



Strategy Paper

Strategy for Doubling Farmers' Income



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Progress Through Science

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All the nations facing problems of poverty, hunger and malnutrition will need to accelerate their agricultural growth for achieving sustainable development goals (SDGs), especially while aiming at no poverty, zero hunger and safe environment for all (Paroda, 2017). The Green Revolution not only led to food self-sufficiency but also helped to reduce the poverty and hunger. And yet, despite fivefold increase in foodgrains production, as against a fourfold increase in population, India still has around 250 million people who live in poverty and about 45 million children below five years of age who are malnourished. Moreover, after 50 years of Green Revolution, India is also facing the second generation challenges like decline in the factor productivity growth, poor soil health, loss of soil organic carbon, ground and surface water pollution, water related stress, increased incidence of pests and diseases, increased cost of inputs, decline in farm profits and the adverse impact of climate change. On the demographic front, India adds annually almost one Australia (about 15-16 million) to its population. Thus, any progress gets nullified by an overall increase in population. Also, around 48% of the population is currently dependent on agriculture and allied fields and the agriculture sector contributes around 17% to national gross domestic product (GDP). Moreover, the public sector capital investment in agriculture and rural development has declined from almost 20% during Green Revolution period to currently less than 10%. In the process, many States have remained deprived of growth and development. As a result, most farmers are not benefitted especially since majority of them are smallholders and find agriculture not profitable any more.

Why Double Farmers' Income

Today, around 138 million Indian farmers' main concern is about declining farm income on the one hand and the increasing cost of inputs on the other. A recent study by the National Institute of Agricultural Economics and Policy Research (NIAP) has shown that around 70% farmers in the country have annual per capita income less than INR15,000 (around USD 250). BIRTHAL *et al.* (2017) have further analyzed the situation and found that their geographical distribution is widespread, but mostly concentrated in Uttar Pradesh (27.4%), Bihar (11.4%), West Bengal (9.9%), Odisha (6.3%), Rajasthan (5.8%), Madhya Pradesh (5.3%), Maharashtra (4.9%), Assam (3.9%) and Jharkhand (3.2%). Most of these states lack the required infrastructure for agricultural income growth. Moreover, around 70% farmers are marginal (owning less than one hectare), and 77% of them earn even a meager income of INR 6,067 per capita a year. Further, about 40 million farmers have just around 500 sq m of land, which is just not sustainable. Accordingly, the distress of small and marginal farmers has drawn specific attention of policy makers lately. The Hon'ble Prime Minister, considering this as a national priority, rightly called for doubling the farmers' income by 2022. It is often argued that Green Revolution mainly helped the country to achieve national level food self-sufficiency, whereas it seemed to have bypassed the majority (almost 86%) of smallholder farmers having less than 2 ha. Further, besides the second generation problems of Green Revolution, farmers are now faced with twin global challenges; i) global climate change, and ii) globalization of agriculture. The average land holding is around 1.1 ha, whereas many have much less than even 1.0 ha which is not sustainable for a farm family. To make farming profitable, these farmers do require both new technologies that can save cost on agricultural inputs, while increasing productivity, and the policy support for getting credit at low interest and also higher income by linking them directly to the markets.

Farmers Income Trend

It is argued that to achieve the set goal, a holistic approach would be needed to reap the benefits from all possible sources

of growth both from agriculture and outside agriculture sector. Doubling farmers' income by 2022, would require some specific policy and institutional reforms that take into account identification and targeting of low income farmers particularly from the regions that were bypassed by Green Revolution, like eastern, northeastern and western regions of the country where the capital investment somehow was not made to build the required infrastructure for overall agricultural development. Further, it is also argued that the information on farmers' income, being so crucial to understand income dynamics of the farm households and to devise strategies to improve farmers' income is not available except the two surveys in the past - one in 2002-03 and another in 2012-13 conducted by the National Sample Survey Office (NSSO). Chand (2017) have provided estimates of the total income and per cultivator farm income (not farmer's income) for the period 1983-84 to 2011-12. According to them, the farm income was reported to be inadequate for 53% of the farm households who operated on less than 0.63 ha of landholdings to escape poverty. As per estimates, between 1993-94 and 2015-16 (almost 20 years), the real farm income had just doubled (Table 1) and farm income per cultivator received slightly higher increase mainly due to a decline in the

Table 1. Trend of farmers' income in India (1993-94 to 2015-16)

Year	Total real farm income of all farmers (INR crores)	Real farm income per cultivator (INR)
1993-94	3,03,814	21,110
1999-00	3,72,923	26,875
2004-05	4,34,160	26,146
2011-12	6,32,514	43,258
2012-13	5,96,695	41,553
2013-14	6,02,922	42,760
2014-15	5,97,020	43,106
2015-16	5,98,764	44,027

(Source: Chand *et al.*, 2015)

number of cultivators after 2004-05, since the young generation seemed to have opted out of agriculture and shifted for the employment to urban areas.

Further, the low income and increasing disparity between income of a farmer and non- agricultural worker (almost double) is one of the reasons for agrarian distress. The low and highly fluctuating farm income is detrimental to the farming and farm investments, and forces the cultivators, particularly the youth, to leave farming. Even the labour cost for cultivation has gone up considerably since the implementation of the scheme under Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA).

In view of above, the Government intention to double the farmers' income by 2022 is indeed laudable. Once achieved, it would possibly reduce the agrarian distress and bring in parity between income of farmers and those in the non-agricultural sectors, thus possibly arresting or reversing the current migration trend. The targeted period to double the farmers' income in real terms has been fixed as seven years i.e. from 2015 to 2022. Hence, considering the past trend, it will require a minimum annual growth rate of 10.4%. Again, it is important to know what is to be doubled. As stated above, is it the income of farmers, or the output or the income of the sector or the value added or GDP of agriculture sector? If the technology, input prices, wages and labour used could result in per unit cost savings then farmers' income would possibly rise at a faster rate than the output. In this context, the doubling of farmers' income has to be viewed differently than the doubling of farm output.

