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Editors
P K Shetty
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INNOVATIONS IN AGRICULTURAL POLICY

NATIONAL INSTITUTE OF ADVANCED STUDIES
Bangalore, India

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Preface

Agriculture is a way of life for majority of farmers in India and has influenced significantly socio-economic development of the people of this country. Continued focus and innovation in agriculture is essential to achieve self-reliance in this sector and also ensure food security. In recent decades, one of the key concerns is falling share of agriculture and allied activities in India's Gross domestic product (GDP). When the five year plans were launched in 1951, its share was as much as 56 percent but declined steadily over the decades. In 1999-2000 it was 28.4 per cent, in 2011-12 it further declined to 13.8 per cent. If agriculture and allied sectors can grow at least at the rate of 4 percent per annum, then the overall GDP growth of over 8 percent can become a reality. In India contribute 4 per cent GDP growth per annum then it will help to achieve the overall 9 percent GDP growth. In order to reach this goal, India needs to have a viable and innovative agricultural policy.

The innovations in agricultural policies or programmes are required at the National level as well as at the regional level for enhancing the agricultural production and productivity on the one hand and overcoming the pitiable plight of the farmers. The Innovations in agriculture need to focus on the vast untapped growth potential in agriculture including strengthening of rural infrastructure, promotion of agri-business and subsidiary farm enterprises and creation of more employment to avoid migration from rural areas to urban areas. The climate change and rise in temperature is an inevitable process in India. We need to focus on development of drought-resistant, less water intensive and short-duration crops in drought prone distinct of the country. India can adopt many of the cost-effective innovative irrigation techniques developed by Israel.

It is essential to popularise and adopt innovative practices in enhancing soil moisture conservation techniques developed by various institutions within and outside the country. The need of the hour is to build confidence of small and marginal farmers in India through right policies by ensuring easy credit availability, remunerative prices for agricultural products, supply of drought resistant varieties and short-duration high yielding varieties,

establishment of self-help groups and encouraging direct marketing and selling of agriculture products by the farmers.

This book contains lead papers from distinguished scientists, agricultural economists and policy makers in the country. It has endeavoured to garner latest data on the changing structure of the Indian agriculture that includes cropping patterns and many other developments that have taken place over the last seventy years or so. It also highlights the major handicaps faced by farmers and also attempts to bring out the critical factors promoting or deterring the growth of agriculture. More particularly, it emphasises the policy imperatives necessary for sustainable agricultural development and offers several points for an effective policy to achieve them.

Some of the important aspects covered in this context are: sustainable and inclusive agricultural development in the country; strengthening of rural infrastructure to support faster agricultural development; establishing agro-economic zones on the lines of Special Economic Zones (SEZs) to boost agro-processing industry in order to reduce the agrarian distress; innovations in policies for promotion of judicious mix of yield-enhancing and input-responsive technologies; policies for easy credit availability, remunerative prices for agricultural products, supply of drought-resistant and short-duration high yielding varieties; emphasis on individual-farmer insurance policy; innovations in food storage; future policies to be directed to have a judicious mix of food crops and cash crops for ensuring food security in the country; minimum support prices for all the crops to be fixed with a scientific basis; need for interventions in rainfed horticulture, disease diagnostics, seed and planting material, mechanisation, labour shortage, climate resilient technologies and strengthening of market linkages; new initiatives such as interaction with farmers through video conferencing involving subject matter specialists, community radio station, use of DVDs for disseminating of information on various technologies to be adopted throughout the country, so that it would help bring down the transaction costs in many of the Government programmes.

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M.V. Srinivasa Gowda

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Editors' Note

The problems faced by the Indian agricultural sector is has reached crisis proportions. This crisis has two facets: one is developmental crisis that lies in the neglect of the sector arising out of poor design of programs and inadequate allocation of resources; the other is a livelihood crisis, threatening the very basis of survival for the vast majority of the population dependent on agriculture. On the one hand, there is a neglect of farming, and on the other hand, there is a neglect of the farmer. The two dimensions of the crisis are interrelated in that the problem at the larger structural context cannot be separated from the problem that the individual farmer faces.

A very disturbing feature of the crisis in agriculture, which has been there for nearly two decades now, is that it is taking place at a time when the overall Indian economy, except during the recent global financial crisis, has been witnessing a high growth. The key aspects of the agricultural crisis can be listed briefly: Compared to the 1980s, agricultural production, productivity and value of output from early 1990s, have decelerated for almost all crops. The state instead of facilitating the risk-taking farmers has been withdrawing. There has been a decline of public investment in irrigation and related infrastructure. An increase in private investments on borewells / tubewells in some parts of the country led to a tragedy of the commons through declining water tables.

Inadequate access to formal sources of credit led to increasing dependence on informal sources of credit with a greater interest burden. Declining link between research & extension and farming increased reliance on the input provider for farm advice, leading to supplier-induced-demand. With changing technology and market conditions the farmer is increasingly being exposed to the uncertainties of the product as well as factor markets. The farmer faces multiple risks, vagaries of weather, price shocks and spurious inputs among others, further worsening the already lower returns from his efforts.

This volume is a collection 15 papers attempting to examine the different dimensions of the plight of farmers and the innovative policy innovations needed to overcome it. This note gives a bird's eye view of each of these papers.

The paper by Srinivasa Gowda takes a critical look at the present state of agriculture in the country and attributes it to the policy failures especially during the post-reforms period, during which the preoccupation of the policy makers and planners with the non- agricultural sectors led to a clear bias against the agricultural sector which eventually lead to poor and unstable growth of the sector. The advocates of liberalisation-globalisation listed certain hypothetical benefits from it to the farmers of developing countries. These were: i) it would help to increase farm production and improve the economic and social condition of farmers, ii) it would increase efficiency of the workers, while the enhanced use of HYV seeds and machinery produced and marketed by multinational companies would facilitate increase in agricultural productivity, iii) it would improve animal husbandry as the developing countries would be able to import exotic breeds of animals from the other countries, iv) developing country farmers would enjoy the privilege of selling in the international market through export of agricultural products to developed countries.

The paper observes that, as if to exploit these hypothetical benefits, the economic reforms initiated by the policy makers sought to gradually phase out government control over the market in the early nineties (liberalisation), selectively privatize public sector organizations (privatization), and provide export incentives and relax import restrictions to enable free trade (globalization). This was a striking departure from the protectionist, socialist nature of the policies pursued till then. While this paradigm change in the economic policy in general was hotly debated, its harmful repercussions on agriculture started coming to surface in the late mid-1990s, when a very large number of farmers especially in the dry land farming regions of south Indian states committed suicide. Coupled with this was a sharp drop in agricultural growth from around 4 percent in the 1980s to around 2 per cent through the 1990s and also during the last decade. The paper attempts to unfurl the different facets of

the present agrarian crisis and analyse causes for them as well as their ramifications.

The growth rate of agricultural output has slowed down because on one hand the acreage under crop is shrinking and on the other hand the yield per hectare has also remained stagnant for most crops. The post-liberalization period has also witnessed increasing input costs and deteriorating soil conditions. As a result, the growth in crop yields per hectare has plummeted across the board. The Steering Committee on Agriculture and Allied Sector constituted by the Planning Commission for the formulation of the 11th Five Year Plan observed that after independence, such a long term deceleration in the growth of agricultural output is being witnessed for the first time.

The paper discusses certain policy anomalies affecting agriculture, such as the MGNREGS creating the problem of labour availability and labour cost for farming activities, and growing tendency to replace draught animal power by indiscriminate mechanization leading to increasing fuel import costs and environment pollution. The paper calls for immediate steps to correct these anomalies.

Prakash *et al* discuss the Income and Livelihood Security of Farmers in the Era of Economic Reforms with particular reference to Karnataka. They observe that Indian agriculture has been hit hard during the post-reform period especially after signing of WTO treaty. They point out that the share of agriculture in India's global exports has in fact declined during this period. In this scenario, the global agricultural trade became oligopolistic and imperfect rather than competitive (Prakash, 2001). Returns of various crops have declined due to increase in the cost of production, weak marketing mechanism and increased un-sustainability of the productive system due to fall in the water table, decline in soil fertility, increased occurrence of pests and diseases and so on. As a result, farmers have become highly indebted and are resorting to suicides in different parts of the country (Singh, 2011). The authors observe that there are fundamental flaws in not only approaching but also conceptualizing the whole process of reforms in agriculture in a country like India. They say: "These flaws stem from our inability to understand the very nature of agriculture as a core sector of economy and to focus exclusively

on the issues of income and livelihood of farmers. Importance of land, small holdings that are scattered throughout the country side, over dependence on natural factors, season bound, and region bound nature of agricultural production are peculiar features of agriculture compared to industry. Due to these peculiarities prevalence of a more or less, 'perfectly competitive market situation' for farm products is unique to agriculture. And hence, the farmers have very less or no control over the prices of what they produce. Relatively smaller lots of marketable surplus which are homogeneous in nature further disadvantage the farmers in wielding any influence on the prices of the products they produce".

"The so called growth in the Indian economy is confined mainly to industry and service sectors and these belong to private segment and corporate bodies. The growth of these sectors is "market led" with efficiency and profit maximization as the motivating thrusts. The growth in agriculture, on the other hand is being pursued under the leniency of the government that too with overriding equity considerations and social obligations. The agricultural land, the basic means of production, is under the 'ceiling limit', and hence distribution of land is governed by the broader rules of Land Reforms in India. Secondly, the prices of the majority of agricultural commodities are 'administered' in the forms of Minimum Support Price, Issue Price, Procurement Price and so on, in order to 'control' their violent fluctuations, especially upward as it hurts the interests of the politically articulated consumers inter alia organized workers, government employees and urban middle class".

Deshpande gives an overview of agricultural policies pursued in India from time to time. He observes that initially Indian agricultural policy was aimed at food distribution and then followed by food production and resource management. After stabilizing the food production, later policies were focused on pricing, market, insurance and further liberalizing the agricultural sector. He asserts that till 1999, India had no agricultural policy. What existed all through was a maze of schemes covering various aspects of agricultural sector. These were designed more as fire-fighting measures. And, many a time the schemes failed at the threshold of implementation. What existed all through is a maze of schemes covering various

aspects of the agricultural sector. These were designed more as fire-fighting measures. And, many of these schemes failed at the threshold of implementation.

Deshpande opines that to be able to move forward, India needs to take up the good points from our history which include, land reform policy advocated by J C Kumarappa in his Congress Working Committee report as also the reports like Royal Commission on Agriculture or Deccan Riots Commission. We need to learn from these historical documents which provide enough through an 'Error Learning Model'. With reference to innovations in policies, Deshpande says there is need to address the following four policy platforms: i) Diversity in land and landholdings: Diversity of land refers to the different agro-climatic zones in India like rainfed area, dry land, upland etc and the landholdings include small and marginal and large holdings. Further, (land and landholdings) this diversity should be utilized by making the groups of farmers to work together. ii) Diversity in cropping pattern v/s monoculture: India needs to spread risk and optimization of income through diversification of cropping rather than monoculture. This should be achieved through proper incentives and that will bring down the aggregate risk. iii) Diversity of climate: Currently our generation is struggling to adjust to the changing climate, frequent floods and droughts. We need to develop mitigation and amelioration policies in the country. For instance, drought is not a problem it is only a climatic events but the problem is our incapability and unpreparedness to address the issue of drought in the country despite years of experience. iv) Adoption of area-specific policy: we need to adopt area-specific policies like utilizing the diverse agro-climatic zones and b. taking up the good in past policies.

