thomas to Chair the Function. He was especially pleased to have other dignitaries like Dr. MS Swaminathan, Dr. S Ayyappan and a large number of distinguished scientists and students in the auditorium.



Dr. S Ayyappan complimented TAAS for choosing Dr. Rajaram to receive the prestigious fifth Dr. MS Swaminathan Award. Dr. Rajaram is one of the most celebrated wheat breeders, whose wheat varieties have made tremendous impact on increasing wheat productivity in wheat producing countries of the world. He wished Dr. Rajaram all success in his future endeavours.



Dr. RS Paroda, Chairman, TAAS also welcomed Hon'ble Dr. Abdul Kalam and other dignitaries. He gave a brief overview of TAAS activities, including the present Award. Talking about the genesis of the Trust he said that during the beginning of this Millennium, the 88th Session of the Indian Science Congress was held on the IARI Campus in 2001. At that time, the Organizing Committee decided to



establish a Trust for the Advancement of Agricultural Sciences (TAAS) with a view to link Science to Society. This Trust subsequently decided to institute a prestigious award in the name of Dr. MS Swaminathan to honour world renowned eminent scientists for their life-time achievements, and contributions towards growth and development of Indian Agriculture. He informed that so far, four such awards had been given. The first one was given to Dr. Norman E Borlaug, the second to Dr. GS Khush, third to Dr. SK Vasal and fourth to Prof. Rattan Lal. This fifth award is being presented today to Dr. Sanjay Rajaram who is a renowned wheat breeder and an old associate of Dr. Norman Borlaug.

Among these awardees, three recipients are also the World Food Prize winners, an award equivalent to the Nobel Peace Prize. The contributions of these scientists have made India proud. Dr. Paroda drew attention of Dr. Kalam to the words of Dr. Borlaug which he stated while receiving this Award at his hands, that "Indian scientists are second to none." Dr. Paroda expressed his happiness that the current recipient is Dr. Rajaram, an old associate of Dr. Borlaug. On behalf of Indian Scientists and farmers, he thanked him for all that he did to improve wheat production in India.

Dr. Paroda also briefed the audience about various scientific activities of TAAS which had been acting as a Brain Trust to debate on issues of considerable importance in the present context for growth and development of Indian Agriculture. He mentioned that TAAS had organized brainstorming meetings on themes such as Regulatory mechanisms for release of transgenic crops; Role of science and society towards plant genetic resource management; Role of ICT in taking scientific knowledge to the end users; Public-Private Partnership; Farmer-led innovations for increased productivity, value addition and income generation; Strategy for increasing productivity growth rate in agriculture; Improving production of quality protein maize for nutrition security; Managing world food and agriculture crisis Policy Change; Institutional innovation and science; Emerging

challenges before Indian agriculture-the way forward; Strategy for conservation of farm animal genetic resources; Climate change, soil quality and food security; Quality seed for food security through Public-Private Partnership; Revitalizing Indian seed sector for accelerated agricultural growth.

He concluded by thanking Dr. Barwale for sponsoring the prestigious Dr. MS Swaminathan Award.

Dr. MS Swaminathan expressed his happiness for being associated with this important function where an eminent wheat breeder of the calibre of Dr. Rajaram was being honoured for his outstanding contributions which have gone a long way in ensuring food security in many developing countries. He conveyed his greetings and best wishes to Dr. Rajaram.



Prof. KV Thomas, Minister of State for Agriculture expressed his happiness to be present at this function. He gave some figures to indicate the present state of agricultural productivity in India and elaborated on the future needs in view of the increasing population and shrinking agricultural land. He expressed hope that with the advances made in scientific knowledge, we would be able to cope up with the challenges of the coming decades. He then went on to appreciate the aims and objectives of TAAS and the role that it is playing in achieving some of these objectives. He finally congratulated Dr. Rajaram for receiving this prestigious award today and wished him success.



Dr. BR Barwale, Chairman, MAHYCO Foundation who had sponsored this prestigious Award was pleased to participate in the Function. He read the Citation concerning outstanding achievements of Dr. Sanjay Rajaram (Annexure-IV). Also, Dr. Barwale mentioned the importance of hybrid wheat for

improving productivity, for which both upstream research and public-private partnership will be important.

