

Making world hunger free by 2030

through agricultural research, education and extension

A. K. Singh¹ and R. Roy Burman²

Indian Agricultural Research Institute, New Delhi 110 012

Technically, hunger is the result of food deprivation. Right to food or right to freedom from hunger is an internationally recognized right. The commitment of nations to make the world free from hunger can also be gauged from the universally accepted Sustainable Development Goals. The SDG 2 made clear that by 2030 all forms of hunger and malnutrition must end. In accord of this direction, India, being an emerging global leader, has set its armor ready to achieve the target by 2030 but the task of achieving hunger free world by 2030 is tricky especially when India's position on Global Hunger Index scrolled down to 100th position with more than 800 million are suffering from hunger, 8% of Indians do not get two square meals a day and there are pockets where severe under-nutrition takes its toll even today. India supports 18% of world population on 2.3% of geographical area indicating a highly dense habitation of its population. Every third child born is under weight and over 40 million stunted and 17 million children are wasted.

Key words: Agriculture, Hunger free, World

HUNGER is an uncomfortable or painful sensation caused by insufficient food energy consumption. Agriculture is its major sector directly employing half of the population and indirectly providing raw materials. Although India stands second worldwide in agricultural production, the economic contribution of agriculture to India's GDP has been declining steadily from 57% in 1st Five-Year Plan to 14.1% by the end of 11th Five-Year Plan. Agriculture is, however, the largest economic sector and plays a significant role in the overall socio-economic fabric of the country with more than 55% of its population dependent on agriculture. Indian agriculture contributes to 8% global agricultural gross domestic product on only 9% of world's arable land out of which nearly 120.72 million ha of land in the country is degraded due to soil erosion and about 8.4 million ha has soil salinity and waterlogging problems. This is the major

contributing reason for pegging the production frontier of agricultural enterprise in India. The another important socio-economic factor underlying low efficiency is continual diminishing average size of the land holding (from 2.30 ha in 1970-71 to 1.32 ha in 2000-01), and increasing absolute number of operational holdings (from about 70 million to 121 million during the same period). If this trend continues, the average size of holding in India would be only 0.68 ha in 2020, and would be further reduced to a low of 0.32 ha in 2030. It is now projected that with the increase of world population by 2050 a sustained increase of 75 to 100% food production is obligatory to meet the food demand, given present diet pattern and consumption scenario. In India, the demand for foodgrains would increase from 192 million tonne in 2000 to 345 million tonne in 2030. Hence in the next two decades, production of foodgrains needs to be increased @ 5.5 million

tonne annually. The demand for high-value commodities (such as horticulture, dairy, livestock and fish) is increasing faster than foodgrains—for most of the high-value food commodities demand is expected to increase by more than 100% from 2000 to 2030. Hence, an agricultural growth rate of 4% per annum is necessary (as against 3.6% during the XI Five-Year Plan) not only to meet the growing demand of food, feed and fodder but to continue to have 8-9% growth in GDP to reduce poverty and support the overall economic growth of the country. The future requirement of food grains, vegetables and fruits in 2020 and 2050 indicated a growth rate of 1.12% for food grains, 2.41% for vegetables and 3.71% for fruits to maintain self-sufficiency.

This exposition contemplates that a major paradigm shift in the formulation and execution of agricultural policy is necessary for attaining this target. Hence the

proper understanding of the success of the most important event in the realm of agriculture and food security viz. Green Revolution is critical to find a guide to deal with the present alarming situation of food shortage.

Green Revolution: the rhetoric and the reality

From being a poverty stricken food insecure country in 1951 to food surplus nation in 21st century, India has come a far way. The then Prime Minister's request of keeping fast a day to the country to the slogan of 'Jai Jawan, Jai Kisan' had directed the collective effort of the country to move from food starving nation to food adequate nation. However, this great success is the result of techno-policy mix of Green Revolution and thus abridged food shortage similar like India and in some other food insufficient nations also. But the prevalent fact that the food insufficiency situation had not altered in some least developed nations or region rather led to increased dependency in external aid *de facto* and put them in the path of chronic dependence and negatively affected nation's perseverance for food security. However, the Green Revolution is not a single policy intervention or any particular government support that led to reap the fruit of food adequacy, it is rather a policy mix that made a paradigm shift in the production pattern of the whole country or a larger region.