The paper by Vijay Kumar examines the innovative policy initiatives of Central and State Governments for promoting agricultural development in the country. Tracing the evolution of agricultural development policies in India, he maintains that in India while formulating policies, we need to place emphasis on what farmers require in different agro-climatic zones. Commenting on the loan waiver scheme in Karnataka, he avers that not all farmers can benefit from it. He remarks that we are good in formulating policies but we often fail in the course of implementation of these policies.

Regarding labour problem in agriculture, Vijaykumar maintains that there is need to bring in second generation reforms**.** Labour availability is more problematic than fertilizer availability. For a farmer, even in his own family, labour is not available. Because of this all the operations are getting delayed and he is not able to get what he expects at the end. Gone are the days when the labourers in agriculture were being paid less or overworked. Today it is the other way round; instead it is the farmers who have started complaining that labour is not available during the crucial farm operations time. If we go to any plantation like coconut or arecanut plantations in Kerala, farmers have started thinking about partial mechanization.

The paper by Basavaraja *et al.* deals with the impact of economic reforms on production and productivity of Indian agriculture. The percentage changes, coefficient of variation around the trend and compound growth rates were computed and compared to analyze the impact of economic reforms on production and productivity of major crops. The time series data on area, production and productivity of major crops for the period from 1974-75 to 2009-10 were used for the analysis. The study period is divided in to two sub periods as 1974-75 to 1991-92 (pre economic reforms period) and 1992-93 to 2009-10 (post economic reforms period).

The analysis indicated that the agricultural sector has started responding to economic reforms initiated in the country. The crop pattern is getting diversified with a shift away from food grains crops towards high value, in some cases export oriented, crops. This has implications for food security in the country. The growth rate in food grain production in the post economic reform period has slowed down. This development is depressing when viewed in the light of existing nutritional intake and future demand for food grains. There was a significant change in cropping patterns during post reforms period, both in terms of area allocation and share in total output. The most important change was a significant decline in the share of area under coarse cereals and an increase in the share of area under higher value crops brought about because of changes in relative prices and productivity. During the post reforms period the shifts occurred mainly towards plantation and condiments and spices, and towards remaining crops have continued. The

diversification towards oilseeds has slowed down considerably. In short, economic reforms and trade liberalization have failed to hasten the process of diversification in agriculture.

Bagchi reviews the policy measures for revitalizing Indian agricultural research. This paper is based on a study carried out for the government of India. The policy measures are intended to fix constraints and provide an environment for researchers to develop world class research outputs. He observes that even though India has a rich tradition of good quality R&D in agricultural sciences, its productivity in recent years has not been able to keep pace with the fast changing dynamics of the economic environment in the country. The research establishment needs to develop a lot more varieties of seeds, more pest resistant crop varieties, new farming equipments, better cropping techniques, etc. than it is developing at present to enable the country to achieve 4% growth in agriculture as envisaged by the government.

Based on the analysis of the quantitative data and qualitative data from the interviews with the experts, the author identifies certain broad issues that constrain the productivity growth of agricultural research in the country and he suggests some remedies including: tackling human resource issues, issues regarding the quality of research output, Incentivizing excellence in research by monetary and non-monetary rewards and creating disincentives for poor quality research, infusion of capital to improve the research infrastructure in NARS to be taken up during the 12th plan and creating a central level organization for promoting technology commercialization in agricultural research.

Sharma *et al*. discuss achievements, challenges and opportunities relating to integrated pest management in Indian agriculture. The authors observe that in the absence of clear cut IPM policies at the national level, we are still struggling to increase the area under the IPM from current 4 to 10 % in comparison to the USA where 27% of its arable area is under IPM. Apart from various technological constraints, consensus and confidence among field workers is lacking. Despite several initiatives taken by the Government of India, establishment of infrastructures and registration of more than 600 *Trichoderma* formulations the bio-

agents are not getting popularized. Among other factors, this is due to intricate behaviour of bio-agents, compatibility with native organisms, shelf life and their quality. The authors also suggest several IPM- based programs to make the agriculture sustainable.

Highlighting the growing significance of ICT in agriculture, Kulkarni *et al.* discuss the initiatives taken by the University of Agricultural Sciences, Bangalore for improving the knowledge level of farmers about ICT tools. The University of Agricultural Sciences, Bangalore located in the IT hub of India, initiated several ICT based information delivery mechanisms in recent years to keep up with the pace of development in the field of communication, which involves: Internet based connectivity though UAS website and Portals, Video conferencing through VRCs/VKCs, Mobile message services, Multimedia DVDs and, Information Touch Screen Kiosks.

The authors observe that ICT initiatives have opened a whole new set of options for agricultural extension education services to improve the speed and accuracy of communication at relatively lower cost in contrast to traditional extension systems. Application and success of ICT largely depend on availability of necessary infrastructure and the education of users for wider acceptance of the technology. As the ratio of the number of extension workers to the number of farmers is significantly declining in the recent days, ICT tools can be of great help in the future extension system. However, ICT should not remain as a showcasing tool; instead, it should make real contribution towards strengthening the economy of the individual farmers.

In view of the growing importance of horticulture in recent years, the paper by Gajanana *et al.* discuss the economic policies and programs required for sustainable horticultural production. The paper also points out certain nagging problems that are affecting the development of horticulture in the country and these include: low and declining productivity, deteriorating production environment, huge post-harvest losses and their impact on per capita availability of horticultural products, failure of the sector to changing quality consciousness and global competition and adverse impact of climate change on horticulture and, lack of market linkage and stable prices.

Lalith Achoth brings out the crucial significance of livestock economy in India's agricultural development. Analyzing the growth and trends in the different segments of the livestock sector, he also discusses the handicaps faced by the sector and the solutions for the same. For instance, writing on the draught animal power in India, he points out that 80 m draught animals (DAs), mostly bullocks, make available 40 million horse power in as many points of application for ploughing and carting. DAs provide energy for ploughing 100 m hectares, forming 2/3 of the cultivated area. DAs haul 25 billion tonne km of freight in 14 m bullock carts (BCs). DAP saves 6 m tonnes of petroleum, valued at Rs. 12,000 crore ($2.4b) per year. Small and marginal farm lands are further getting fragmented, and dependence on DAP would continue.

Mechanization of agricultural operations by tractors and transport by trucks should be encouraged, wherever technically feasible, economically viable and ecologically desirable. Replacement of DAP by petroleum based mechanical power would need an investment of Rs. One lakh crore ($20b), which is beyond the reach of marginal and small farmers. He observes that draught animal power in India is greatly underutilized. About 70 million rural based bullocks are used only for 100 days a year for ploughing and carting. Unlike tractors and trucks, DAs have to be fed during the 250 days, when they are idle. There is a 50 per cent shortage of fodder, the price of which is so high that small farmers are unable to purchase commercial fodder. Farmers are then compelled to send their DAs to slaughter houses ahead of their useful life. They then borrow money for buying DAs for the next season, which increases farmers' indebtedness.

The paper by Natarajan *et al.* examines the status of land resources in India and the role of resource inventory for resource management. They particularly point out causes and consequences of growing soil degradation and suggest solutions for the same. The root cause for the degradation, they say, is neglect and irrational use of land resources at the grassroots level in the country. To address the emerging issues at this level, the first and foremost thing needed is a detailed site-specific database on land resources at the farm level for all the villages in the country. This can be obtained by carrying out detailed characterization and mapping of all the existing land resources like soils, climate,

minerals and rocks, ground water, vegetation, crops, land use pattern, socio-economic conditions, infrastructure, marketing facilities etc. Soil survey provides the required information for farm-level planning. From the data collected at farm level, viable, sustainable land use options suitable for each and every land holding can be identified easily. The importance of land resources survey in the rational management of the land resources has been brought out by many studies carried out in the past in the country.

The paper by Ravindra brings out the innovative policies and schemes introduced by the Agricultural and Processed Food Products Export Development Authority (APEDA), for promoting Exports of Indian agricultural products. These innovative steps include creation of: Tracenet to address the problem of traceability of the products and to enhance the country's credibility in the foreign market. This initiative was started with Grapes and has now been extended to Pomegranate and other horticulture crops. India is the first country to introduce this Web-based traceability in the organic sector; Agri Exchange Portal which is one of the very useful portals wherein information pertaining to various countries, product profile, trade leads etc., is available. Exporters/Importers can also host their offer in this Interactive Portal; Participation in International Exhibitions related to food, wherein the country's strength in the export of agro products is highlighted and opportunity is provided to registered exporters to participate along with APEDA to showcase their products and; product-specific campaign and financial assistance schemes for agricultural exporters.

Two papers by Soundarya *et al.* and Sravanthi *et al.* attempt an institutional-economic analysis of the realization of benefits from the Government schemes by farmers – based on empirical studies conducted in Karnataka and Andhra Pradesh, respectively. Their studies also attempt to estimate the transaction costs incurred by the target groups in realizing the benefits from government schemes. The extent of realization of the benefit and the transaction costs incurred depend upon several factors such as the size of holdings.

It must be mentioned here that while the scholarly papers included in this volume do help enrich the readers' understanding

of the nature and problems of the Indian agricultural economy, the views expressed by the authors in their respective papers are their own and the editors do not necessarily subscribe to them.

P.K. Shetty
M.V. Srinivasa Gowda

Crisis in Indian Agriculture - Call for prompt Action

M. V. Srinivasa Gowda

The agricultural sector in India which had registered a commendable growth during the pre-liberalisation period, turning the country from a net food importing one to a food self-sufficient and even food-exporting one, has been adversely affected during the post-liberalisation period. The votaries of liberalisation-globalisation do list several hypothetical benefits from it to the farmers of developing countries. These are: i) it would help to increase farm production and improve the economic and social condition of farmers, ii) it would increase efficiency of the workers, while the enhanced use of HYV seeds and machinery produced and marketed by multinational companies would facilitate increase in agricultural productivity, iii) it would improve animal husbandry as the developing countries would be able to import exotic breeds of animals from the other countries, iv) developing country farmers would enjoy the privilege of selling in the international market through export of agricultural products to developed countries.

As if to exploit these hypothetical benefits, the economic reforms initiated by the Indian Government in the early nineties sought to gradually phase out government control over the market (liberalisation), selectively privatise public sector organizations (privatization), and provide export incentives and relax import restrictions to enable free trade (globalization). This was a striking departure from the protectionist, socialist nature of the policies pursued till then. While this paradigm change in the economic policy in general was hotly debated, its harmful repercussions on agriculture started coming to surface in the late mid-1990s, when a very large number of farmers especially in the dry land farming regions of south Indian states committed suicide. Coupled with this was a sharp drop in agricultural growth from around 4 percent in the 1980s to around 2 per cent

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through the 1990s and also during the last decade. This paper attempts to unfurl the different facets of the present agrarian crisis and analyse causes for them as well as their ramifications.