In his response, **Dr. Sanjay Rajaram** thanked the Hon'ble Dr Abdul Kalam, Prof. Thomas, Prof. Swaminathan, Dr Ayyappan, Dr Paroda and all those present in the Award Function. He offered formal thanks to TAAS for this honour. One always feels good when his/her work is recognized – but



when that recognition comes from own peers and fellow professionals back at home than the value is a lot more and one feels really elated. He thanked Prof. Swaminathan, in whose name this award has been instituted. Dr. Swaminathan is a towering figure in India's development – leading from the front, as a scientist and administrator. He has inspired not one, but several generations of scientists in India and abroad. He said that he was a privileged student of Dr. MS Swaminathan when in sixties he studied at the Indian Agricultural Research Institute, New Delhi.

Dr. Rajaram was especially grateful to Dr. Paroda for his very kind words about his work, in fact, much more than I deserve. He emphasized that whatever work was done, same was done not by him alone, but by teams of highly dedicated researchers. I had been privileged to work at two international centers, CIMMYT in Mexico and ICARDA in Syria, and with many ICAR Research Centers, Agricultural Universities and Private Sector in India. Everywhere, I was fortunate to be a part of teams of very talented professionals. Today we had discussed how to increase wheat production to 100 million tons within next 5 years. Of course this is a huge challenge – but from my experience, I am confident that we have the people, the skills, the knowledge and the motivation to succeed. I am very pleased that we are considering a target of 100 million tons. This can be achieved through joint ventures involving scientists, farmers, policy makers and through public and private partnership. It would require the same commitments and policy support as it was provided at the beginning of Green Revolution. Finally, he said that he will continue his efforts in ensuring that India becomes number one in wheat production in the world.

Dr. APJ Abdul Kalam, former President of India, was extremely pleased to present the fifth Dr. MS Swaminathan Award for Leadership in Agriculture to Dr. Sanjay Rajaram. While appreciating the role of TAAS in instituting this prestigious Award in the name of Doyen



of Indian Agriculture, he appreciated the role of TAAS in addressing various issues under the able leadership of Dr. R.S Paroda. He was pleased to be associated with the Award Ceremony for the second time since he presented the first Award to Noble Laureate, Dr. Norman E. Borlaug in 2005. Dr. Kalam lauded the scientific contributions of Dr. Rajaram, in the form of improved wheat, which

now occupies more than 60 million hectares, netting an additional income of about US\$ 2 billion for wheat farmers across the world. He congratulated Dr. Rajaram for his unique achievements. He subsequently presented a formal talk with power point presentation on the topic "Agriculture and Farmers are the Vital Force for National Development"(Full text is given at Annexure-V).

In the end, **Dr. NN Singh**, Secretary, TAAS gave vote of thanks. He expressed his deep sense of gratitude to Hon'ble Dr. APJ Abdul Kalam for kindly agreeing to be the Chief Guest, Dr. KV Thomas for Chairing the function, Honoured Guest Dr. MSSwaminathan, Chairman of the Trust Dr. RS Paroda, Director General (ICAR) & Secretary (DARE) & Trustee, Dr. S Ayyappan, Trustee Dr. BR Barwale, Awardee



Dr. S Rajaram, our Trustee and Vice-Chairman Dr. S Nagarajan, Honoured Guests for gracing this occasion. He also congratulated Dr. Sanjay Rajaram for receiving the Award.



A view of audience

Program of Brain Storming Session

Chairperson: Dr. MS Swaminathan, Chairman, MSSRF

Co-Chairperson: Dr. SK Dutta, DDG (CS), ICAR

14:00 - 14:10	Welcome and Background	Dr. RS Paroda
14:10 - 14:40	Keynote Address "Wheat Strategy for India"	Dr. S Rajaram
14:40 - 15:00	Integrated Approaches for Increasing Wheat Production in India	Dr. SS Singh
15:00 - 15:20	Management of Natural Resources for Enhanced Wheat Production – New Innovations	Dr. Raj Gupta
15:20 - 16:00	General Discussion	
16:00 - 16:15	Chairman's Concluding Remarks	Dr. MS Swaminathan
16:15 - 16:20	Vote of Thanks	Dr. NN Singh
16:20 - 16:50	Tea Break	

List of Participants

Dr. MS Swaminathan

Chairman, MS Swaminathan Research Foundation, Chennai (TN)