Seat of Green Revolution

Indian Agricultural Research Institute (IARI), the premiere agricultural research institute played a crucial role in Green Revolution through its research programmes in plant breeding, in conceptualizing the wheat revolution, in providing viable technological support, devising novel farm methodologies and models and extension efforts Jawahar Jyoti seed village concept. The journey started from development of wheat varieties NP 809 and NP 824 in 1954 which was resistant to all three types of rust prevailed in India. The high-yielding varieties of wheat were developed by importing, breeding and acclimatizing the hybrids of Mexican

HD 2967 wheat and Pusa Basmati 1121 rice:

Flag bearers of IARI technologies

HD 2967 is a high-yielding wheat variety yielding 4.4 tonne to 8.5 tonne is a choice of million farmers due to obvious reasons like high grain protein, excellent *chapatti* making quality, uniform grain size and higher flour recovery. It helped north-eastern and north-western farmers to enhance their income. Pusa Basmati 1121 rice is fetching dollar in India due to its superior traits like medium duration (145 days), pleasant aroma and grain qualities. It is being marketed in 80 brand names and generated 1.5 lakh crores approx. during 2016-18.

wheat i.e. Lerma Rojo 64 A and Sonora-64 developed by Norman Borlaug in early 1960s. The varietal selections like Kalyan Sona and Sonalika and breeds like Pusa Lerma and Sharbati Sonora were the revolutionary generation of wheat varieties which contributed to the noteworthy enhancement in the production and productivity. Similarly, for rice, the dwarf varieties Taichung Native 1 (TN 1) and Tainan 3 brought from Taiwan provided impetus to breeding programme, which eventually led to food grain revolution. IR 8 was the miracle rice variety introduced in India resulted in phenomenal change in rice production.

Technology generation and technology dissemination are complementary to each other. Suitable extension strategies adopted to supplement technology cluster developed by incessant effort of multidisciplinary scientists backed by government support. The Government of India started programmes like Intensive Agricultural District Programme, Intensive Agricultural Area Programme and most importantly High-Yielding Variety Programme with brainchild of IARI National Demonstration, 1964 to disseminate Green Revolution technologies. Farm and Home unit of AIR started in 1966 provided mass media support for easy disposal. The Intensities Agricultural District Programme eased the distribution of fertilizer and needed inputs, reorganized administrative machinery, streamlined credit facility, and made available effective extension services thus providing needed impetus to the development in progress. Intensities

Agricultural District Programme implemented in 114 selected districts where the potential of agricultural development was high following popular notion of 'betting on strong horse'. Both the IAAP and the Intensities Agricultural District Programme followed 'big push' theory of economic development.

Lighthouse of Indian Agriculture

IARI's field yielded a lot of new varieties, methodologies, innovations which was adopted throughout India. It has developed remarkable number of varieties in major cereals e.g. rice (14), wheat (45), maize (4), pulses e.g., chickpea (15), field pea (3), lentil (3), pigeonpea (3), moong beans (4), oilseeds e.g., mustard (14), soybean (2) and vegetables, fruits, flowers which are superior in not only productivity but also in other qualitative traits like cooking quality, taste, nutritional values *etc* using novel breeding methods.

Other noteworthy innovations from the soil of IARI include first soil map of India, first cowdung gas plant, first soil fertility map of India and Pusa Soil Test and Fertilizer Recommendation Meter Pusa Hydrogel for efficient utilization of water and neem oil coated urea for enhanced nitrogen use efficiency are some among the major contribution done by the Agricultural Chemicals division. The Division of Microbiology developed and commercialized biofertilizers like *Rhizobium*, *Azotobacter*, *Azospirillum*, PSB, AM fungi, and BGA including the liquid formulations that provided the greatest input for practising organic agriculture and natural farming aimed with safe food production in India.

Our Actions are our Future.

Apart from research and extension, IARI has contributed in transforming Indian agriculture by providing the country with highly trained manpower for national agricultural research, teaching and extension system. IARI has 26 different disciplines in both Postgraduate and Ph.D. degree courses with systematic research and experiential learning under the preview of 6 different schools like School of Crop Improvement, School of Plant-Protection, School of Basic Sciences, School of Natural Resource Management, School of Social Science, and School of Horticultural Science. Till now Postgraduate school of IARI has awarded 8,395 degree to students including 366 international students from 38 foreign countries. With the purpose of human resource development in agriculture sector, Centre of Advanced Studies scheme sanctioned in 1994-95, which was renamed as Centre of Advanced Faculty Training in 2010. Due to the excellence in teaching and training, IARI is awarded with 5 centres of Advanced Faculty Training in different disciplines.