It is also argued that if inflation in agricultural commodities is high, farmers' income in the nominal terms can be doubled in a much shorter period but the Government's intention appears to double the real income of farmers. Unfortunately, the latest data on the number of cultivators is available only up to the 2011-12. Therefore, while calculating per cultivator income, it is assumed that farmers would continue their withdrawal from agriculture at the rate observed during 2004-05 to 2011-12. This

is rather contradictory that on one hand we want farmers' income to be doubled so that they find agriculture attractive and on the other economists and policy makers expect them to withdraw from agriculture. This process should rather remain evolutionary and not to be made revolutionary. The real strength of Indian agriculture lies in the fact that it sustains around it almost 48% population of India.

Initiatives by the Government

For quite some time now, the distress of small and marginal farmers has been drawing the attention of policy makers. In 2004, the Government had set-up a National Commission on Farmers, headed by Dr. M.S. Swaminathan. The Commission had submitted the reports in 2006 (Govt. of India, 2006) aiming at "faster and more inclusive growth". It came out with several useful recommendations to revitalize agriculture and protect farmers from vagaries of nature and price volatility. The key recommendations were: i) improving farmers' income from farm and non-farm sources, ii) enhancing efficiency in the use of resources, iii) minimizing expenditures on non-renewable inputs, and remunerative price to farmers at 50% higher than the minimum support price (MSP). Somehow, the last recommendation, which is directly linked to farmers' income, has not yet been implemented. On the contrary, the price fluctuations in the market of farmers' produce and the higher cost of inputs have caused widespread discontentment among farmers, resulting in protests and even suicides, thus drawing an urgent attention of the policy makers to draw a strategy for doubling farmers' real income.

As a first step, the Government changed the name of the Ministry as: Ministry of Agriculture and Farmers' Welfare. It also initiated the programmes like Attracting Rural Youth in Agriculture (ARYA), Mera Gaon Mera Gaurav, National Skill Qualification Framework, Skill Training, Value Addition and Technology Incubation Centres in Agriculture (VATICA)', Knowledge Systems and Homestead Agricultural Management in Tribal Areas,

Nutri-sensitive Agricultural Resources and Innovations (NARI), Climate-Smart Villages, Web and Mobile Advisory Services. The potential role of farmer producers organizations (FPOs) in innovation up scaling for increasing overall income has also been given due importance.

The present Government has taken many new initiatives for increasing the farmers' income such as: i) "per drop, more crop", ii) availability of quality seeds, iii) soil test based nutrient management- distribution of soil health cards, iv) post-harvest crop losses- large investments in warehousing and cold chains, v) value addition by the farmers, vi) creation of a national agricultural market, by removing distortions and having e-markets to link farmers to market, vii) Pradhan Mantri Fasal Bima Yojana, viii) high priority to diversification towards high value activities – horticulture, dairying, food processing, poultry, sericulture, bee keeping and fisheries, etc.

Also, the Govt. in its budget of 2014-15 had established National Adaptation Fund for Climate Change, also a long- term Rural Credit Fund, provision of financial assistance of INR 5 lakhs for Bhoomi Heen Kisan through National Bank for Agriculture and Rural Development (NABARD), launching of soil health cards, Pradhan Mantri Krishi Sinchayee Yojana, Agri-Tech Infrastructure Fund. In its budget of 2015-16, the Government had emphasized on rural infrastructure development and created a Long-Term Credit Fund, Short-Term Cooperative Rural Credits Refinance Fund and Paramparagat Krishi Vikas Yojana to promote organic farming. Further, in the budget of 2016-17, a provision for Long-Term Irrigation Fund was made and the Union Budget of 2017-18 made some special provisions: i) allotted INR 10 lakh crores to ensure adequate flow of credit to under-service areas, ii) allotted INR 9,000 crores to increase the coverage under Pradhan Mantri Fasal Bima Yojana, iii) emphasized contract farming for strengthening and linking horticulture sector and agroprocessing units, iv) allotted INR 2,000 crores for dairy processing and infrastructure development to NABARD for modernizing milk processing

units. Besides these, several other measures were taken in the past for promoting agriculture and farmers' income such as MGNREGA, Rashtriya Krishi Vikas Yojana (RKVY), etc.

The resources of NABARD are also being augmented substantially following Parliament's nod to a six-fold increase in its authorized share capital to INR 30,000 crores. The Development Financial Institution (DFI) is eyeing a balance sheet size of INR 7 lakh crores by 2023 as against INR 3.90 lakh crores as at present. The rural India focused DFI plans to achieve this balance sheet size by stepping up focus on providing support to irrigation projects, dairy farming, improving market infrastructure in rural areas (so that farmers get remunerative prices for their produce), enhancing credit flow to deprived areas such as central and eastern States, and support to rural housing.

Despite these initiatives, the agricultural economists have differing views. Some have even expressed doubts and consider the goal unrealistic and unachievable since there is negligible information available on farmers income and also there is no clarity as to how to double the income (Gulati and Saimi, 2016). This is because the real income in the past has increased only by 5.2% per annum between 2002-03 and 2012-13. At this rate, it may take at least more than a decade to double the real income of farmers, unless a new and dynamic strategy is put in place and implemented in a Mission Mode (as suggested later) to achieve higher than 10% income per annum, which appears to be a gigantic task. NITI Aayog has indicated that doubling the farmers' income may take a little longer than the target year of 2022, unless needed reforms are expedited (Chand, 2017). Also, the combined effect of growth was found to be 75.1% in seven years and 107.5% in 10 years. According to him, if the farmers' income growth is considered to rise at the same rate as experienced between 2001 and 2014 (except price factor), the income will rise by 66% by 2022-23 and will possibly double in 10 years i.e., by 2025-26.

Strategy for Faster Agricultural Growth

It is quite clear that business as usual will not help in achieving the target of doubling farmers' income. Nor the suggestion

by some to take farmers out of farming will help. What would farmers do without the new skills and where would they find employment? Instead, better to retain farmers in agriculture by making the profession more attractive and rewarding through diversified options, including post-production management and value addition related activities. Obviously, out of the box thinking with focused efforts on outscaling innovations linked to higher productivity, sustainability and profitability through most appropriate diversified, secondary and specialty agriculture linked to post-harvest management, especially around proper storage, value addition and better access to market - would help in doubling farmers' income.