Poor growth of farm sector and unabated farmer suicides

Agriculture harbours 56% of the Indian population today, yet it contributes hardly 17% to the GDP. Farm production in India fluctuates widely because of its dependence on rainfall. The agricultural GDP growth rate came down from 3.3 percent during 1980-1995 to 2 percent during 1995-2005. Very low and unstable growth rate in this sector in contrast to over 8% growth rate of the industrial and service sectors for the past two decades points to the increased impoverishment and insolvency of the farmers.

Notwithstanding the media attention and government's debt relief packages, the suicides across the states continue unabated. Unofficial estimates put them beyond 100,000 across the country, while government estimates are much lower at about 30,000. This, of course, is the extreme symptom of a very deep rooted and widespread rural distress. According to the NSSO Report 496 (*'Some Aspects of Farming', 2003*), 27% of farmers did not like farming because it was not profitable and in all 40 percent farmers reported that they would quit farming if better options were available outside the farm.

The agricultural output in India fluctuates widely because about 60 percent of the cultivated area continues to depend on rainfall which fluctuates from year to year. The long term trend is observed by taking the three-year moving average data. The table below presents the growth rates of agricultural sub-sectors. One can notice that the crop sector which grew at 3.22 percent (Table 1) during 1990-91 to 1996-97 collapsed in the next period i.e. during 1996-97 to 2003-04, the growth rate came down to 0.61 percent. If one excluded horticulture from the crop sector then the growth rate was negative in absolute terms (-0.31 percent).

The growth rate of agricultural output has slowed down because on one hand the acreage under crop is shrinking and on the other hand the yield per hectare has also remained stagnant for most crops. The total operated area was 125.10 million hectares in 1991-92. It has come down to 107.65 million hectares

in 2002-03 (NSSO Report 493). The net irrigated area declined from 57.1 million hectares to 55.1 million hectares during this period. Surface water irrigation has taken a back seat in most areas and dependence on ground water irrigation has increased alarmingly. The water table has come down in 264 out of 596 districts.

Table 1: Growth rate of output in various sub-sectors of agriculture (at 1993-94 prices)

Period	Crop sector	Live-stock	Fisher-ies	Fruits & Vegetables	Non-horti-culture crops	Cereals
1980-81 to 1989-90	2.71	4.84	5.93	2.42	2.77	3.15
1990-91 to 1996-97	3.22	4.12	7.41	5.92	2.59	2.23
1996-97 to 2003-04	0.61	3.76	4.28	3.66	-0.31	-0.11

Source: Report of the Steering Committee on Agriculture & Allied Sectors for Formulation of the 11th Five Year Plan (2007-2012)

The period has also witnessed increasing input costs and deteriorating soil conditions. As a result, the growth in crop yields per hectare has plummeted across the board *(Indiastat.com).* The Steering Committee on Agriculture and Allied Sector constituted by the Planning Commission for the formulation of the 11th Five Year Plan observes that after independence, such a long term deceleration in the growth of agricultural output is being witnessed for the first time.

Food security in jeopardy

With dwindling area under crop production and ever-rising demand for food grains as a consequence of rise in population and urban incomes, it will be a Herculean task for the nation to feed the teeming millions in the years to come. Viewed from this angle, persistence of food inflation in the ensuing years cannot be easily ruled out. Export oriented agriculture resulting from liberalization and globalization is also gradually reducing the area under food crops, as more and more land is being used for cash crop production. With the crop sector growth going down, the per capita net availability of food grains declined to the levels attained in 1950s.

Net availability of food grains is equal to gross production minus seeds, minus wastage, minus export, plus import, plus or minus changes in the buffer stock. In the decade of the 1990s, per capita availability of food grains fluctuated around 174 kg per annum. It was 186.2 kg in 1991. Since 2000, it has come down to 160 kg and below. It was 151.9 kg in the year 2001. Just for comparison, one should note that the per capita annual availability of food grains in the USA is around 1000 kg. Corresponding to the decline in food grain availability, the per capita per diem calorie intake has also gone down from 2153 k-cal to 2047 k-cal in rural India and from 2071 k-cal to 2026 k-cal in urban India during the period from 1993-94 to 2004-05 (NSSO Report 513).

Further, the findings of the National Family Health Survey for the year 2005-06 point towards serious nutritional inadequacy. As many as 47 percent of Indian children below age 3 are underweight, 19 percent are severely malnourished and 79 percent are anaemic. At the same time, 56 percent of adult women are also anaemic. When such a large section of the population is nutritionally deprived over extended period of time, even a slight disturbance like monsoon failure or fluctuations in farm prices can lead to a major disaster. The reports on starvation deaths from different parts of the country are as alarming as those on farmers' suicides.

Export-oriented farming also tends to accentuate farm income disparities as it is generally biased in favour of large farmers. Indiscriminate pursuance of such a policy will only make us more and more dependent on food imports, and continued dependence may prove fatal for the country, as it has proved for many African countries. The memories of Bengal famine are again of special importance. Ashok Mitra, former Chairman, Agricultural Prices Commission and Chief Economic Adviser to the Government of India, in his memoir *Apila-Chapila* (Ananda Publishers, 2003) [in English translation *A Prattler's Tale* (Samya, 2007)], tells of millions from the countryside dragging themselves to the cities to beg and to die in the streets. 'We went to college, stepping over these live corpses, these half-dead men, women and children. It was an appalling situation. Yet the daily lives of the middle and upper classes were largely unaffected'

Steady increase in unviable land holdings

With unabated growth of population, the size of operational landholdings is declining steadily. The NSSO reports reveal that the average area operated per holding in 2002-03 was 1.06 hectares, down from 1.34 hectares in 1991-92, 1.67 hectares in 1981-82 and 2.63 hectares in 1960-61. Marginal holdings (of size 1 hectare or less) in 2002-03 constituted 70% of all operational holdings, small holdings (size 1 to 2 hectares) constituted 16%, semi-medium holdings (2 to 4 hectares), 9%, medium holdings (4 to 10 hectares), 4%, and large holdings (over 10 hectares), less than 1%. The share of marginal holdings in the total operated area went up by 6-7 percentage points since 1991-92 to reach 22-23% in 2002-03. Estimates from the latest (8th) Census of Agriculture held in 2005-06 are not yet available, but the guess is that the number of land holdings has risen from about 120 million in 2002-03 to almost 140 million, with the marginal holdings accounting for over 80 percent of the total.

The debt trap - perilous dependence on private money lenders

Although the quantum of institutional credit to agriculture has gone up for the last four decades, the share of investment credit in the total agricultural credit has gone down. The declining share of investment credit tends to constrain the farm sector to fully realise its potential. Inequity in the distribution of institutional credit across different categories of farmers is glaring. In spite of the Government's claims regarding the debt relief packages and the RBI's direction to the banks to increase credit flow to small and marginal farmers, the institutional credit accounts for only 20 percent of the total credit taken by small and marginal farmers, with the bulk being provided by private moneylenders who are known to charge usurious interest rates.

An NSSO survey in 2005 found that 66% of all farm households owned less than one hectare of land. It also found that 48.6% of all farmer households were in debt. In fact the biggest problem Indian agriculture faces today and the number one cause of farmer suicides is indebtedness of farmers. With nationalisation of major banks priority was given to farm credit which was till then appallingly severely neglected. However, with liberalisation, efficiency being given utmost importance, such lending was deemed as being low-profit and inefficient,

and credit extended to farmers was reduced severely, to 10.3% of the total bank credit in 2001 against a recommended target of 18%.

Further, rural development expenditure, which averaged 14.5% of GDP during 1985-1990, was reduced to 8% by 1998, and further to about 6% since then. This at a time when agriculture was going through a crisis proved disastrous for farmers, forcing to seek credit from private money lenders at very high rates of interest. Escalating input costs not compensated for by a commensurate rise in output prices coupled with crop failures and droughts have pushed farmers into a debt trap. A large number of studies and enquiry committees point towards indebtedness as the single major cause of farmer suicides.

The seeds muddle

The major inputs for our farmers are seeds, fertilizers and labour. Prior to globalisation, farmers had access to seeds from the public sector seed agencies. The seed market was well regulated, and this ensured quality in privately sold seeds too. With liberalization, India's seed market was opened up to MNCs like Monsanto, Cargill and Syngenta. Also, following the so-called SAP guidelines of the IMF-WB duo, a large number of seed processing units were closed down across all the states. This hit the farmers very hard: in a sort of a free-for-all market, seed prices shot up, and fake seeds emerged in a big way, with the cost of genetically modified pest-resistant seeds like Monsanto's BT Cotton costing over Rs. 4000 per acre.

BT Cotton is a cotton seed genetically modified to resist pests, the success of which is disputed; farmers now complain that yields are far lower than promised by Monsanto, and there are fears that pests are developing resistance to the seeds. Expecting high yields, farmers invest heavily in such seeds. Further, BT Cotton and other new seeds have a much lower germination rate of about 60% as opposed to a 90% rate of state-certified seeds. Hence 30% of the farmer's investment in seeds turns waste. The abundant availability of spurious seeds is another problem which leads to crop failures. Either tempted by their lower price, or unable to discern the difference, farmers invest heavily in these seeds, and again, low output pushes them into debt. Earlier, farmers could save a part of the harvest

and use the seeds for the next cultivation, but some genetically modified seeds, known as Terminator, prevent harvested seeds from germinating, hence forcing the farmers to buy them from seed companies every crop season.

Rising costs of fertilizers and pesticides

With the devaluation of the Indian Rupee in 1991 by over 20% (an explicit SAP condition put by the IMF for its loan to India), Indian farm products became cheaper in the global market, leading to an export drive. Farmers were encouraged to shift from growing a mixture of traditional crops to export-oriented 'cash crops' like chilli, cotton and tobacco. These crops need much higher doses of pesticides, fertilizers and water than traditional crops. Liberalisation policies reduced pesticide subsidy (another explicit condition imposed by the IMF) by two-thirds by 2000. Fertilizer prices have since increased by more than 300%. Electricity tariffs have also been increased rapidly. These costs increased considerably when farmers turned to cultivation of cash crops which need more water, hence more water pumps and higher consumption of electricity. Also, the fact that hardly 40 percent of India's cultivated land is irrigated makes cultivation of cash crops largely unviable, but export-oriented liberalisation policies and seed companies looking for profits continue to push farmers in that direction.