To reach farmers effectively, IARI, the superlative agricultural research institute in India, continually evolving with efficient extension models like Model Village. Four villages in NCR were developed as lighthouse of improved farm technologies for the adjoining areas through integration of IARI improved technologies; IARI Post-office Linkage Extension Model: An approach through linkage with Rural Branch Post-office for disseminating technology information to the remotely located farmers; Innovative Farmer led Extension Delivery System: technology dissemination through network of progressive/innovative farmers and National Extension Programme and IARI-VO partnership programme: 16 State Agricultural Universities/ICAR Institutes and 28 VOs were associated with IARI with the objective of creating location-specific models to properly utilize the rural resources for agriculture and Along with these infrastructure facilities. IARI used to perform national level

Krishi Vigyan Mela for the Technology showcasing and *Mera Gaon, Mera Gaurav* programme for facilitating farmers–scientist interaction. Every scientist of the Institute is involved in this programme and the Institute has covered 600 villages of 17 NCR districts of 4 states in this programme.

Innovative frontline-extension approaches

Innovative frontline extension methodologies like Farmer FIRST, Attracting and Retaining Youth in Agriculture and *Mera Gaon, Mera Gaurav* were initiated for further spearheading frontline extension.

Farmer FIRST

Through assessing different solutions in an innovative approach, Farmer FIRST is an opportunity for the researchers, extension personnel and farmers to work together and find appropriate ways. Under this scheme the research question is decided based on need and interest of farmers where scientists' role is of facilitators. The project is being implemented at 52 centres across the country covering about 45,000 farm-families.

Attracting and Retaining Youth in Agriculture (ARYA)

To inculcate the practice and perception of modern farming enterprise as an innovative solution, ARYA initiative of ICAR to develop a comprehensive model for sustainable development of youth in agriculture to attract and empower the youth in rural areas to take up various agriculture, allied and service sector enterprises for sustainable income and gainful employment in selected districts, enable the farm youth to establish network groups to take up resource and capital intensive activities like processing, value addition and marketing and demonstrate functional linkage with different institutions and stake holders for convergence of opportunities available under various schemes/programmes for sustainable development of youth. Over 42,000 youth were facilitated in 25 districts.

The project is being extended to another 75 districts to cover total 100 districts.

Mera Gaon, Mera Gaurav

The essence of this programme is incorporating direct delivery of scientific technology and practice. Under *Mera Gaon, Mera Gaurav*, the scientists of Indian Council of Agricultural Research will adopt villages and introduce the technologies developed by ICAR in the villages. Each scientist will adopt a village based upon proximity and make regular visits to the village and extend technical guidance to the farmers. Multidisciplinary teams of scientists of ICAR Institutes, State Agricultural Universities scientists covered 13,500 villages. This is a unique model for ensuring frequent farmer-scientist interface for developing personal rapport, knowledge sharing, facilitating linkage with development departments and agencies and generate and share feedback.

ICT Initiatives for technology dissemination

Mobile-based agro-advisory services like M-krishi, IKSL, Nokia life tools etc. are doing praiseworthy job in this regard. The mobile apps like *Pusa Krishi* and *Krishi Suvidha* were developed to disseminate timely information and services to farmers. *DD-Kisan*, a television channel was also launched especially to disseminate agricultural innovation and initiatives in 2015, which helps in supplementing and complimenting technology dissemination through need-based agricultural programmes. The community radios is also an effective media to reach out farmers in their local languages. Government of India approved a policy to grant licenses for community radio stations in December 2002. The programmes are produced by the local people, in their local dialect which is the main fragrance of this initiative. Educational institutions, Krishi Vigyan Kendras/State Agricultural Universities/ICAR Institutes and N G O s / C o m m u n i t y - b a s e d Organizations are establishing the CRS. State Agricultural Universities

and Krishi Vigyan Kendra have established CRS. It benefits farmers within the radius of broadcast of CRS.