It has also been established from past trend that to achieve 8% growth in GDP, a minimum of 4% growth in agriculture sector is a must. Hence, there is no room for complacency just because India had achieved Green, White and Blue Revolutions in the past and the problem of food scarcity has been resolved. On the contrary, the problems of smallholder farmers have magnified and the real income has declined. To reverse this trend, we shall need a clear strategy, including a Road Map, that can lead us to sustainable and profitable farming using innovative approaches to harness opportunities. Also, as stated earlier, accelerating agricultural growth is critical for achieving the Sustainable Development Goals (SDGs), especially to remove poverty, have zero hunger and ensure environmental security. Moreover, greater the emphasis on agricultural research for innovation, higher will be the growth of agricultural GDP (Pratt and Fan, 2010).

In fact, Green Revolution in itself was an innovation led initiative around use of high yielding dwarf wheat and rice varieties that responded favourably to higher inputs leading to quantum jump in productivity. The cradles of success were: i) political will, ii) good institutions and human resource, iii) availability of critical inputs (seeds, water, fertilizer, etc.), iv) enlightened extension workers and hardworking farmers, and, v) the partnership at the global level.

Considering the current challenges of factor productivity growth decline, depleting natural resources, increasing cost of inputs, higher incidence of diseases and pests, higher cost of inputs, less profit to farmers and above all the adverse impact of climate change, the task of increasing income, especially of 86% farmers who are small and marginal (Govt. of India, 2018), would require technologies by which they can save cost on inputs and have more income by higher productivity and by linking themselves to markets. Obviously, therefore, the strategy to double the income would demand sustainable intensification, diversification, improved resource use efficiency and resilience in farming that is economically rewarding. In this regard, the following three pronged strategy needs to be pursued seriously:

- Improving productivity and production efficiency
- Agricultural diversification - including secondary and specialty agriculture
- Policy support and linking farmers to market

Improving Productivity and Production Efficiency

Bridging the Yield Gap

India's cropped area has been stagnant around 141 m ha for over a decade now, whereas net irrigated area is currently 65.3 m ha and the gross cropped area is 195 m ha with cropping intensity of 135%. Of this, almost 55% is still rainfed. Since there is no scope for horizontal expansion any more, vertical expansion through increased productivity is the only way forward, for which considerable scope exists. In this context, has suggested a clear strategy was suggested for productivity enhancement state-wise/crop-wise projecting an increase of 80 mt of foodgrains (Hooda Committee Report, 2010). Some States have productivity less than National average, whereas some can achieve yet higher productivity in view of rich resources and availability of technological options.

The existing yield gaps can also be bridged by increasing seed replacement rates/the area under seeds of improved varieties and especially hybrids, by adopting large scale use of biotechnology, including the use of genetically modified (GM) food crops and by adopting good agronomic practices, that are based on natural resource conservation, and both water and nutrient use efficiency.

Globally, use of GM crops has benefitted the farmers in reducing the cost on pesticides use and for increased productivity. More than 185.1 m ha area was globally cultivated in 2016 under GM crops, whereas India has so far released only cotton, covering around 11 m ha, with considerable benefits to millions of smallholder farmers. Moreover, it has reduced the use of pesticides by almost 40% and has increased both production and productivity of cotton leading to export worth around USD 3.0 billion annually. Thus, Government must come out with a clear strategy in support of using these innovations in crops like maize, soybean, canola, rice, brinjal, etc., which can help the farmers to raise their income while reducing the cost on inputs and getting higher productivity as well as income.

Conservation Agriculture

In addition, there is a possibility to increase cropping intensity through efficient water use. Also, there are options for improved input-use efficiency, especially of fertilizers, pesticides, energy, etc. to ensure resilience in agriculture. For this, conscious efforts are needed to swap unsustainable elements of the conventional-tillage-based monoculture production practice with temporally and spatially high productive, profitable and sustainable intensification, through large-scale adoption of conservation agriculture (CA) as a vehicle of change. It is well established globally over 180 m ha area that CA helps in achieving sustainable and profitable agriculture through three principles - minimal soil disturbance, permanent soil cover and proper crop rotation. The CA based management practices also help in adapting climatic risks and in lowering environmental foot prints. CA technologies have been developed, adapted and promoted since the past

two decades, primarily to conserve resources and increase farm income. The CA based management optimization in the cereal-based cropping systems in South Asia has helped in increasing crop productivity, input-use efficiency with economic returns, improving soil health, increased adaptive capacity of production systems to climate risks, reducing emissions and enhancing soil-carbon sequestration (Jat *et al.*, 2016).

Conceptually, conservation agriculture based sustainable intensification (CASI) is not a single technology. It is an innovation for sustainable farming, assimilating effective germplasm/crops, integrated nutrient/pest management, minimal and efficient farm mechanization, and efficient soil and water management practices. Therefore, it requires application of farming systems' related coherent interventions that would increase both income and adaptive capacity of farmers for diversified as well as resilient agriculture. Additionally, its infusion is seen to sustain ecological services and in providing greater environmental benefits to a landscape (TAAS, 2017)

Scaling Innovations

There are some major innovations that currently need to be outscaled as a matter of priority, keeping in view the expected impacts on production and productivity. These are: i) hybrid rice - the current area coverage (over the last two decades) is only around 2.0 m ha, whereas scope exists for covering at least 10.0 m ha in next one decade; ii) single cross maize hybrids - the area covered under these hybrids presently is less than 60%, whereas scope exists to double the maize production in next decade provided >90% of maize area is brought under promising single cross hybrids; iii) the area under CA in rice-wheat cropping system in the Indo-Gangetic plains, is about 3.5 m ha only, whereas scope exists for almost 10.0 m ha. The CA innovation also has vast scope under rainfed farming covering around 55% of the total 141.0 m ha cultivable area in India; iv) protected cultivation - the current area under protected cultivation in India is only around 50,000 ha, compared to >2.0 m ha in China; v) microirrigation - out of total irrigated area of 64.7 m ha, the area

so far covered under micro-irrigation is around 8.6 m ha only, which can certainly be doubled by 2022 provided direct subsidy support to the farmers is enhanced for adopting practices such as: drip, sprinkler, laser leveling, plastic mulching, raised- bed planting, direct seeding of rice etc. Also, the current initiatives by the Govt. to augment and complete irrigation schemes may add additional 2.0 m ha area under irrigation. However, for more efficient water use, both free supply of water and the flood irrigation practice will have to be stopped as a matter of national policy. It will also be a bold decision if the water is brought under concurrent list (ex. Israel) to resolve inter-state disputes and enhance water productivity in the larger national interest and to bring more area under irrigation.