Unsustainable irrigated agriculture

In Punjab and other regions having canal irrigation, extensive use of nitrogen fertilizer and pesticides has increased concentration of nitrates and pesticide residues in water, food, and feed, often above tolerance limits. Nearly two-thirds of farm land is degraded. About 22 million hectares are affected by acidity or salinisation while another 14 million hectares are water logged. In dry land regions soil erosion due to rain water run-off, streams and floods is the main form of land degradation affecting 94 million hectares. Besides these forms of degradation, soil health has also been compromised by loss of macro and micro-nutrients and organic matter that occurs due mainly to mono cropping and excessive application of nitrogenous fertilizer. The distortionary fertilizer policy has contributed a lot to the nutrient imbalance in the soil.

Competition from subsidised overseas farm products

With advent of the WTO, in an urge to open the domestic markets for foreign products, the Indian government severely reduced customs duties on imports, which exposed the Indian farmers to competition from subsidised dumping of farm products from developed countries. By 2001, India completely removed restrictions on imports of almost 1,500 items including food. As a result, cheap imports flooded the market, pushing prices of crops like cotton and pepper down. Import tariffs on cotton and other items now stand between 0 - 10%, encouraging imports into the country. The excess supply of cotton in the market-led cotton prices to crash more than 60% since 1995. As a result, most of the farmer suicides in Maharashtra were concentrated in the cotton belt till 2003 (after which paddy farmers followed the suicide trend).

Decline in rural employment

With a severe deficiency of investment and poor growth in agriculture, chances of generation of rural employment are slim. The daily-status unemployment in rural areas of continues to be over 8% of the rural labour force. The report of the Planning Commission's Task Force on Employment Opportunities shows an absolute decline in the number of people employed in agriculture at the all-India level between 1993-94 and 1999-2000. During the post-reform years, the overall employment growth rate in rural areas has declined in 13 states, compared to the preceding decade.

The employment elasticity of agricultural growth declined from 0.52 during 1983-1993/94 to 0.28 during 1993/94-2004/05. The share of unorganized sector agricultural workers in the total agricultural work force was 98 per cent during 2004-05. The growth rate of agricultural employment decelerated from 1.4 per cent during the period 1983/1993-94 to 0.8 per cent during the period 1993-94/2004-05. Between 1993-94 and 2004-05, the unemployment rate increased by 1 percent.

Dwindling rural incomes and rising poverty

Studies by the Ministry of Agriculture have clearly demonstrated that farm incomes have fallen in recent years. For instance rice farmers in West Bengal earned less by 28 per cent in 2002-03 than what they earned in 1996-97. Incomes of

sugarcane farmers in Uttar Pradesh decreased by 32 per cent and in Maharashtra by 40 per cent. Farm incomes of north Indian farmers eroded by 10 per cent on an average. The sharp decline in farm incomes is happening at a time when incomes in the urban areas are on an upswing. Add to it the declining consumption of cereals in real terms, the message is crystal clear. For bulk of the population, the capacity to buy food is eroding fast.

The poverty ratio as estimated by the Planning Commission on the basis of the 61st Round of NSSO survey on monthly per capita consumer expenditure (Uniform Recall Period, URP) in 2004-05 is 28.3 per cent for rural areas as against 25.7 per cent for urban areas and 27.5 per cent for the country as a whole. The committee constituted by the Ministry of Rural Development for suggesting a methodology for estimation of BPL households in rural areas observed that the national poverty line at Rs 356 per capita per month in rural areas and Rs 539 per capita per month in urban areas at 2004-05 prices permitted both rural and urban people to consume about 1,820 k-cal as against the desired norm of 2,400/2,100 k-cal. The Committee has reported that at the 2400 k-cal norm as much as 41.8 percent of the rural population is below poverty line.

Imbalance between industry and agriculture

The policy bias against agriculture in general and subsistence agriculture in particular is traceable to the colonial rule. In order to transfer surplus from India to Britain, the colonial power snapped the domestic links between agriculture and industry. The artisan manufacturing was destroyed and linkages from new industry and railways were not allowed to spread out domestically. This led to lop-sided industrialisation. While surplus was transferred from agriculture to industry at home and industry abroad, sufficient employment could not be generated in manufacturing to facilitate the shift of workforce in that direction.

The post-independence Nehruvian development strategy failed to make a decisive break from our colonial past. The transfer of surplus from agriculture to industry and services continued but the workforce remained confined to agriculture and allied sectors for lack of productive employment possibilities outside. While strict import restrictions and over-valued exchange rate

provided a preferential protection to the organised industry, a policy of controlled farm prices through levy system milked the farm sector and transferred the purchasing power from the latter to former and to the privileged urban consumers.

Inequitable resource base in agriculture

The land reforms launched after independence did abolish absentee landlordism and intermediaries but failed to correct the skewed distribution of land holdings created by the colonial rule. According to the NSSO survey for the year 2003-04, the top 5.2 per cent of rural households own 42.8 per cent of the area, and the top 9.5 per cent own 56.6 per cent of the area. The remaining 90.5 per cent of households owned just 43.4 per cent of the area. The bottom 60.15 per cent of rural households own only homestead land (less than 0.4 hectares) and 10 per cent do not own even homestead land. (NSS Report 491: Household Ownership Holdings in India).

The way out

Now let me turn to the way out of the crisis. It would be a mere repetition to discuss here the recent policies such as the debt-relief, RKVY, and the National Food Security Mission. The solution to the agrarian crisis does require increased public expenditure for providing better (physical) infrastructure like irrigation, road connectivity, electricity and (social) infrastructure like education and health facilities, universal public distribution system and so on. These and other policies apart, steps are needed for tackling the root causes of the crisis. The important of these steps are briefed hereunder.

Protection from global farm price fluctuations

Resolution of the crisis requires that at the present juncture, the farmers are protected from world price fluctuations. Violent fluctuations in farm prices play havoc with livelihood security of farmers. Management of crisis requires that government imposes tariffs and quota restrictions to protect the farmers. Of course opting out of globalization is not a feasible choice. There are at present 153 member countries in the WTO and more than 20 countries are waiting to join it. What is needed is to evolve an appropriate strategy to extract maximum benefits out of international trade and investment. This framework

should include (i) making explicit the list of demands that India would like to make on the multilateral trade system, and (ii) steps that India should take to realize the full potential from globalization. India must voice its concerns and in cooperation with other developing countries modify the international trading arrangements to take care of the special needs of such countries. At the same time, we must identify and strengthen our comparative advantages.

The liberalisation and globalisation policies adopted by the government of India during the last two decades played an important role in the present agrarian crisis. However, this is not to say that these policies *per se* are bad, or inherently inimical to an economy. It is the *'one size fits all'* brand of liberalisation adopted by the IMF and the World Bank which forces countries to liberalise and globalize without exception that has failed.

Ensuring remunerative prices for farm produce

Farmers need to be ensured viable profit margin for their products by raising the minimum support prices instantaneously as and when the cost of cultivation rises not with inordinate bureaucratic / political procrastination. To cite a pertinent example, the Government of Karnataka always takes its own sweet time to revise the price of *'Nandini'* milk collected, processed and distributed by the para-statal, KMF, even when there is genuine need to offer higher prices to the dairy farmers to cover their ever-rising cost production. While the other so-called administered prices like petrol and diesel are automatically linked to the market-driven costs of production, it is sheer injustice to force farmers to produce and sell their product at a loss!

The Government's failure to act expeditiously in this regard only helps the urban consumers to enjoy *'Nandini'* milk at irrationally subsidised price at the cost of millions of small and marginal farmers of the state. The failure of the State Government to act in right earnest in this regard has resulted in the milk from the local farmers being collected and sold by private traders in the neighbouring states for higher prices, thus denying a fair price to the state's dairy farmers.

Unfair pricing of farm land acquired for non-farm uses

There is urgent need for a law preventing the government, para-statals and corporate bodies from forcibly acquiring farm land and transferring it to non-farm use. The law should also ensure that if acquisition of farm land is absolutely unavoidable, the farmers are paid the prevailing market value for their land. Most non-agricultural end users of agricultural land are corporate bodies, MNCs and high-income urban dwellers. The clamour for offering the market price to the farmers' land is often touted as a leftist argument, but this has been a loud public outcry for years, and the industry/urban / political caucus has been immorally suppressing this just demand of farmers. The buyers ought to cough up the market price for permanently dispossessing the farmers of their land which is only their asset. This is what of our former President Prof. A.P.J. Abdul Kalam has suggested in his famous PURA model in order to overcome the rural anguish and reduce the rural-urban divide.

Significance of non-farm employment in rural areas

Contrary to common perception that agriculture is the dominant source of income for farm households, a recent study by the National Centre for Agriculture Economics and Policy Research (NCAP), has found that small and marginal farmers depend heavily on non-agricultural sources for their income, since their holdings are mostly non-viable. "With falling farm sizes and lower yield, the rural marginal and small farmers are increasingly looking towards non-farm sector for earning their livelihood, which also reflects the crisis Indian agriculture faces in the coming years," the NCAP study said. The study showed that small land holders tend to diversify more towards non-farm activities while farmers with large land holdings tend to remain in agriculture.

"The message is loud and clear that agriculture is no longer a preferred occupation for smaller farm households and there is need to create remunerative, sustainable and equity-oriented income generating opportunities outside the agricultural sector to enhance their incomes," the NCAP study has observed. The study has suggested that the government should facilitate farm households' entry into high payoff non-farm sector by reducing financial and skill barriers including access to credit, insurance and information.

"For creating sustainable and remunerative income opportunities in the non-farm sector, there is need to promote intensification and diversification of agriculture towards enterprises such as horticulture, animal husbandry and fisheries that generate large returns to land, labour and capital," the study recommended.

Resource use efficiency – key to future growth

Improving productivity and resource use efficiency is critical to growth of Indian agriculture. Contrary to the general impression, our natural resources are not large. India has 17 per cent of world's population but only 2.4 percent of world's land area. After all the natural resources such as minerals, water and forests are only in proportion to the land we have. While China's population is 25 percent more than ours, its land area is three times ours. In fact, from the point of view of long-range sustainability, the need for greater efficiency in the management of natural resources like land, water and minerals has become urgent. Similarly, in a capital-scarce economy like ours, efficient utilization of the installed capacity becomes equally critical. These call for enhancement of literacy levels as well as literacy ratio among our farmers.

Contract farming and retail food chains as panacea for farmers' nagging problems

Two important institutional developments in the private sector that have apparently come as boons to farmers are the rise of contract farming and modern food retailing both of which offer prospects of lower marketing costs and reduced spoilage leading to lower prices for consumers and higher price realization for farmers. Of course, neither of these is free from drawbacks. Although contract farming is found to provide higher and more stable incomes to farmers, it has generally been biased towards the corporate sector and the farmers are often exploited by the business firms, especially the MNCs, in subtle ways. There is urgent need for enacting a comprehensive law on contract farming in order to protect the interests of contracting farmers.

Corporate food retailing is supposed to eliminate market intermediaries and offer better prices for farmers' produce but this business has become controversial partly because the food

chains are trying to exploit farmers in the pretext of quality control and partly because those involved in the existing trading mechanisms, especially the ubiquitous market intermediaries, feel their vested interests are endangered. However, although there is room for mutually beneficial modernization in this area and this will evolve in course of tome, a genuine area of concern is that if front-end investment by the corporate sector outpaces the backward linkage with farmers, the immediate outcome may simply be higher imports and lower farm prices.