Dr. BR Barwale

Trustee, TAAS & Chairman, MAHYCO Research Foundation, New Delhi-12

Dr S Nagarajan

Vice-Chairman, TAAS, Pusa, New Delhi-12

Dr. NN Singh

Secretary TAAS & Vice Chancellor, BAU, Ranchi, Jharkhand

Dr SK Vasal

Distinguished Scientist, CIMMYT, C-2/2394 Vasant Kunj, New Delhi-70

Dr. CD Mayee

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Dr. Raj Gupta

Head, CIMMYT-India, NASC Complex, New Delhi-12

Dr. RR Hanchinal

Vice Chancellor, UAS, Dharwad

Dr. SK Sharma

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Pr. Investigator (Crop Protection)
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Pr. Scientist (Plant Breeding)
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Dr. AK Dubey

Ex-Editor, Hindi Publication Unit
IARI, New Delhi -110012

Program of Award Ceremony

17:00 – 17:05	Lighting of the Lamp	
17:05 – 17:12	Welcome	Dr. S Nagarajan, Vice-Chairman, TAAS
17:12 – 17:20	Special Remarks	Dr. S Ayyappan, Secretary, DARE & Director General, ICAR
17:20 – 17:28	About the Award	Dr. RS Paroda, Chairman, TAAS
17:28 – 17:38	Special Address	Dr. MS Swaminathan, Chairman, MS Swaminathan Research Foundation
17:38 – 17:50	Chairman's Address	Prof. KV Thomas, Minister of State for Agriculture and Consumer Affairs, Food & Public Distribution
17:50 – 17:55	Reading of Citation	Dr. BR Barwale, Chairman, Barwale Research Foundation and Trustee, TAAS
17:55 – 18:00	Presentation of Award	Chief Guest
18:00 – 18:05	Response by the Awardee	Dr. Sanjay Rajaram
18:05 – 18:25	Address by the Chief Guest	Hon'ble Dr. APJ Abdul Kalam, Former President of India
18:25 – 18:30	Vote of Thanks	Dr. NN Singh, Secretary, TAAS



**TRUST FOR ADVANCEMENT OF AGRICULTURAL SCIENCES
(TAAS)**

IARI, New Delhi, India

Dr. M.S. SWAMINATHAN AWARD

for

LEADERSHIP IN AGRICULTURE

Presented to

Dr. Sanjay Rajaram

Citation

Dr. Sanjay Rajaram is one of the most distinguished wheat breeders known for his valuable contributions globally. He led CIMMYT's wheat breeding program for over two decades. Under his leadership, the CIMMYT program made tremendous impact on global wheat production.

As wheat breeder, Dr. Rajaram contributed towards the development of as many as 480 wheat varieties that have been released in 51 countries, and are grown on an estimated 58 million hectares worldwide. Twenty-five of his varieties have so far been released in India. For this contribution of his he has been honoured with a number of national and international honors and awards.

Using a novel approach of exploiting winter and spring wheat gene pools, together with shuttle breeding and mega environment testing, Dr. Rajaram and his team developed outstanding cultivars with very high yield potential. Applying the concept of slow rusting, he developed wheat varieties with durable resistance to leaf rust, which invariably remained effective for more than 20 years. Dr Rajaram and his team also successfully incorporated blight resistance into modern wheat varieties.

Dr Rajaram graduated with a B.Sc. degree in Agriculture from the University of Gorakhpur. He obtained his Masters in Genetics and Plant Breeding from IARI, and proceeded to do his PhD in Plant Breeding from the University of Sydney, Australia. Dr. Rajaram has authored/co-authored more than 400 research publications, including 110 papers in refereed journals, and mentored 700 young scientists from the developing world. He also guided 22 Masters and PhD students. During his long career, he has served as Director of Wheat Research at CIMMYT, Director of ICARDA's Biodiversity and Integrated Gene Management Program, and consultant to a number of governments and international organizations. In 2009, he led a study in Egypt, the report of which is being used by the Egyptian Ministry of Agriculture to plan a major expansion of wheat production program.

The Trust for Advancement of Agricultural Sciences takes pride in honouring Dr. Sanjay Rajaram with the Fifth Dr. M.S. Swaminathan Award for Leadership in Agriculture on this day, Saturday, the 18th December, 2010.