Increasing Nutrient-Use Efficiency

One of the reasons of higher productivity in irrigated areas had been the increased use of chemical fertilizers. Today, India uses, on an average, around 105 kg/ha of nutrients and total consumption of chemical fertilizers is around 32 mt, of which nitrogenous fertilizers are around 25 mt. On the contrary, unfortunately the nutrient-use efficiency (NUE) is not more than 30%. Thus, increasing the fertilizer-use efficiency is one of the biggest challenges for which there is need to adopt innovative ways like use of seed-cum-fertilizer drill, adopting effective use of soil testing/ soil health cards and the decision support systems for soil/plant test based use of nutrients, use of *neem* coated urea for slow release and better uptake, use of customized fertilizers, fertigation, etc.

Agricultural Diversification Including Secondary and Specialty Agriculture

New Options

It must be understood well that unless smallholder farmers adopt diversified agriculture in a farming systems' mode, including both secondary and specialty agriculture, the expected doubling of their income will not be possible. Fortunately, India has made

great strides in sectors like horticulture (now second largest producer in the world in fruit and vegetable production of more than 304.5 mt), livestock (White Revolution by achieving the highest milk production in the world of 155 mt), and fisheries (Blue Revolution by achieving 11.0 mt of total fish production). All these sectors have shown much faster growth (>5.0 - 7.0%) compared to food grains over the last two decades. Also, considerable scope exists to increase the income of farmers by adopting agroforestry, rural based low cost primary processing for value addition, cool chain and by adopting secondary and specialty agriculture such as: protected cultivation, mushroom production, bee keeping, sericulture, growing low volume high value crops like nuts, spices, medicinal plants, nutri-crops, etc., seed production of vegetable hybrids, nursery raising to provide disease free saplings, fish seed production, growing of flowers, vegetable seedlings to promote peri-urban agriculture, use of plastic culture, post-harvest processing, rural based low cost value addition, cool chain, etc.

These new options would certainly provide opportunities to enhance farmers income substantially, and shall attract youth (including women) to agriculture provided right knowledge is disseminated, competent human resource is built and enabling policy support and incentives are provided. Youth can also play an important role as technology provider, input supplier, besides being a rural entrepreneur. For increasing income, farmers would also need a change in their attitude/perception towards adoption of diversified agriculture to make a difference.

Innovations in Extension

In fact, enlightened farmers of India are more interested today in getting right knowledge rather than to have subsidy. In this context, agricultural extension would certainly need transformation. The public extension system did play a key role during the Green Revolution phase, but it remained confined mainly to the irrigated areas. The success then was also due to holy alliance among researchers, extension specialists, farmers and policy-makers. At that time, the technology dissemination

approach remained ‘top-down’ focusing on demonstrations on individual farmers fields. As already mentioned, the current scenario of Indian agriculture is confronted with multi-faceted challenges arising out of inefficient management of natural resources (soils, water, agrobiodiversity). All these have led to considerable deceleration of factor productivity and decline in farm profitability. Apparently, this complexity cannot be overcome by routine transfer of technologies. Rather, more serious efforts are now needed towards translational research requiring out scaling of innovations through ‘Out of Box’ extension systems. Also, conscious deployment of rural youth, women and progressive farmers would help in speedy transfer of technology and the needed impact on livelihood of smallholder farmers.

Moreover, farmers’ welfare needs to be ensured through ‘Farmer First’ approach to benefit equally both producers and consumers. Further, in view of diverse demand of new innovations, new products, new information and new extension services, there is a need to shift from “top-down” to “bottom-up” approach, involving farmers’ participation at the grass-root level, while ensuring confidence building among farming communities to take risk and adopt more scientific and resilient agriculture. In the process, knowledge sharing on good agricultural practices (GAP), without dissemination loss, and incentives for timely supply of inputs become highly critical to double farmers’ income. At the same time, partnerships among key stakeholders, especially the private sector, become vital for promoting agricultural growth. In the process, care is also needed to overcome complacency that has crept in the public extension system, therefore, necessitating much greater vibrancy in the National Agricultural Research and Extension System (NARES); requiring active involvement of stakeholders (especially the private sector, NGOs and the farmers) and a policy shift in the extension approach towards farming communities rather than individual farmers.

Attracting Youth to Agriculture

Empowering youth (men and women) through vocational training and building a cadre of ‘Technology Agents’ to provide

technical backstopping as well as custom-hire services to the smallholder farmers would go a long way in linking research with extension, and thereby accelerating agricultural growth (TAAS, 2015). There is also a need to link now the 'land with lab', the 'village with institute' and the 'scientists with society' to ensure faster adoption of efficient resource utilization technologies which would benefit both the producers and consumers. In the suggested transformation process, the Agriculture Technology Agents will need to become "job-creators" and not "job-seekers" and provide best technologies as well as quality inputs on farmers' door steps. Another important action that can change the game is to promote establishment of 'Agri-Clinics', where technology agents are able to join hands in providing single window system of advisory services to farmers.

Another helpful approach would be to involve innovative young farmers as knowledge providers. Their own innovations, once recognized, could help in out scaling economically efficient farming practices. The concept of demand-driven extension approach around integrated farming systems should henceforth be pursued.