Diversification of Indian agriculture towards high-value crops such as horticulture and dairying is needed so as to promote income generation among the small and marginal farmers. Driven by rise in urban incomes and changing food consumption pattern, the domestic and overseas demand for horticultural and live-stock products is growing at over 6 percent a year. So, these products offer considerable potential for employment generation and productivity growth.

In order to shun indiscriminate use of nitrogenous fertilizers and pesticides which leads to increased concentration of nitrates and pesticide residues in water, food, and feed, often above tolerance limits, it is necessary to adopt more diversified cropping systems that can reduce the need for chemical fertilizers and pesticides (for example, mixed legume-cereal systems). Power, fertilizer, and output subsidies, which are provided to appease large farmers, discourage a shift to alternative cropping patterns.

Significance of draught animals vis-à-vis farm mechanisation

Although livestock and fisheries have been growing faster than the crop sector and together account for nearly 30% of agricultural GDP, this sector has not been given due policy attention in terms of public investment and other incentives. This sector is also important from an equity point of view. Livestock ownership is widely distributed among the poor and is a valuable income supplement in mixed farming systems. Further, in arid and semi-arid environments which are not quite suited to crop production, there is a greater dependence on livestock farming. Crop and livestock enterprises have a strong complementarity with one another; a large portion of livestock is used as draught

animals and their feed consists largely of crop residues and crop by-products. In return, the manure from livestock is an organic source of fertilizers for crops, and is also used as fuel.

Selective farm mechanisation does enhance farm production and productivity by ensuring timely operations and precision in the application of inputs. The other side of the picture, however, is that indiscriminate farm mechanisation is causing enormous increase in fossil fuel burning leading to emission of greenhouse gases and pressures on import of crude oil on the one hand and replacing environment friendly animal power in farming operations on the other, which in turn is causing dearth of organic manure and increased dependence on chemical fertilizers. The negative externalities of farm mechanisation and chemical fertilisers *vis-a-vis* draught animal power and animal dung in India have seldom been systematically studied.

Animal power has immense significance in the Indian context, as it is both a renewable and sustainable energy source. It is renewable because aged draught animals can be replaced by breeding and rearing the required number. It is sustainable because draught animals drive their energy for work from the feed and fodder arising from crop production, indeed largely from farm by-products. It is a pity that despite its benign effect on the environment, the stock of draught animals in India is declining, while the stock of farm machinery, particularly, tractors/tillers, has been rising. The votaries of farm mechanisation look down upon animal draught power on the debatable grounds that grazing by livestock population destroys forest / grasslands while animal dung and urine pollute the environment. The very same 'experts' on farm mechanisation turn a blind eye to the cultural and environmental damages caused extensive raising of bovine population for beef purpose in developed countries!

Subsidised pricing of farm machinery compared to free market prices of draught animals has created a paradoxical situation in Indian agriculture where a pair of good breed bullocks now costs over Rs. 90,000 while a subsidised power tiller costs around that much! Shadow pricing of the two energy sources by taking into account the positive externalities arising from the environmental benefits and farmyard manure contribution of draught animals *vis-à-vis* the negative externalities of fossil-

fuel burning and climate warming by the use of power tillers/ tractors would require the price of a bullock pair to be subsidised at around Rs. 30,000 and hence make them affordable for small and marginal farmers while the price of the power tiller ought to have been almost Rs. 2 lakh, thereby discouraging irrational replacement of draught animal power by mechanical power.

The diesel equivalent of the animal energy used in Indian agriculture is massive; it was as much as 19.5 million tons in 2003. If this much amount of fuel were to be burnt to run the tractors in the absence of over 60 million draught animals in India, it would have caused an emission of over 6.14 million tons of carbon dioxide. These effects are highly valuable from the perspective of both national energy budget and global warming (Dixit and Birthal, 2010). This anomaly, if not overcome urgently, is bound to inflict further costs on the Indian economy and society.

It is fondly hoped that Planning Commission and the sector-wise expert working groups nominated by it for drafting the 12th Five Year Plan would take serious note of these and other critical issues dogging agricultural development planning in India.

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Income and Livelihood Security of Farmers in The Era of Economic Reforms

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The Indian economy has registered a rapid growth in terms of macroeconomic indicators such as gross domestic product (GDP) and per capita income since the initiation of economic reforms. This optimistic scenario is, however, elusive in the agricultural sector that witnessed rather a deceleration in growth rates of aggregate yield and output since initiation of the economic reforms. (Bhalla and Singh 2009). The protagonists of reforms believe that it is still early to see observable evidence of gains in Indian agriculture after opening up of economy. They even advocate for further reforms in order to reap the benefits of economic reforms in agriculture (Mahadevan 2003). The Prime Minister's Economic Advisory Council suggests rigorous prescriptions, inter alia for removal of supports and subsidies given to essential agriculture inputs such as fertilizers, power and resources like water, apart from removing rigidities in the land markets and repealing tenancy laws so as to make the prices of these inputs and resources 'competitive' (The Hindu, 2012)

The critics, on the other hand feel that Indian agriculture has been hit hard during the post-reform period especially after signing of WTO treaty. They point out that the share of agriculture in India's global exports has in fact declined during this period. In this scenario, the global agricultural trade became oligopolistic and imperfect rather than competitive (Prakash, 2001). Returns of various crops have declined due to increase in the cost of production, weak marketing mechanism and increased un-sustainability of the productive system due to fall in the water table, decline in soil fertility, increased occurrence of pests and diseases and so on. As a result, farmers have become highly indebted and are resorting to suicides in different parts of the country (Singh, 2011).

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These contrasting views and divergent positions clearly show fundamental flaws in not only approaching but also conceptualizing the whole process of reforms in agriculture in a country like India.

These flaws stem from our inability to understand the very nature of agriculture as a core sector of economy and to focus exclusively on the issues of income and livelihood of farmers. Importance of land, small holdings that are scattered throughout the country side, over dependence on natural factors, season bound, and region bound nature of agricultural production are peculiar features of agriculture compared to industry. Due to these peculiarities prevalence of a more or less, 'perfectly competitive market situation' for farm products is unique to agriculture. And hence, the farmers have very less or no control over the prices of what they produce. Relatively smaller lots of marketable surplus which are homogeneous in nature further disadvantages the farmers in wielding any influence on the prices of the products they produce.

The price of agricultural commodities to a large extent, is determined by the operation of demand and supply forces and the real producers in agriculture are just 'price takers.

The so called growth in the Indian economy is confined mainly to industry and service sectors and these belong to private segment and corporate bodies. The growth of these sectors is "market led" with efficiency and profit maximization as the motivating thrusts. The growth in agriculture, on the other hand is being pursued under the leniency of the government that too with overriding equity considerations and social obligations. The agricultural land, the basic means of production, is under the 'ceiling limit', and hence distribution of land is governed by the broader rules of Land Reforms in India. Secondly, the prices of the majority of agricultural commodities are 'administered' in the forms of Minimum Support Price, Issue Price, Procurement Price and so on, in order to 'control' their violent fluctuations, especially upward as it hurts the interests of the politically articulated consumers inter alia organized workers, government employees and urban middle class.

And hence, the so called profit or 'surplus', unlike in other sectors, has to pass through the scrutiny of these peculiarities,

equity considerations and social obligations in agriculture, that not only constraint the magnitude of farm income but also impinge upon on the livelihood of farmers in India.

In this backdrop the epistle is a modest attempt to address directly, the issues of farmers' income and livelihood by taking the case of Karnataka.

In this study, a meta analysis to assess the economics of 16 principal field crops of Karnataka is attempted to link with farmers' income and livelihood. The Directorate of Economics and Statistics (DES), Ministry of Agriculture, GOI, collects data through 'cost accounting method' on all aspects of cultivation of 26 principal crops in all the States. Through this, the DES facilitates the Administered Pricing Mechanism of GOI to announce Minimum Support Price (MSP) every year. Out of these 26 crops, the Comprehensive Scheme on Cost of Cultivation of Principal Crops in Karnataka, UAS, Bangalore collects cost data on nineteen mandated crops and submits to DES. These crops are Cereals (Paddy, Ragi, Maize, Bajra, Jowar, Wheat), Pulses (Red gram, Bengal Gram, Green gram, Black gram, Horse gram), Oil seeds (Soybean, Groundnut, Sunflower, Safflower), Cash Crops (Sugarcane, Cotton, Tobacco) and Onion. These 19 crops occupy around 70 percent of gross cropped area in Karnataka.

In addition, the Farm Management Division of the State Department of Agriculture (KSDA) also reports on the cost of cultivation of major crops every year for providing data for market intervention and price stabilization operations. The costs and return estimates of the two reports are given in Appendix I A and B.

The meta-analysis is performed to work out the average costs and return estimates from the two reports for 19 principal crops of Karnataka.

The costs are estimated as per the Farm Management Cost Concepts of Acharya and Agarwal (1994). For simplicity, these costs are grouped as variable and fixed costs in which some are paid out costs and other are imputed as under:

Particulars	Paid out Costs	Imputed Costs
Variable Costs	1. Hired labour • Human, • Animal, • Machinery 2. Material inputs • Seed (purchased) • Fertilizers, • Manure (purchased) • Pesticides, • Irrigation charges • Diesel / electricity 3. Interest on working capital 4. Rent paid for leased-in-land 5. Misc. expenses (artisans etc.)	1. Family labour • Human, • Animal, 2. Seed (home grown) 3. Manure (owned)
Fixed Costs	1. Land Revenue and other taxes 2. Interest on long term borrowing 2. Maintenance of Owned Animal 3. Insurance premium	1. Rent on Owned Land 2. Depreciation on • Implements, • Farm buildings • Machinery

Capital formation and asset building are the key requirements that determine the prosperity of agriculture. Hence it is essential to consider the interest on fixed assets while estimating the cost of cultivation. An interest rate of 12 per cent per annum on the value of owned fixed capital is considered in this study. Working capital is charged at the rate of 12.5% per annum and calculated for the crop duration.

Valuing land rent has attracted attention from different quarters. While it is conventional to consider the prevailing rental value of the land in the locality, in principle the 'fair rent' - the return to the land or the opportunity cost of the land as a factor of production is crucial. However this should be within the limits of 'fair rent', determined as a fixed proportion of the output value at the harvest price.

The present practice by DES is to consider 1/6th of the gross value of the produce minus land revenue, taxes and cesses as the imputed value of the rent of the owned land.

Family labor is charged as the rate of wage paid for attached farm labor or prevailing local wage rate of casual

labor. If the family labor performs skilled jobs like tractor driving, harvesting and processing, the locally prevailing wage rates for the same are considered. Home grown seed and farm yard manure are charged at the prevailing market prices in the village.