TRUSTEES OF TAAS

Avenue - II, IARI
New Delhi-110012

Dr. APJ Abdul Kalam

Agriculture and Farmers is the vital force for National Development

**I ploughed and ploughed,
Where is the knowledge treasure, my Lord?**

I am delighted to participate in the presentation of 5th Dr. MS Swaminathan Award for Leadership in Agriculture here in New Delhi. I greet Trust for Advancement of Agricultural Sciences with the mission for facilitating the great scientific talents and great contribution. The award carries a great pioneer agriculture scientists and the leaders in propagation of national food policy and improving the farmers earning capacity and their development. Dr MS Swaminathan Award indeed are given to great contributors for our societal development.

I am also happy to see that this year the award is being presented to Dr. Sanjay Rajaram, who is renowned for his all round contribution to the development of agriculture, especially in the critical sector of wheat cultivation. I was reading about him, and I was glad to know that in his professional career of over 4 decades now, he has been in positions of leadership in many scientific and academic institutions. I am also happy to know the scientific contribution of Dr. Rajaram, in the form of improved wheat, now occupies more than 60 million hectares netting an additional income US\$ about 2 billion for wheat farmers across the world. He is a gifted agricultural scientist, who holds the unique distinction of breeding the largest number of varieties of any crop with now over 500 improved wheat varieties being developed by him and released in 51 countries across the world. My congratulations to Dr. Rajaram for his unique work of agricultural development and contribution to nearly half the population of the world. My greetings to all the participants of this beautiful function. When I am in the midst of all of you, I would like to talk on the topic **“Agriculture and Farmers is the vital force for National Development”**

Let me first discuss on how farmers bring strength to the nation.

Farmers bring strength to the nation

During the last few decades, we have achieved success in many areas. One of the primary accomplishment was the first green revolution which made India come out of ship to mouth existence. Who has made it possible? When sanctions were imposed on us by the west when India became a nuclear weapon state, we could with stand the sanction

because of our food security. Thus, we can see the farmers have brought glory to the nation at all critical times. 2000 years ago, one of the poet said, whole world will follow the man who ploughs the field. First I want to greet you and thank you for all you have done to the nation. A grateful nation will have to find solution to the problems faced by the farmers and people working in agriculture. The most important solution has to be towards equipping the farmers with results of farming science, so that farmers always work with multi cropping in a year and their revenue and income should not suffer with vagaries of seasonal variations.

Better value of Agriculture through organic farming

Friends, when the entire planet Earth is faced with the problem of climate change, there is a need for Farmers, Agricultural Planners, Educationists and researchers to increase the quantum of organic farming in the country. Organic agriculture recognizes that crop rotation and intensive partnership with animal husbandry is important to maintain ecological balance. In this respect, organic farming becomes a sustainable development process. Farmers can realize better value from the agricultural residue. In this context, I would like to discuss some experience from the nation of Taiwan.

Farmer friendly application of technology and management

Friends, during the first week of this month I was in Taipei (Taiwan), where I visited high-tech agriculture farm which they have evolved by the Council of Agriculture.

The Council of Agriculture (COA) of Taiwan, which is their primary body dealing in agro improvements. The COA with its team of scientists deals in a variety of areas, and help infuse technology in a variety of domains including cultivation, fishing, orchids and animal husbandry.

It is building an island of “Toxin-free Agriculture” and has established special organic farming zones and expanded organic production, in a step by step campaign, to build an all-inclusive safe agriculture practices. These would be covering every step from inputs, like seeds and fertilizer, and from production to sales.

To increase the productivity, in every aspects of seeding to cultivation and harvesting, I observed automation which is friendly to farmers and above all, the farmer themselves can build farming equipment and maintain them. The COA aims at providing a business model for the farmers, which is sustainable, efficient and healthful so that the produce can

be of superior quality and marketable globally. This would ultimately benefit the farmer community of the nation.

I am sharing this experience to the experts assembled here to inform you, it is essential to keep in mind, what we invent, discover, and what we develop, have to have farmer friendly usage of applications.

Let me now discuss about my interaction with the farmers from various parts of the nation at Rastrapati Bhawan in 2006.

My interaction with farmers

At Rashtrapati Bhavan, I had invited 6000 farmers and had lunch with them. Subsequently whenever I visited rural areas, I had interactions with farmers in different parts of the country. We discussed their problems and arrived at certain solutions. I have discussed the solutions with the government and the scientists. One of the actions taken is that our farmers are going to China for studying their farm practices. Our farmers have gone to Africa and helped African countries to take up *Jatropha* plantation. The government has rightly decided to pay more attention to farming and agro-processing which will not only improve the conditions of farmers but also enable maintenance of the overall growth rate of India's GDP in the present environment. Let me now talk about the very important area of seed quality and its impact on the farmer.