Policy Support and Linking Farmers to Market

National Mission on Farmer First

As stated earlier, a large number of initiatives and new schemes have been started by the Government to support farmers, but there appears a need to have better coordination and convergence mechanisms to ensure effective outcome and impact. Accordingly, concerns for collaboration, convergence and synergy need to be addressed along with issues of optimizing institutional arrangements of prevailing pluralistic agricultural extension and farm advisory. Agricultural extension system urgently needs a radical change. For this, a policy reorientation towards farmers' welfare through innovative and efficient technology delivery system, remunerative rural based low cost value chains, and assured market linkages would help in achieving 'Farmer First' objective. For this, a 'National

Mission on Farmer First', by additional funding support and by integrating different inter-related on-going programmes under the Ministry of Agriculture and Farmers' Welfare (MA&FW) and other Ministries be established to meet the objective of doubling farmers' income. The proposed National Mission can oversee the coordination and convergence of various inter-Ministries programmes and have a key role to promote innovations through Krishi Vigyan Kendras (KVKs), Agriculture Technology Management Agency (ATMA), Agri-Clinics, Agriculture Technology Information Centres (ATIC) and active involvement of private sector institutions. Hence a Mission on Farmer First , with an initial allocation of INR 10,000 crores, be mandated to promote establishment of Agri-Clinics, by encouraging well trained group of young individuals as small scale private entrepreneurs. At least one Agri-Clinic per district could be targeted to begin with, linked to performance based incentives and funding support in a phased manner, Also, under this Mission, a Farmers' Innovation Fund (FIF) be established for the validation and refinement of cost saving/ efficient technologies for out scaling. This Mission should also be mandated to support the self-help groups/associations of progressive farmers/cooperatives or even farmers' producer companies to link them with markets. In addition, it must oversee and support the initiatives related to knowledge/technology sharing and capacity building by the private entrepreneurs using ICT, media, TV, smart phones, market advisory services, etc. As the information needs of the farmers are exploding, which is presently accessible to only 45% of farmers, innovative ways need to be found out with greater involvement of youth in agriculture. The initiative of DD Kisan, as a dedicated channel for farmers, is indeed a good beginning, but its programmes need to be made more innovative and attractive, especially to attract youth around new options by which they can enhance income while adopting sustainable and diversified agriculture. Penetration of mobile phones and the use of internet in rural areas be another goal under the proposed Mission on Farmer First.

It is a fact that despite being the custodian of the country's food security, Indian farmers, especially smallholders (around 86%) are stuck in a low-income syndrome. As already stated, their per capita income (INR 15,000 per annum), is just one-fifth of the national average. Only around 7% of marginal farmers earn more than INR 50,000 per capita per year. In their case, moreover 60% of the income comes from non-farm sources. Also, they are engaged in diversified agriculture like animal husbandry, horticulture, growing cash crops etc. Unfortunately, allocation of research and development (R&D) resources to these allied sectors like livestock, fishery, agroforestry are not proportionate to their actual contribution to agricultural GDP, which as a matter of policy needs urgent attention (Govt. of India, 2018) .

Increasing Funding Support

As already emphasized, in the long run, the boost to farmers' incomes must come from technological breakthroughs that raise yields and resource-use efficiency, reduces cost on production and ensures resilience in agriculture (Govt. of India, 2018). It is also a fact that those developing nations that have supported well their agricultural research for development (AR4D), have made faster progress. China currently spends almost twice than India on agricultural R&D, whereas challenges before Indian agriculture are equally daunting (Lele, 2017). Current funding of 0.4% of its agricultural gross domestic product on agricultural research for development (AR4D), in indeed much less than many developed and developing countries. This, therefore, calls for an immediate increase in resource allocation (almost three times) to address the emerging challenges in agriculture. India would do much better if Government allocates a minimum of 1.0% of its agricultural GDP on research for development.

It is also clear that for successful scaling of innovations, there is a need for enabling policies such as: i) institutional policies for facilitation of farmers collectives like, self-help groups (SHGs), Cooperatives, FPOs (commensurate with legal framework),

establishment of cadre of agribusiness professionals at the village level, creation of Agri-Clinics, provision of credit at low interest rates (<4%) to the farmers across value chain, machine rental services, etc.; ii) promotion of ecoregional research, marketing and trade policy, agroprocessing, value chain development, sustainable livelihood, new funding models for translational research by the State Governments, etc.; iii) price policies like minimum support price (MSP) for most crops/commodities, incentive support around efficiency, avoidance of risk through provision of insurance, compensation for ecosystem/environmental services, etc; iv) investment policies to ensure higher capital investment (around 15-20%) in the States needing critical infrastructure like roads, irrigation, power, markets etc.; gradual reduction in subsidies but linked to incentives that are performance oriented, promoting private sector, etc; and v) policies on land and water use that encourage more efficient use of these natural resources. There is also considerable scope for attracting private sector and youth for developing whole sale markets, warehouses, cold storage facilities, rural based agroprocessing infrastructure, promoting micro-irrigation system, sale of quality inputs, and providing agricultural extension services.

Market Reforms

It is urgent that perishable commodities like fruits and vegetables are immediately delinked from centralized sales through Mandis, as at present, by revisiting and amending the Agriculture Produce Marketing Committee (APMC) Act. The initiative to implement the new Model APLM Act 2017 is a right step but its implementation by all States is to be facilitated and monitored by NITI Aayog. Also, for the proposed electronic network for agricultural marketing (e-NAM), it is necessary that movement of agricultural produce is not restricted by the State Governments. Even we need bold Export-Import (EXIM) policy keeping in view the long-term goals to take advantage of globalization of agriculture. Present short- term policies of allowing sometimes the exports and sometimes abruptly putting restrictions on exports is counter productive. This has happened in the

recent past by imposing restrictions on export of cotton, meat, foodgrains, etc. Even creating positions of Agricultural Attachee in the Embassies of selected countries would be of great help in boosting agricultural exports, thus benefitting indirectly the farmers.