Cost of maintenance of owned animal labour include (a) costs of green and dry fodder, feed /concentrates, veterinary medicines etc. (b) depreciation on animals and cattle sheds (c) cost on labour for upkeep of animals and (d) miscellaneous expenses. Cost of maintenance of owned farm machinery includes diesel, electricity, lubricants, depreciation, repairs, interest and other charges. Annual cost of machinery, building and implements and other assets is estimated on the basis of depreciation by using the formula given below:

$$\frac{\text{Purchase Value} - \text{Junk Value at the End of Life of The Asset}}{\text{Average Life (in years) of The Asset}}$$

Around 10 percent all costs put together is taken as remuneration towards the managerial functions performed by farmers. The State Department of Agriculture also charges a risk premium, estimated on total insurance amount of the concerned crop. An amount equal to 1.5 to 3.5 per cent of the sum assured is taken as the risk premium.

Based on these cost estimates, net returns in the case of 19 crops mentioned above were worked out. An assessment is also made to understand the adequacy of MSP program, yield gap in comparison with the scientific yields as given in the Package of Practices of State Agricultural Universities and the market gap i.e. the proportion of retail (consumer) price that has been passed on to the producers, in the case of these 19 crops were worked out.

The supply of labor in agriculture and associated cost of it has become a cause for concern in recent years (Santhosh, 2008, Savitha, 1999 and Vinu, 1988). Hence, the labor use pattern is further analyzed using the results of a study by Prakash *et al* (2011) on three principal crops namely paddy, cotton and red gram.

The purpose of this paper is to analyze the income that farmers ultimately receive from the 19 crops and to examine the associated livelihood issues. This has been accomplished by collecting the primary data of 120 farmers from Karnataka who are part of the ongoing Cost of Cultivation Scheme, UAS Bangalore. The farmers belong to below mentioned 5 size groups with equal proportion as stipulated by the DES:

Size Group (Acres)	Category	No of Farmers	State percentage*
0 to 2.19	Marginal	24	48.21
2.20 to 4.39	Small	24	26.57
5.0 to 9.39	Medium	24	16.86
10.0 to 14.39	Semi-Medium	24	7.32
15 & above	Large	24	1.04

* Directorate of Economics and Statistics, GOI, New Delhi.

A functional analysis is also performed to assess the factors that explain the total income of the farmers by using the multiple regression models as given below:

Total Income (Y) = $a + b_1 X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_1X_3 + U$

Where Y= total income (in Rs) of farmers, X_1 = Area under crops (in ha), X_2 = (1,0) Dummy for plantation crops, X_3= (1,0) Dummy for dairy, X_4= agriculture income as Percentage to total income, a= intercept, b_1, b_2, b_3 and b_4 are regression coefficients respectively. Co-efficient b_5 captures the interaction effects of dairying and area denoting the rate of increase in income due to dairying.

And finally, an attempt is made to work out the total income that the farmers receive from different sources so as to access whether it is adequate to be on par with the state per capita income (around Rs. 70,000) or at least, to lift them above poverty line (Rs 12,000). An assessment is also made, based on the past studies, to appraise the adequacy of various developmental schemes by governments in bridging the income gap mentioned above. At the end, a few key measures required to address the issues of farmers' income and livelihood are outlined in detail.

Before getting in to the issues of costs, returns and income of the farmers growing these 19 crops, a time series analysis was attempted to know the growth and stability in area, yield and output of these crops since 20 years from 1990. The compound annual growth rate (CGR) and co-efficient of variation (CV) techniques were employed in this regard. The data and results mentioned above pertain to the crop year 2009-10. The results and discussions pertaining to the various aspects of farmer's income starting with growth and stability of farm output in Karnataka have been presented in the subsequent sections.

Table 1: Growth and stability in production of principal crops in Karnataka, 1990-91 to 2009-10.

Sl No	Crops	Area		Productivity		Production	
		CGAR	Insta-bility	CGAR	Insta-bility	CGAR	Insta-bility
1	Paddy	0.58	9	0.99	9	1.57	15
2	Ragi	-1.77	13	0.98	18	-0.44	22
3	Maize	8.36	47	-0.9	12	7.38	46
4	Bajra	-0.53	19	1.32	24	0.79	36
5	Jowar	-2.63	16	4.64	33	1.51	28
6	Wheat	1.32	10	1.07	19	2.41	26
Cereals		**-0.09**	**4**	**2.17**	**20**	**0.63**	**12**
7	Red gram	2.53	18	3	29	5.6	44
8	Bengal Gram	6.53	44	2.14	20	8.81	55
9	Green gram	3.23	32	-5.42	44	-2.37	53
10	Black gram	0.14	18	-5.44	52	-4.15	47
11	Horse gram	-2.8	19	-0.45	16	-2.91	23
Pulses		**2.45**	**16**	**3.15**	**26**	**-0.54**	**17**
12	Soybean	6.36	57	2.92	67	9.78	52
13	Groundnut	-2.62	18	-1.98	20	-4.55	34
14	Sunflower	0.09	29	1.08	16	1.17	35
15	Safflower	-5.63	41	2.42	22	-3.34	38
Oil seeds		**-1.29**	**17**	**-2.07**	**22**	**1.34**	**24**
16	Sugarcane	-0.22	20	-0.12	10	-0.34	27
17	Cotton	-2.74	21	-1.58	20	-2.1	27
18	Tobacco	3.56	22	-2.05	17	1.84	16
Cash Crops		**-1.33**	**13**	**-0.65**	**23**	**-0.29**	**10**
19	Onion	6.65	36	32.88	22	4.73	85

Source: Directorate of Economics and Statistics, GOI, New Delhi.

Growth and stability of Karnataka agriculture

Growth with stability of farm output is the most sought after property that determines the stability of earnings and ultimately decide the livelihood security of farmers. However, as the Nobel laureate Prof. Schultz has said growth and instability are born twins, and one should be ready to accept the trade-off between these two, especially in agriculture. There may also be a situation of 'no growth but stability' or in the worst case 'no growth and no stability' situation.

Total farm output, technically is a product of area and productivity. A productivity-led rather than the area-led growth is much more desired growth pattern. Hence, the growth and stability analysis is performed on all these three components separately for nineteen crops of Karnataka. The results of CGR and CV of area, production and productivity of these crops are given in Table 1.

Production of ragi, pulses, groundnut, safflower, sugarcane and cotton, has exhibited negative growth rate (deceleration) over the years in Karnataka. The CGR in the case of maize, red gram, Bengal gram, soy bean and onion is more than four percent, as envisaged under National Agriculture Policy (2000) and hence satisfactory. The growth in maize and onion is area-led as they have exhibited negative growth rate in the productivity. Growth in production of Bengal gram and soya bean is, to a large extent, area-led as their CGRs in area are higher than that of productivity. In the case of red gram, growth in productivity surpasses the growth in area.

Barring jowar, red gram, Bengal gram, soya bean and safflower, productivity of all other crops has recorded either negative growth or very low growth rate during the last two decades. Moderately high productivity growth in crops like jowar may be due to their low base values, and is neutralized by negative growth in the area. A further disturbing feature of Karnataka agriculture is the high degree of instability as captured by high values of CV in all the crops, especially in those crops that have displayed high growth in the production. The CV values in the cases of crops that have registered more than four percent growth rate in production, is in the range of 43 % to 85 %, implying the Schultz's observation of growth with instability phenomenon.

Table-2: Cost of cultivation of principal crops in Karnataka 2009-10.

(Rs/Acre)

Sl. No.	Crop	Total Cost (Rs / Acre)	%	Total Variable Cost	Total Fixed Cost	Labour cost	Input costs	Land costs	Managerial Cost	Others
										All figures in per cent
A	**Cereals**									
1	Paddy	20298	100	61	39	40	15	27	11	7
2	Ragi	9858	100	69	31	48	13	18	11	10
3	Maize	11119	100	62	38	39	17	25	11	8
4	Bajra	4843	100	69	31	49	11	19	11	10
5	Jowar	6680	100	66	34	50	10	20	11	9
6	Wheat*	9099	100	57	43	35	12	26	13	14
	Average	**10316**	**100**	**64**	**36**	**44**	**13**	**23**	**11**	**9**
B	**Pulses**									
7	Red gram	8887	100	57	43	34	16	34	11	5
8	Bengal gram	7795	100	66	34	37	22	23	11	7
9	Green gram	5390	100	63	37	43	14	25	11	7
10	Black gram*	8857	100	51	49	37	12	32	13	6
11	Horse gram	6770	100	60	40	51	4	23	13	9
	Average	**7540**	**100**	**59**	**41**	**40**	**14**	**27**	**12**	**7**
C	**Oil seeds**									
12	Groundnut	8579	100	66	34	43	22	15	13	7
13	Sunflower	5278	100	69	31	38	24	19	11	8
14	Safflower++	4723	100	72	28	44	21	16	11	8
15	Soybean*	9488	100	65	35	41	16	21	12	10
	Average	**7017**	**100**	**68**	**32**	**42**	**21**	**18**	**12**	**7**
D	**Cash Crops**									
16	Sugarcane	43091	100	55	45	30	15	34	12	9
17	Cotton	12650	100	61	39	38	18	27	11	6
18	Tobacco*	31305	100	47	53	28	10	33	13	16
	Average	**29015**	**100**	**54**	**46**	**32**	**14**	**31**	**12**	**11**
E	**Others**									
19	Onion++	12450	100	72	28	44	17	26	9	4

Source:

1. Farm Management Division, Karnataka State Department of Agriculture (KSDA), Government of Karnataka.
2. Directorate of Economics and Statistics (DES), Ministry of Agriculture, Government of India.

Note: ++ Only DES Estimates. * Only KSDA Estimates.

Overall, the rate of growth of production of principal crops of Karnataka is a modest 1.47 per annum coupled with a very high degree of instability; in terms of co-efficient of variation of around 35 percent in the past two decades.

Cost of cultivation of principal crops of Karnataka

Cost of cultivation of the principal crops of Karnataka calculated comprehensively by incorporating all the cost items mentioned earlier, and the results of data analysis are given in the Table 2. It can be seen from the table that sugarcane tops the cost of cultivation on per acre basis (Rs. 43, 091) followed by tobacco, paddy, cotton, onion and maize. The duration of the crop has to be considered before arriving at any conclusion in this regard. Sugarcane is a long duration crop (nearly 14 months) compared to other crops such as the pulses, which are short duration crops (around 90 days).

Among the food crops, paddy is the most expensive crop to cultivate incurring Rs. 20,298 / acre that is more than double compared to other food crops. Paddy under irrigated conditions is input intensive and the intake of fertilizers is high in paddy compared to other crops. This adds to total cost of cultivation in paddy. Pulses on the other hand are capable of fixing the atmospheric nitrogen and hence require less fertilizer. Fertilizer and pesticide use in oil seeds is also relatively lower. Group wise, the cash crops are the high cost crops that require around Rs. 30,000 / acre followed by onion, cereals, pulses and oilseeds. Proportion of variable costs in total costs comes to 60 to 70 percent in food crops, 54 percent in cash crops. Fixed investments such as the bore well and land rental are high in the case of cash crops. Hence proportion of fixed costs is also higher.