Quality of Seeds

Some of our agricultural universities and institutions have indeed core competence in quality seed development. They are fully equipped to further improve the quality of the seeds for enabling farming in areas where the soil has salinity and the environmental temperature gradient is high. This should be achieved through production of salinity tolerant and temperature tolerant seeds. In addition, seeds also have to be resistant to the stress induced by the residual effect of the pesticides and insecticides. Universities and research organizations have to lay more emphasis on developing and leading to production of the seeds including genetically modified seeds which require less water for supply to the farmers for achieving increased productivity even in critical environmental conditions. Also, future seeds design and development have to enrich the farmer and the village economy. Organizations will have to ensure that certified quality seeds alone reach the farmers like fertilizer, so that they are not subjected to unexpected reduced output and related losses.

Achieving High Agriculture Growth: The Gujarat Case Study

Recently, I was in IIM Ahmedabad, where the specialists from the Center for Management in Agriculture (CMA), presented to me, the reasons for high growth rate of agricultural GDP attained by the state during the past few years. I am sure, this experience could be useful to many other states. They highlighted how the agriculture of the state has been consistently growing over 9% per annum, more than 3 times the national average. They brought out the many reasons for increased productivity.

Firstly, reforms in the rural electrification by setting up a dedicated grid for rural applications ensure quality power supply for agricultural applications. This has also reduced losses due to pilferage of power, further enhancing the available supply for the farms.

Secondly, the state embarked on an integrated water management for irrigation through creation of more than 240,000 farm ponds, and their management by desilting and recharging. This was matched by a state wide micro-irrigation scheme to manage the demand side.

Thirdly, Gujarat Government started an annual Krishi Rath Yatra, which aims at creating awareness among farmers regarding seeds, irrigation, crop pattern and other aspects and how to use technology. In 2010, the Yatra passed through 26 districts of the state in its month long journey. Of course at all stages, with the increase in agricultural produce, stability of the price was been managed by opening export of agricultural produce.

Let me now discuss about a unique farming experience in Haldwani (Uttarakhand) which I witnessed.

Unique farming experience

I would now like to share with you an experience of one of the farmers in Haldwani district in Uttaranchal. He grows dwarf Papayas, mangoes, soyabeans, ginger, flowers such as gladiolas, coronation and marigold and also few medicinal plants. This is done through total organic farming and use of vermi-compost. The method of multi-cropping such as simultaneous growing of Papaya and ginger and rotation of different crops during different seasons lead not only to continuous utilization of the land throughout the year but also rejuvenation of the soil characteristics. Apart from this, he produces organic milk by feeding organically grown fodder to the cattle. To maintain the soil quality, he ensures that the weeding is done manually. The overall economics of this type of farming results in generation of 500% increase in the income for the same area using conventional methods.

While at National Institute of Rural Development, Mr. Yadav of Andhra Pradesh with his experience in organic farming says, **“timely sowing, optimum plant population, balanced nutrition, proper water management, early weed control and pest control can lead to record production of mango and coconut with the application of organic manure”**.

Now let me discuss the experience of National Innovation Foundation in organic farming.

Grass root innovation

National Innovation Foundation (NIF) has found substantial amount of work being done by the farmers in different parts of the country. Areas where rain fall is poor, where the land remains flooded for long period of time, mountain region and forest region are most suitable for organic farming. This is the area where the farmers should take to organic farming immediately. NIF has reported over 240 combination of herbal pesticides in different parts of the country. There are many local cost effective solutions for the problems faced by farmers. For example: planting ladies finger (Bhindi) as a border crop ensures prevention of cotton crop being attacked by pests since the ladies finger flowers attract the pests and cotton crop grows fine. This is an important zero cost solution since 40% of the pesticides are being used for protecting cotton crop in the country. Also, I have come across successful production of organic paddy in Kerala's Thrissur district. 2400 farmers joined together to cultivate organic paddy in 2500 acres of Kol wetland in the panchayats and they realized a productivity of 6.25 tonnes per hectare which is same as the productivity achieved by conventional methods. Also, I have seen in Allahabad by planting Jatropha in the waste land, an alkaline land has been made neutral and productive. I am sure, these examples will be used by agriculturalists to their advantage.