SMS Portal was inaugurated by the Hon'ble President of India, Shri Pranab Mukherjee, on July 16, 2013 and since its inception nearly 327 crore messages or more than 1,044 crore SMSs were sent to farmers throughout the length and breadth of the country. These figures are rising ever since. More than 90 lakh farmers were provided advisory by the Krishi Vigyan Kendras. These messages are focused on farmers' specific needs and relevance at a particular point of time and generate heavy inflow of calls in the Kisan Call Centres where people call up to get supplementary information. SMS Portal for Farmers has empowered all Central and State Government Organizations in agriculture and allied sectors (including State Agriculture Universities, Krishi Vigyan Kendras, Agromet Forecast Units of India Meteorological Department, ICAR Institutes, Organization in Animal Husbandry, Dairying and Fisheries etc. to give information/services/ advisories to farmers by SMS in their language, preference of agricultural practices and locations.

Smart marketing reforms

Agricultural market reforms were introduced by changing the existing Agricultural Produce Marketing Committee Act for setting up competitive rural markets and to facilitate direct sale of farm produce, without entering the market yard. Electronic National Agricultural Market (e NAM) was introduced for making one market across the nation by removing state barriers to ensure enhanced profitability of the small holders.

The small farmers may be mobilized and linked to large organized supply chains e.g., Reliance Fresh, Food World, Safal etc., for ensuring higher marketing price at the farm gate. Such linkage may also provide better storage and transportation facilities.

Basmati rice varieties are highly remunerative, if the market price is higher than ₹ 3,000/quintal. The cost

of production is around ₹ 20,000/- per acre and the yield is around 22-25 quintals with good crop management and high-yielding varieties. The estimated net profit goes up to ₹ 50,000/acre, if the market price is in the range of ₹ 3,000/acre.

Promotion of farmer producer organization

The Producer Organizations (PO) of primary producers, viz. farmers, milk producers, fishermen, weavers, rural artisans, craftsmen are forming producer companies, provide sharing of profits/benefits among the members. Small Farmers' Agribusiness Consortium is providing support for promotion of Farmer Producer Organization. PO is a generic name for an organization of producers of any produce, e.g., agricultural, non-farm products, artisan products etc. There are some successful cases and one such FPC is Perundurai Groundnut Farmers Producers Company, Erode District, Tamil Nadu which was mentored by Krishi Vigyan Kendra, Erode. The company was registered in 2015 under Company Act and has current membership of 540 (420 men and 120 women), current share capital mobilized from members is ₹ 34.20 lakh. The capital received from NABARD was ₹ 13.0 lakh for three years. The FPC has leased in 5 acres (0.02 ha) of land and set up a state of the art oil expelling machine. Oil is extracted from the groundnut aggregated from its members and branded for bulk as well as retail sale. Groundnut-cake is prepared and distributed among Members on cost basis as cattle feed. Groundnut shell is briquetted and used as fuel for broilers.

Climate resilience through technological, institutional and community-led innovations

The smallholder farmers are becoming more and more vulnerable to the climate change and under National Innovations on Climate Resilient Agriculture (NICRA) climate resilient technologies applications were carried out with several institutional reforms and

community led interventions. Total 151 Climate smart villages were developed consists of implementing these resilient practices at a scale to cover the entire village in a saturation mode depending on the resource endowments of the farmers with one or several interventions for imparting resilience to the production systems. Though it is planned to saturate the entire village gradually with the resilient interventions, the number and kind of interventions implemented are largely determined by the resources available, and vulnerability status and involvement of communities.

Village Climate Risk Management Committee was constituted at each location comprising of 12 to 20 villagers with nominated members as President, Secretary and Treasurer. A bank account is opened in the name of Committee and is operated by any two signatories. The committee fixes the charges for hiring for different implements and hiring rates are to be displayed prominently. Farmers' contributory share towards inputs like seeds, fertilizer, animals etc., is also deposited in the bank account. The revenue and expenditure details must be shared with the general body.

Custom hiring centres for farm implements were established in 121 NICRA villages which could successfully empower farmers to tide over the shortage of labour and improve efficiency of agricultural operations. A committee of farmers' nominated by the Gram Sabha manages the custom hiring centre. The rates for hiring the machines/ implements were decided by the Village Climate Risk Management Committee an innovative institutional mechanism put in place at the village level for management of the custom hiring centre for farm machinery.