Labour is the single largest cost item forming more than 40 percent of the total cost in food crops, 32 percent in cash crops, as other items such as the depreciation of machinery and equipments are the prominent cost items here. Labor forms almost 50 percent of the total cost of cultivation in jowar, horse gram, bajra and ragi. These crops are grown not only for food grains but also for fodder purpose in which case requirement of manual labor for post harvest operations is high. Next to labour, the cost of land that includes mainly land rent forms 30 percent for cash crops, onion and pulses. In the case of oil seeds and cereals it is around

20 percent as these crops are cultivated mostly under dry land condition where the land rent is relatively lower.

The cost of marketed inputs - seeds, fertilizers, plant protection chemicals is around 15 percent of the total cost in most of the crops except in Bengal gram and oil seeds where it is more than 20 percent. Other imputed costs such as managerial cost, risk premium form around 22 percent in all crop groups except in onion where it is around 15 percent.

Agriculture has become not only a high-cost enterprise but also a high labour cost endeavor where the labour cost forms almost 40 percent of the total cost of cultivation.

This phenomenon of high cost agriculture induced mainly by the labor needs further investigation, undertaken in the subsequent section.

Labor use pattern in three selected crops of Karnataka

For the purpose of further analysis of labour use pattern in the principal crops of Karnataka, results of a study by Prakash et al (2011) on three crops; cotton, red gram and paddy, representing the cash crops, pulses and cereals respectively are considered. The use of all the three labor categories namely human, animal and mechanical power were studied in depth under both dry land and irrigated conditions, the summary of the results is given below:

a) The dependence on external labor force has increased in our agriculture as about 60 to 80 percent of human labour and 70 to 100 percent of mechanical labor were hired labor in all the crops studied.

b) However, own animal labor formed more than 50 percent in red gram and cotton and is 40 percent in paddy. Irrigated famers used relatively more own animal labor compared to farmers under dry land conditions in cotton and red gram. It is other way round in paddy. Further detail of labor use pattern in three main field crops of Karnataka is given in Appendix II.

c) In the case of irrigated cotton, more than 66 percent of human labor was used for weeding and harvest operations.

More than 40 percent of mechanical labor was used for land preparation under both dry land and irrigated conditions in all the three crops. In dry land paddy, almost 95 percent of the animal labor was employed for land preparation. Further details are given in Appendix II.

d) High external labour dependence is mainly due to requirement of more labor for post-harvest operations, weeding and land preparation. There is relative self sufficiency in the use of animal labour in our agriculture.

e) A functional analysis attempted through multiple regressions reveals that the area under the crops has a positive and significant influence on the total labor costs. Farmers with larger holding sizes have to depend more on external labor sources, especially for weeding, spraying and harvesting operations. The small farmers, on the other hand perform these operation using the family labor.

f) Contrary to expectation, mechanization has not turned into a panacea in reducing the labor costs for farmers cultivating field crops in Karnataka.

g) Irrigation not only enhanced yield, but also added cost through employment of more labor in the case of paddy. Even alternative water saving technologies like System of Rice Intensification (SRI) method too were found to increase the labor costs in paddy

h) A study by Basavaraj *et al.* (2008) revealed that the farmers following SRI method have borne high labour cost to the extent of 62 percent of the total variable costs or 26 percent of the gross return.

As large farmers with assured sources of irrigation undertake intensive cultivation, agronomic practices and inter cultivation operations are also intensified, especially in the field crops. Hence, they bear higher labor costs while cultivating the field crops. Though, mechanization is an ideal solution for such a situation, its penetration in agriculture is sluggish. The machine labor formed hardly 30 percent of the total labor use in three crops studied above. In majority of cases the machine

labor was hired from outside private agencies, who normally charge high rates for such services. As a result, mechanization didn't help the farmers in reducing the labor costs in majority of the cases.

Under command irrigation, paddy is cultivated as mono-crop. Hence, there is scarcity of labor during crucial seasonal operations leading to high costs of labor. In addition, irrigated paddy being resource intensive needs more labor for cultivation. Problems of weeds, pests and diseases are pronounced in irrigated paddy under mono-cropping. All these add to labor cost in paddy under irrigation.

Large farmers having the irrigation facilities had to bear the brunt of high labor costs in cultivating the field crops in Karnataka as revealed by the study mentioned above

Against this backdrop, an attempt is made to examine the issue of profitability or otherwise of our agriculture.

Un-remunerative agriculture:

Profitability of an enterprise such as agriculture is normally approached in two ways. In the short run, common expectation of an investor is that the return should cover at least 'paid-out' variable costs. However, the broader approach is that the investment in the long run must cover all the costs; variable and fixed, paid out and imputed ones, from agriculture. The results on profitability or otherwise worked out for 19 principal crops of Karnataka are given in table 3. The table indicates the extent to which our agriculture is un-remunerative. If paid out costs are just taken in to account, most of the principal crops of Karnataka, barring sunflower, soybean and jowar may show a positive net return or profit. The net return over paid out costs is the highest in sugarcane (Rs. 42,594 / ac) followed by tobacco (Rs. 26,615 / ac), onion (Rs. 7,157/ ac), cotton (Rs. 6,516/ ac) and paddy (Rs. 5878 / ac). However, the surplus dissipates drastically if all costs are considered in most of the crops, barring the cash crops and red gram. The surplus so recorded in crops like red gram, green gram, onion and other cash crops attributed mainly to the favorable prices that prevailed during 2009-10 in Karnataka.

Table 3: Profitability of principle crops of Karnataka: 2009-10

Sl No	Crop	Main Yield/acre (Qtls / ac)	Gross returns (Rs/ac)	Costs (Rs/ac)		Net returns (Rs/ac)	
				Total paid out cost	Total cost	Over paid out costs	Over total costs
1	Paddy	19.38	18327	12449	20298	5878	-1971
2	Ragi	6.18	7746	6803	9858	943	-2112
3	Maize	14.52	11626	6904	11119	4722	507
4	Bajra	3.3	3615	3346	4843	269	-1228
5	Jowar	4.25	3871	4432	6680	-561	-2809
6	Wheat	2.09	9080	5175	9099	3906	-19
7	Red gram	2.81	13287	5035	8887	8251	4400
8	Bengal Gram	3.56	7637	5124	7795	2513	-158
9	Green gram	0.83	5700	3391	5390	2309	310
10	Black gram	1.06	9124	4501	8857	4623	267
11	Horse gram	1.29	6081	4037	6770	2044	-689
12	Soybean	3.18	5726	6280	9488	-554	-3762
13	Groundnut	1.87	7047	5953	8579	1094	-1532
14	Sunflower	1.53	3681	3777	5278	-96	-1597
15	Safflower	2.56	4059	3081	4723	978	-664
16	Sugarcane	373	66226	23632	43091	42594	23135
17	Cotton	6.64	14257	7742	12650	6516	1607
18	Tobacco	4.45	41249	14634	31305	26615	9944
19	Onion	21.31	16074	8917	12450	7157	3624

Source: Compiled from the Reports of Farm Management Division, Karnataka State Department of Agriculture (KSDA), Government of Karnataka & Directorate of Economics and Statistics (DES), Ministry of Agriculture, Government of India.

Cultivation of fourteen principal crops has resulted in a net loss or very low return to farmers if all costs are considered. A modest estimation places the cumulative loss to the farmers at around Rs. 3000 crore due to cultivation of these crops in 2009-10 in Karnataka.

The un-remunerative agriculture of such a scale in Karnataka is a baffling issue. It has a direct bearing on income and livelihoods of farmers in the state. This issue is explored in further detail in the next section.

Income and livelihoods of farmers

Income from agriculture as well as other sources, in the case of 120 farmers of South Karnataka has been worked out for the year 2010 -11. As mentioned in the methodology section, these farmers are a part of the ongoing scheme on cost of cultivation and grouped into five classes. Farmers' agriculture income is estimated by considering the net income from the field crops discussed above along with plantation as well as horticulture crops (fruit & vegetable). The net income is worked out comprehensively by taking all costs in to account. In addition, income from other allied activities like dairy, outside works including jobs and daily wages are also considered to arrive at the total income of the farmers. And finally, transfer of income, directly and indirectly through several Governments' schemes and programs, is also estimated and included in total income of farmers. Income of sample farmers so worked from these sources is presented in Table 4.

It can be seen from the table that the total farmers' income ranges from around rupees 25,000 per annum for marginal farmers to around rupees 1.20 lakh in large farmers. The average income of all category together works out to rupees 56,951 per annum. It is important to note that the principal field crops that occupy almost 70 percent of the gross cropped area do not contribute more than 40 percent of the sample farmers' income in Karnataka. This is the highest (62 %) for medium farmers and the lowest (18 %) for marginal farmers. Next to field crops, plantation crops are the prominent source of farm income that contribute around 18 percent of the farmers' income. Large farmers derive 34 percent of their income from plantation crops.

Horticulture, considered as the 'sunshine' sector in the State couldn't contribute beyond five percent of the average income of the sample farmers

The contribution of horticulture crops is the highest (14 %) in the case of small farmers and the lowest in large farmers. Vegetable cultivation is labor intensive and due to their perishable nature, timely marketing of these produce is crucial. Hence, big farmers have not opted the cultivation of vegetables on a larger scale. Next to agriculture, outside jobs (for large farmers) and wage earning (for small farmers) is the major source of income

(27%) to the farmers in the state. Contribution of dairy in this respect is significant as it accounts for around 10 percent of the total farmers' income. It is ironical that various welfare schemes initiated by the government could provide only 4.3 percent of the income of farmers. However, poor, marginal farmers could get relatively more benefit of the government schemes that add around 8.5 percent to their total income.

Table 4: Income of sample farmers from different sources: 2011-12

(In Rs.)

Farmers category	Field Crops	Plantation Crops	Vegetable & other crops	Sub Total	Dairy	Wage Labour & Job	Govt. Schemes	Grand Total
Marginal	4521 (18.2)	373 (1.5)	1217 (4.9)	**6111 (24.6)**	2260 (9.1)	14358 (57.8)	2111 (8.5)	**24840 (100)**
Small	9352 (24.4)	153 (0.4)	5366 (14)	**14871 (38.8)**	6209 (16.2)	17018 (44.4)	230 (0.6)	**38328 (100)**
Medium	25444 (62)	369 (0.9)	1026 (2.5)	**26839 (65.4)**	5171 (12.6)	8208 (20)	821 (2)	**41038 (100)**
Semi-Medium	33346 (54.8)	8032 (13.2)	3286 (5.4)	**44665 (73.4)**	7971 (13.1)	8215 (13.5)	-	**60851 (100)**
Large	40100 (33.5)	42254 (35.3)	1317 (1.1)	**83670 (69.9)**	5865 (4.9)	29207 (24.4)	958 (0.8)	**119700 (100)**
Average	**22553 (39.6)**	**10251 (18)**	**2449 (4.3)**	**35253 (61.9)**	**5524 (9.7)**	**15377 (27)**	**797 (1.4)**	**56951 (100)**

Note: Figures in Parenthesis indicate percentage to the total.