Land laws for tenancy, contract/collective farming, long lease (so that farmers/tenants are encouraged to invest on land development), consolidation of holdings, with no more fragmentation below 1.0 ha, being uneconomical, etc., must be revised and put to implementation at the soonest possible. Also, the implementation of Model Land Leasing Act (2016) be a high priority for which State Governments have to move faster. Similarly, for better value and efficient use of precious water resource, both pricing of water and banning of flood irrigation system be considered, and incentives for micro-irrigation for greater area coverage be a national priority. Obviously, bold policy decisions are, therefore, required or else business as usual will not help.

Given the limits on landholdings, income growth has to be by raising cropping intensity, improving resource-use efficiency and agricultural diversification. Expansion in agriculture needs to exploit intensive cultivation, as only 40% of crop land is cultivated more than once. This can be enhanced by improving farmers' access to quality seeds of short-duration high-yielding crop varieties/hybrids and by adopting efficient cropping systems that are more sustainable. More area coverage under quality seeds of improved varieties and hybrids would need reforms, as proposed under Seed Bill-2004, which is pending for long for Parliament's approval. The needed incentives and hand-holding of Private Seed Sector, especially for making available seeds of promising hybrids of different crops, would go a long way in bridging the existing yield gaps and for increasing farmers' income.

The focus should also be on diversification towards high-value crops/commodities, especially horticulture by bringing minimum of 10% area in each of the States, Also, increased support to animal husbandry and fishery sectors in a Mission

Mode will be of great benefit. Demand for these commodities is growing fast, and there is considerable potential for their value addition, including the export. These enterprises have, however, not received much policy support, except horticulture, as stated before. For example, animal husbandry receives just five per cent of the total public investment and institutional credit to the agricultural sector, though it contributes more than 30% to agricultural GDP. Higher allocation of resources would thus be justified, as stated before, to accelerate the growth of these highly potential sectors. Further, there is a need to create required infrastructure, focusing on improving complementarities, since lack of any of these may restrict farmers from capturing the benefits of investment in others. A typical case is that of Bihar and Northeastern States, where despite some improvement in road network, farmers have not benefited much owing to poor electricity supply, irrigation infrastructure, marketing facilities, etc.

Linking Farmers to Market

There is no doubt that linking farmers to markets (LFM) is critical for improved livelihood of smallholder farmers and beneficial for the consumers. Smallholders are more efficient in production, yet they face serious disadvantage mainly on account of marketing their produce. As a result, smallholders are often bypassed in the process of transformation of agriculture, agri-food and marketing systems. Although, it is relatively easy for smallholders to diversify towards high-value crops owing to their higher resource flexibility and better family labour availability, yet they face disadvantage in terms of scale in production and market. Moreover, they have small marketable surpluses that are costlier to trade in the distant urban markets due to higher transportation and transaction costs. Hence, efforts to improve productivity on small farms may not directly result in higher income unless these are appropriately linked with markets. Their integration in markets or value chains would thus require pro- smallholder policies that create an enabling environment for attracting various stakeholders to act together in processing, marketing and also sharing the benefits on account of emerging

market opportunities. As earlier stated, these include innovative institutional mechanisms, better infrastructure, greater involvement of private sector, easy access to agricultural and market related information and risk management mechanisms and above all a favourable business environment through stable marketing and trade policies (TAAS, 2013).

The Way Forward

To make agriculture both remunerative and attractive as a profession, and especially to double the farmers' income, an action plan for implementing the three pronged strategy proposed above is described here:

Policy Interventions

- A 'National Mission on Farmer First', with an annual allocation of INR 10,000 crores to begin with and by merging/clubbing of various central schemes as well as through some new initiatives to empower farmers need to be initiated soon. This will help in catalyzing the activities/programmes specifically designed for scaling innovations that will increase farmers' income and have direct impact on smallholder farmers through adoption of three pronged strategy defined earlier.
- Needed regulatory reforms in the existing Acts especially pertaining to the land, water, seed, fertilizer, energy and market, etc. must be brought about as a matter of national priority by the Central Government. Also, to have in place an effective coordination and convergence mechanism for various schemes, programmes and activities by different Ministries would help achieving desired outcomes much faster. For this, a high level inter-ministerial committee to be chaired by the Prime Minister and co-chaired by the Vice-Chairman, NITI Aayog and Agriculture Minister will help ensure effective monitoring of the outcomes of various programmes aiming at 'Farmer First'. Also, this coordination committee be assisted by a standing Advisory Panel of Agricultural Experts.

- Remunerative minimum support price (MSP) for most of the commodities needs to be fixed and announced well in advance of planting season by the Ministry of Agriculture and Farmers Welfare (MOA&FW) with assurance for either procurement or compensation directly to the producers for prevailing price difference in the market so that farmer is not a loser. Also, the reforms in methodology for fixing MSP by the Commission for Agricultural Costs and Prices (CACP), is essentially needed, for which a High Level External Review Committee of Experts be established immediately.
- For accelerating agricultural growth, needed incentives and rewards be put in place quickly to attract youth (including women) to diversified, secondary and specialty agriculture as individual producers, SHGs, Cooperatives, Farmers Producer Organizations/Companies or as knowledge/service providers. In the process, farmer led innovations be scaled out through required validation, refinement and incentives in the form of credit at low interest rates (not >4%), bank support for required commercialization, insurance to avoid any initial risks, practically no or very low tax on rural based value additions and marketing of produce/value added products. Incentives to innovators/entrepreneurs could be in the form of state/national recognitions and awards.
- Right policy support for accelerated role of private sector will certainly change the game much faster. Hence, enabling environment to embrace private sector is the most critical need which be given due importance by the Government. In this context, support for hybrid seed production; fabrication of equipments/implements/tool for scaling conservation agriculture and small farm mechanization; micro-irrigation (drip and sprinkler), protected cultivation, including fertigation; agroprocessing and value addition; fertilizers, including customized and biofertilizers; pesticides, including biopesticides, etc. would help accelerate agricultural growth.