Crop residue management

The rice-wheat system is the most prevailing production system in north-western states of Punjab, Haryana and western Uttar Pradesh, and recognized as heartlands of Green Revolution and provide bulk of rice and wheat in the national food basket. About 34 million tonne of

rice residues in this region of which Punjab alone contributes about 65%. With progressive increase in mechanized harvesting of rice and wheat crops coupled with growing labour shortages, crop residue burning became a serious problem and causes phenomenon environmental pollution. Estimates indicated that up to 80% rice residues are burnt by farmers in Punjab. It is estimated that in north-west states of India about 23 million tonne rice residues are burnt annually. Burning crop residue caused phenomenal pollution problems in the atmosphere and huge nutritional loss and physical health deterioration to the soil. Mulching and incorporation of crop residues are the two suggested methods of *in-situ* straw management. Happy Seeder was recognized as a key technological innovation and demonstrated on a large-scale for awareness generation and disseminating the technology in Punjab and Haryana. It is estimated that ₹ 1,000 crore will be earmarked in the coming budget to tackle the menace of stubble burning.

Contingency crop planning

Rainfed agriculture occupies a prominent place in Indian economy and rural livelihoods. At present, about 60% of total net sown area is rainfed, contributing 40% of the total food production. It supports 40% of human beings and 60% of livestock population. Coarse cereals (87.5%), pulses (87.5%), oilseeds (77%), rice (48%) and cotton (65.7%) are predominantly grown under rainfed farming. Agriculture in rainfed areas continues to be a gamble and rainfed farmers face several uncertainties like aberrant weather, lack of timely inputs and credit leading to low and unstable productivity and profitability. The crop production in rainfed region has inherent risks because rain is undependable in time and amount. In this context, All India Coordinated Research Project for Dryland Agriculture under (ICAR) the aegis of Central Research Institute for Dryland Agriculture is

conducting site-specific research programmes in arid, semi-arid and sub-humid agro-ecologies through 25 network centers located across the country for developing contingency crop planning for 623 districts.

Nutri-sensitive agricultural research and innovations

Agriculture sector growth has contributed mainly to economic growth in India over the past several decades but improvements in nutrition remains a major concern. Increased crop and milk yields, increased overall food production as well as productivity have enabled the country to achieve food security. However, the growing number of malnourished, underweight and stunted children, leaving them vulnerable to the chronic and often irreversible effects of poor nutrition issues has to be resolved yet. The programme is focused on empowering farm women with key areas like innovative practices to promote nutrition-sensitive agriculture, awareness and capacity development of various stakeholders, value chain, literacy campaign etc. will be emphasized. This will encourage intensive exchange of knowledge, good practices and governance related issues to evolve a systematic policy framework for agricultural extension systems to promote nutrition-sensitive agriculture.

Madhya Pradesh occupies third position in the country after Tamil Nadu and Rajasthan to provide 'wholesome' meal to poor at affordable price (₹ 5) with the launch of *Deendayal Thali* in 49 out of 51 districts.

Value addition and technology incubation centers in agriculture

Value Addition and Technology Incubation Centre in Agriculture was conceptualized by ICAR to create a facility to provide incubation training to rural youth in processing and value addition. ICAR on its own funding support will create 3-4 units as model units in the Krishi Vigyan Kandra

campuses. That are strategically located and linked with agricultural universities and ICAR Institutes to identify different trades and establish trade-specific value addition and incubation centres for educating youth and the farmers to practice various components of technology management at the incubation centres and with the support from different lending agencies, they can establish their own processing and value addition units for commercial purposes.

Knowledge system and homestead agriculture management in tribal areas

Keeping a view on the importance of the tribal agriculture, the ICAR initiated. Knowledge System for homestead agricultural management in tribal areas in 125 districts where tribal population is 25% or more to facilitate technology support and related inputs to the tribal farmers located in remotest places and have proved to be the nearest to the farming community for technical know-how and do how on crop, livestock and enterprise-based livelihood related activities.

The multidimensional effort of National Agricultural System towards a hunger free world is laudable. Keeping eye on ever increasing population and food demand thereof, National Agricultural System is focusing on better and sustainable technology development. The technologies developed focus not only on production, productivity but also improving quality of life through livelihood security, enhanced income and better opportunities. The need is then to transfer those technologies to farmers' field which is served by National Agricultural Extension System which ensures their diffusion, continued adoption, upscaling and out-scaling.

¹Deputy Director General (Agriculture Extension, ICAR, KAB II, New Delhi 110 012),

²Principal Scientist (Agriculture Extension), IARI, Delhi. Corresponding authors' e mail: aksicar@gmail.com.

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