Welfare of farmers

While the farmers work for agricultural productivity, it is our responsibility to provide them with a clean neighbourhood, opportunities for quality affordable healthcare, ensuring their education, particularly women education, facilities for financing them and providing them with knowledge and skills in both farm and non-farm activities. We have to ensure that the farm ponds are activated and farmers are facilitated to add value to their products through agro-processing. Plantation of Jatropha on the fencing will not only provide the additional revenue, but also enable removal of alkalinity of the soil. Cumulatively these efforts will increase their revenue, enhance their well-being, enhance their productivity and above all enhance the status in the society. This is what is required to attract the youth toward agriculture. Can we think of some innovative scheme by

which their native knowledge, on-line work, with enhanced formal training can result in the award of diploma to the farmer?

Let me now present a unique platform which can bring all these elements together and link economic returns, income generation and societal upliftment as an integrated mission. This is called PURA (Providing Urban Amenities in Rural Areas).

PURA as a Sustainable Development tool

Friends, this year India turned 63 years old as the largest democracy in the world and we witness a defining period for the nation and its people. We stand ten years away from the goal of achieving the vision for a developed India by 2020, and there has been significant progress in all directions. Each step we take towards a developed nation also opens a fresh challenge to overcome. The need of the hour is the evolution of sustainable systems which act as “enablers” and bring inclusive growth and integrated development to the nation.

One such sustainable development system is the mission of PURA (Provide Urban Amenities to Rural Areas). It means that:

1. The villages must be connected with in themselves and with main towns and metros through by good roads and wherever needed by railway lines. They must have other infrastructure like schools, colleges, hospitals and amenities for the local population and the visitors. This is **physical connectivity**.
2. In the emerging knowledge era, the native knowledge has to be preserved and enhanced with latest tools of technology, training and research. The villages have to have access to good education from best teachers wherever they are, must have the benefit of good medical treatment, and must have latest information on their pursuits like agriculture, fishery, horticulture and food processing. That means they have to have **electronic connectivity**.
3. Once the Physical and Electronic connectivity are enabled, the knowledge connectivity is enabled. That can facilitate the ability increase the productivity, the utilization of spare time, awareness of health welfare, ensuring a market for products, increasing quality conscience, interacting with partners, getting the best equipment, increasing transparency and so in general **knowledge connectivity**.
4. Once the three connectivities viz Physical, Electronic and knowledge connectivity are ensured, they facilitate earning capacity leading to economic connectivity. When we Provide Urban Amenities to Rural Areas (PURA), we can lead to upliftment

of rural areas, we can attract investors, we can introduce effectively useful systems like Rural BPOs, Micro Finance.

5. The number of PURA for the whole country is estimated to be 7000 covering 600,000 villages where 700 million people live. There are number operational PURA in our country initiated by many educational, healthcare institutions, industry and other institutions. Government of India is already moving ahead with the implementation of PURA on the national scale across several districts of India.

Conclusion

India has to now embark upon the Second Green Revolution which will enable it to further increase its productivity in the agricultural sector. By 2020 India would require to produce over 340 million tonnes in view of population growth and increased purchasing power. The increase in the production would have to surmount many impeding factors. The requirement of land for the increasing population as well as for greater afforestation and environmental preservation activities would force a situation whereby the present 170 million hectares of arable land would not be fully available. It might shrink to 100 million hectares by 2020. In addition, there will be shortage of water due to competing demands and reduction in the agricultural work force. Our agricultural scientists and technologists in partnership with organizations, have to work for enhancing the average productivity per hectare from 1.1 tonnes to better than 3.4 tonnes of the available land for cultivation with less need of water. The type of technologies needed would be in the areas of development of seeds that would ensure high yield varieties even under constraints of water and land.

The second green revolution is indeed a knowledge graduation from characterization of soil to the matching of the seed with the composition of the fertilizer, water management and evolving pre-harvesting techniques for such conditions. The domain of a farmer's work would enlarge from grain production to food processing and marketing. While doing so, utmost care would have to be taken for various environmental and people related aspects leading to sustainable development. I am sure the scientific and agriculturalist community present here would like to evolve and contribute for an action oriented plan towards the second green revolution.

Let me once again congratulate Dr. Sanjay Rajaram for being awarded the 5th Dr MS Swaminathan Award for Leadership in Agriculture. My greeting and best wishes to all the members present here.

May God bless you.