Research and Development

- Besides the focus on productivity and production growth, we now need increased research and development emphasis on post-production, value addition, and market linkages (both domestic and foreign).
- There is an urgent need to improve the empowerment of targeted smallholder farmers and ensure delivery of last mile services. Hence, the technology dissemination related programmes will have to be tailored and reoriented according to present day needs. In fact, a paradigm shift from public to private innovation extension system is the need of the hour to provide much needed knowledge, the quality inputs and much needed custom hire services at the farmer's doorstep.
- It needs to be ensured that smallholder farmers, especially the youth including female farmers, get their entitlements and are not sidelined. .
- Identification of agencies/institutions responsible to take specific actions at the local, State and Central level and their effective coordination will be very helpful. Also, an independent monitoring and evaluation process for the much needed impact will be extremely useful.

Capacity Development

- Knowledge sharing and capacity development (especially women and youth) need to be considered a top priority to bridge the yield gaps, achieve diversification, scaling innovations that can save on production costs and help in rationale use of natural resources, ensure value addition and link the farmers to market.
- Greater emphasis must be given henceforth on skill (on farm as well as off farm activities) development at all levels. This will greatly help the farmers especially the smallholders to raise their income.

Financial Support

- There is an urgent need to triple annual budget allocation for the Indian Council of Agricultural Research (ICAR), an apex AR4D organization with proven track record, in order to continue meeting emerging challenges while providing national public goods for the betterment of farmers as well as Indian agriculture.
- Capital investment in agriculture for much required infrastructure in the States, that were left behind during Green Revolution period (especially the eastern region), must immediately be enhanced (at least to a minimum level of 15-20% from present <10%) to create much needed infrastructure to help farmers increase their production as well as income. Such an effort will also help in achieving Sustainable Development Goals (SDGs) much faster.
- The State Governments (as they have major responsibility, agriculture being a State subject), must provide necessary financial support and the commitment for implementation of above three pronged strategy to double farmers' income. Role of NITI Aayog is thus very critical in this context.

Conclusion

In India, while farmers are the major producers, they also constitute the largest proportion of consumers. Hence, improving small farm production and productivity, as a major development strategy, can make significant contribution towards elimination of hunger and poverty, provided farming is made efficient and remunerative. Experience of countries that have succeeded in reducing hunger and malnutrition shows that growth originating in agriculture, through smallholder farmers, is at least twice as effective in benefiting the poorest as growth from non-agriculture sectors. The World Development Report of the World Bank (World Bank, 2008) has clearly emphasized that: 'Using agriculture as the basis for economic growth in agriculture-based countries requires a productivity revolution in smallholder farming'. As stated earlier, higher productivity

requires higher investment in agriculture and agricultural research - a fact that needs to be heeded by the policy makers to make sure that 1.0% of agricultural GDP is invested on AR4D, as against present level of just 0.4%. Hence, three-fold increase in resource allocation for the national agricultural research system (NARS) be considered a prerequisite to double the farmers' income.

It is also a fact that India will remain predominantly an agricultural country during most of the 21st century. Therefore, we must have both vision and national strategy for shaping the destiny of agriculture by making it highly productive, efficient and economically attractive for the smallholder farming community. The target of doubling farmers' income by 2022, though apparently not easy yet a very laudable goal, augurs well of Government's intention to help farmers. It is also clear that if concerted efforts, as per suggested action plan, are made in a Mission Mode, chances of making agriculture an engine of national economic growth and for smallholder farmers a respectable profession are indeed much brighter.

References

- Birthal, P.S., Negi, D.S. and Roy, D. (2017), Enhancing Farmers' Income: Who to Target and How?, Policy Paper No.30, ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi, xiv+38.
- Chand, R., Saxena, R. and Rana, S. (2015) Estimates and analysis of farm income in India: 1983-84 to 2011-12, Economic and Political Weekly, Vol. L No. 22, Pp. 139-145.
- Chand, Ramesh. (2017) Doubling Farmers' Income: Rationale, Strategy, Prospects and Action Plan, NITI Policy Paper No. 1/2017, NITI AAYOG, Government of India, New Delhi, 34 p.
- Government of India. (2006) Report of National Commission on Farmers on "Faster and More Inclusive Growth", Headed by M.S. Swaminathan, Government of India.
- Government of India. (2018) Report of the DFI Committee on "Strategy for Doubling Farmers' Income by 2022", Chaired by Ashok Dalwai, MOA&FW, Government of India.
- Gulati, Ashok and Saini, Shweta. (2016) "Farm Incomes: Dreaming to Double", The Indian Express (<http://epaper.indianexpress.com/c/12056965>). 28 July, 2018.
- Hooda Committee Report (2010), Report of "Working Group on Agriculture Production (WGAP)", Headed by B.S. Hooda, Government of India, 66 p.
- Jat, M.L., Dagar, J.C., Sapkota, T.B., Singh, Yadvinder., Govaerts, B., Ridaura, S.L., Saharawat, Y.S., Sharma, R.K., Tetarwal, J.P., Hobbs, H. and Stirling, C. (2016) Climate Change and Agriculture: Adaptation Strategies and Mitigation Opportunities for Food Security in South Asia and Latin America. *Advances in Agronomy*, 137: 127-236
- Lele, Uma. (2017) Climate Change and Doubling Farmers' Income Experience around the World. Paper presented in XIII Agricultural Science Congress held at UAS, Bengaluru, 21-24 February, 2017.

- Paroda, R.S. (2017) Strategy paper on “Indian Agriculture for Achieving Sustainable Development Goals”. Trust for Advancement of Agricultural Sciences, New Delhi, 28 p.
- Pratt, A.N. and Fan, S. (2010) R&D investment in national and international agricultural research: an ex-ante analysis of productivity and poverty impact. Discussion Paper 986, IFPRI, Washington, D.C.
- TAAS. (2013) Proceedings of “Brainstorming on Achieving Inclusive Growth by Linking Farmers to Markets”, held at IARI, New Delhi, 24 June 2013, 24 p.
- TAAS. (2015) Proceedings of “National Dialogue on Innovative Extension Systems for Farmers’ Empowerment and Welfare”, held at NASC Complex, New Delhi, 17-19 December, 2015, 18 p.
- TAAS. (2017) Scaling Conservation Agriculture for Sustainable Intensification in South Asia, TAAS, New Delhi, 6 p.
- World Bank. (2008) World Development Report on “Agriculture for Development” The International Bank for Reconstruction and Development, Washington DC, 365 p.

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- Brainstorming Workshop on Upscaling Quality Protein Maize for Nutritional Security - Recommendations, May 21-22, 2015.
- The Ninth Foundation Day Lecture on “21st Century Challenges and Research Opportunity for Sustainable Maize and Wheat Production” by Dr. Thomas A. Lumpkin, Former DG, CIMMYT, September 28, 2015.
- National Dialogue on Efficient Management for Improving Soil Health - New Delhi Soil Health Declaration - 2015, September 28-29, 2015.
- Regional Consultation on Agroforestry: The Way Forward - New Delhi Action Plan on Agroforestry 2015, October 8-10, 2015.
- National Dialogue on Innovative Extension Systems for Farmers’ Empowerment and Welfare - Road Map for an Innovative Agricultural Extension System, December 17-19, 2015.
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- Policy Brief on Scaling Conservation Agriculture in South Asia, September, 2017.
- Retrospect and Prospect of Doubling Maize Production and Farmers’ Income – Strategy Paper by Dr. N.N. Singh, September 10, 2017.
- Indian Agriculture for Achieving Sustainable Development Goals – Strategy Paper by Dr. R.S. Paroda, October, 2017.



Brief Resume

Dr R.S. Paroda has made valuable contributions in the field of agriculture both as a researcher and an able administrator. He has made significant research contributions in the field of plant breeding and genetic resource management. During the period 1994-2001, Dr. Paroda spearheaded and modernized the national agricultural research system (NARS) as Director General, ICAR and Secretary, DARE, Government of India. During his leadership of ICAR, more than 20 new institutions were created in crops, horticulture, livestock, natural resource management, fishery, agricultural engineering and social science sectors. Dr. Paroda

is well known for initiating and strengthening many visionary programs at the national level. The prestigious National Agriculture Technology Project (NATP) of the World Bank was designed by him to reorient agricultural research, education and extension system to meet new challenges faced by the agricultural research system. Dr. Paroda is the main architect of one of the world's largest and most modern National Gene Banks housing more than 200,000 crops germplasm accessions. The impressive National Agricultural Science Centre (NASC) Complex, located at Pusa Campus, was built mainly at his initiative and direction. International Crop Research Institute for Semi Arid Tropics (ICRISAT), Patancheru and Agriculture Research Institute of Kazakhstan have named their Gene Banks after Dr Paroda in recognition of his notable contributions in the field of genetic resource management. Dr Paroda has received several national/international awards and recognitions, including the most prestigious PADMA BHUSHAN in 1998. Other awards conferred on him are: Rafi Ahmed Kidwai Memorial Prize (1982-83), ICAR Team Research Award (1983-84), FICCI Award (1988), Om Prakash Bhasin Award (1992), Asia-Pacific Seed Association Special Award (1995), CGIAR Award for Outstanding Partnership (2000), Life Time Award by Association of Agricultural Scientists in America (2001), Dr Harbhajan Singh Memorial Award (2001), Dr B.P. Pal Memorial Award (2003), Borlaug Award (2006), ISCA Gold Medal for Excellence in Science (2006), Gold Medals from Ministry of Agriculture of Armenia (2006) and Vietnam (2012), Life Time Achievement Award of 'Agriculture Today' (2008), Dr A.B. Joshi Memorial Award (2012), Prof. Kanniyam Memorial Award (2012), and Krishi Shiromani Samman by Mahindra and Mahindra Ltd. (2013). He has been conferred Fellowship of several National Science Academies like, INSA, NAAS, NASI and was elected as General President of the prestigious Indian Science Congress in 2000-2001. Among international recognitions, he was elected as Fellow of Agricultural Academies of Russia, Georgia, Armenia, Tajikistan and the Third World Academy of Sciences (TWAS). He had also been the President of more than a dozen Agricultural Scientific Societies. Both American Society of Agronomy and the Crop Science Society of America had awarded their prestigious Honorary Membership on Dr Paroda in 2001. Dr Paroda has been conferred honorary D.Sc. by 15 academic institutions including Ohio State University, Indian Agricultural Research Institute, Scientific Council of Agricultural Academy, Republic of Azerbaijan and State Agricultural Universities at Pantnagar, Kanpur, Jorhat, Coimbatore, Hyderabad, Udaipur, Varanasi, Srinagar, Meerut, Bhubneshwar, Ludhiana and Dharwad. Dr Paroda served as founder President of Global Forum on Agricultural Research (GFAR) from 1988-2001. He also served for more than two decades as Executive Secretary of Asia-Pacific Association of Agricultural Research Institutions (APAARI), a well known regional organization fostered by him to strengthen regional research collaboration. He had served as Chairman as well as Vice-Chairman of ICRISAT Board, member of Board of Trustees of IRRI, member of WMO High Level Task Force on Climate Services, member of Advisory Council of Australian Center for International Agricultural Research (ACIAR), member of Finance Committee of CGIAR and a member of the Governing Board of the Commonwealth Agriculture Bureau International (CABI). Dr. Paroda has spearheaded the organization of several international conferences and discussion sessions including, International Crop Science Congress (1996), Indian Science Congress (2001), Global Conference on Women in Agriculture (2012), Agricultural Science Congress (1997, 1999), Global Conference for Agricultural Research and Development (2012) and 1st International Agrobiodiversity Congress (2016). Till recently, Dr Paroda worked for the overall benefit of farmers as Chairman, Farmers Commission of Haryana, Chairman of Working Group on Agriculture and member of Rajasthan Planning Board, when State Agriculture Policies both in Haryana and Rajasthan were released. Currently, He is Member of Strategic Impact, Monitoring and Evaluation Committee (SIMEC) of CGIAR. As Chairmen of the Trust for Advancement of Agricultural Sciences (TAAS), his goal is to link science to the society.