Agriculture can hardly contribute 50% of the total income of majority of the farm households in Karnataka. Government's interventions through various welfare schemes are ineffective to make any significant dent in this regard.

Thus, the majority of farm population has been surviving on the supplementary income from dairy and other non-farm sources in Karnataka. A functional analysis was undertaken to understand the factors that influence the total income of the sample farmers.

Factors influencing farmers' total income:

By fitting a multiple regression model, the functional analysis was made to study the influence of holding size, plantation crops, dairy enterprise on income of the farmers in

the study area. Results are given in Table 5. A perusal of the table indicates that the holding size has a significant and positive bearing on farmers' total income. Farmers' total income has risen to the extent of around Rs.25,000 for every additional hectare of land area. Plantation crops such as areca nut and coconut add substantial return, to the extent of Rs. 76,840 to farmers' total income.

Table 5: Multiple regression analysis of factors influencing farmers' income

Sl. No.	Variables	Regression Co-efficient	t-value
	R^2	0.37	
1	Intercept	30375	0.94
2	Area (Ha)	24619*	3.92
3	Plantation crops (Dummy)	76840	1.55
4	Dairy (Dummy)	27	0
5	Agriculture income as Percentage to total income	214	0.76
6	Interaction (Area X Dairy)	14687***	1.7

Note: *** Significant at 10 % level, ** Significant at 5 % level, * Significant at 1 % level

Farmers received an additional income of around Rs. 15,000 from dairying for every hectare of land they possess, indicating a complementary relationship between dairy and agriculture enterprises.

The complementarily between these two sectors in terms of supply of fodder (from agriculture to dairy) and manure (from dairying to agriculture) is well established in farm management economics studies. The complementarily between agriculture and dairying is captured through an interaction effect and has an equity implication. In recent years, rearing of cross breed cows rather than the local breeds is increasing. Rearing cross breed cows requires higher investment and maintenance cost, hence it is suitable to large farmers. Supply of adequate fodder is an additional advantage for farmers having higher holding size.

But, the moot question is whether the income so received by the farmers from these different sources is adequate enough to (a) lift them above poverty line and (b) bring their income on

par with the state's per capita income. These crucial questions that ultimately throw a clear light on the livelihood status of the farmers is assessed in the next section.

Adequacy of farmers' income in Karnataka:

By assuming a family size of four, the per capita income of farmers from agriculture and other sources has been worked out for the different categories of sample farmers considered for the study. The results in comparison with the poverty line of Rs. 12,000 per person per annum as well as the state per capita income of around Rs. 70,000 for the year 2010-12 are presented in Table 6. The table gives the category wise annual per capita income of the sample farmers estimated from agriculture and other sources. If widely accepted poverty line of rupees 12,000 per person per annum is considered, it is distressing to note that barring large farmers, total agricultural income in majority of the cases falls much below the poverty line.

Table 6: Farmers' income vis-a-vis poverty pine (BPL) and state per capita income: 2011-12

Farmers category	State percentage*	Total Agricultural Income	Total farmers income	Agriculture per capita income	Total per capita income	BPL*	State Per capita Income*
Marginal	48.21	6107	24840	1527	6210	< 12000	69946
Small	26.57	14877	38328	3719	9582	< 12000	69946
Medium	16.86	26853	41038	6713	10260	< 12000	69946
Semi-Medium	7.32	44630	60851	11158	15213	< 12000	69946
Large	1.04	83618	119700	20905	29925	< 12000	69946
Average		**35217**	**56951**	**8804**	**14238**	**< 12000**	**69946**

Note: Agriculture per capita income is worked out assuming a family size of four in Karnataka * Indian economic survey 2011-12.

The average per capita income of sample farmers from agriculture works out to just Rs. 8804 per annum which falls short of the poverty line income by 27 percent.

However, the average per capita income of farmers from all sources works out to rupees 14, 228 that is a modest 19 percent higher than poverty line. Even the per capita income of big farmers from all sources is no where nearer to the State's per capita income of Rs.69,946.

The total income of the large farmers forms a modest 40 percent of the State's per capita income, and a meager 20 percent if average income of all categories of farmers is considered.

The afore-said results indicate the level of livelihood insecurity of farmers and the predicaments they are facing in Karnataka. Hence a comprehensive approach is required to seek solution for the woes that the farmers of the State are facing. For this, the critical sources from which the farmers' miseries have their origin need to be identified first and assessed thoroughly.

Sources of despair to the farmers:

Severe curtailment of farmers' income and livelihood is due to following predicament that exists in agriculture:

(a) Sub-optimal yield compared to possible or potential yield that can be obtained if proper agronomic practices and scientific methods are fallowed. This can be described as yield gap caused due to improper extension service, inadequate irrigation and infrastructure to deliver credit, agro inputs and services to farmers.

(b) Inadequacy in government's protection and State intervention especially in pricing and procuring of agricultural commodities as free market forces may not protect the interests of farmers for the reasons mentioned section 1.2. The adequacy of State interventions can be gauged in terms of administered pricing (MSP) and procurement programs of the government. Any lacuna in this regard is due to government failure and termed as intervention gap.

(c) There exists a major market failure due to the inherent features and peculiarities in agriculture. As a result, the market mechanism fails to transfer a fair share of consumers' rupee to the ultimate producers. This is termed as market gap that adversely affects the farmer's income to a great extent.

(d) And finally, all these culminate in to a larger government failure where in the political system is unable to launch policies, programs and institutional mechanisms to address

the issue of inadequacy of farmers' income. This has resulted in such a huge policy gap where the income that farmers get is abysmally low even to keep peasantry above the poverty line, let alone place them on par with the State's average income. The results given in Table 7 shed a light on different forms of gaps mentioned above.

a. Yield gap: The yield gap in agriculture is taken as the difference between the potential yield that can be realized through scientific methods of farming as prescribed in the Package of Practices of the State Agricultural Universities and the actual yield realized by the farmers. The yield gap so worked out for these 19 crops is given in Table 7. It is evident from the table that, barring commercial crops, in which case a large number of high breed varieties are available and paddy, where mostly high yielding varieties are planted, the yield gap in all other crops is quite high. It is the highest in sunflower (81 percent) followed by jawar (76 %), bajra and onion (81 %) . In addition to inadequate irrigation and recurrent attack of pests and diseases, minor variations in the weather and climate related factors too affect the yield in agriculture to a great extent. For instance, morning mist at the time of pollination drastically reduces the yield in sunflower. Similarly excessive rain at the time of bulb formation affects yield of onion. In addition, pests such as black and red hairy caterpillar, diseases such as downy mildew and powdery mildew, necrosis virus were found to affect the yield of sunflower drastically. As a cash crop, sugarcane is cultivated with assured irrigation coupled with appropriate inputs and agronomic managements. Hence, the yield gap is lower in sugarcane. As safflower is a drought tolerant crop, the yield gap in it is relatively lower.

Table 7: Different forms of gaps in agriculture of Karnataka, 2009-10

Sl. No.	Crop	Yield Gap			Intervention Gap			Market gap		
		Scientific Yield (Qt/ac)*	Actual Yield (Qtls/ac)	Gap	MSP (Rs/qtl)	Cost of Production (Rs/qtl)	Gap	Farm Gate Price (Rs/qtl)	Retail price (Rs/qtl)	Gap
A	**Cereals**									
1	Paddy	24	19.38	19	950	1047	91	897	3500	74
2	Ragi	17	6.18	64	915	1595	57	959	2800	66
3	Maize	28	14.52	48	840	766	110	740	1800	59
4	Bajra	12	3.3	73	840	1468	57	975	2500	61
5	Jowar	18	4.25	76	840	1572	53	704	4000	82
6	Wheat	12	5.05	58	1100	1802	61	1657	5000	67
	Average	**19**	**9**	**56**			**72**			**68**
B	**Pulses**									
7	Red gram	7	4.1	41	2300	2168	106	3206	7000	54
8	Bengal Gram	6	3.56	41	1760	2190	80	2136	5500	61
9	Green gram	5	1.9	62	2760	2837	97	2904	6500	55
10	Black gram	6	2.85	53	2520	3108	81	3201	6500	51
11	Horse gram	4	2.7	33		2507		1707	3500	51
	Average	**6**	**3**	**46**			**91**			**55**

Sl. No.	Crop	Yield Gap			Intervention Gap			Market gap		
		Scientific Yield (Qt/ ac)*	**Actual Yield** (Qtls/ac)	**Gap**	**MSP** (Rs/qtl)	**Cost of Production** (Rs/qtl)	**Gap**	**Farm Gate Price** (Rs/qtl)	**Retail price** (Rs/qtl)	**Gap**
C	**Oil seeds**									
12	Groundnut	7	**3.1**	56	2100	2767	76	2111	5000	58
13	Sunflower	10	1.9	81	2215	2778	80	1919	4000	52
14	Safflower	6	3.5	42	1680	1349	124	1153	4500	74
15	Soybean	9	3.5	61	1370	2711	51	1636	6000	73
	Average	**8**	**3**	**60**			**83**			**64**
D	**Cash Crops**									
16	Sugarcane	400	351	12	130	123	106	130	**300**	57
17	Cotton	8	**7**	13	2750	1905	144	2100	**12035**	83
18	Tobacco	6	5	15		6138		7967	13200	40
E	**Average**			**13**			125			**60**
19	Onion	80	21	73		584	0	753	1500	50
Grand average				**50**			**93**			**60**

Sources: Package of Practices of SAUs from Karnataka under irrigated conditions.

Actual Farm Yield, Cost of Production & Farm gate Price from DES and KSDA.

MSP from DES, New Delhi. Retail Prices: www.krishimaratavahini.kar.nic.in

The average yield of cereals is around nine quintals per acre in Karnataka indicating an yield gap of around 53 percent. Except paddy, which is cultivated under assured command irrigation in a majority of cases, the yield gap is high in other cereals. In oil seeds it is still higher 64 percent. This highlights the production constraints faced by cereals and pulses in Karnataka.

By and large, farmers cultivating the major field crops are not in a position to obtain even 50 percent of the potential yield in Karnataka. A plain estimation points out that the farmer's agricultural income can be enhanced, depending on the marketable surplus, by around 30 percent, if the yield gap is bridged.

b. Intervention gap: As discussed in the introduction chapter, agriculture as a production sector faces various forms peculiarities and the farmers have been thrust upon several social obligations and equity considerations. Added to this, a few features of a perfectly competitive market structure too affect the agriculture product prices and keep the farmers in a further disadvantaged position. As a result of these, income earning capacity and livelihood security of farmers has been severely constrained. Under such circumstance, it is imperative for the government to 'intervene' in the market and provide all supportive measures to safeguard the interests of the farmers. Two such measures long envisaged under the banner of 'Administered Pricing Mechanism' are; (a) ensuring "Minimum Support Prices" to farm products that should cover at least the cost of production in a comprehensive way, and (b) resort to direct procurement or other indirect measures so that the price support measures are put into operation. Table 7 sheds some light on the adequacy of these two intervention programs while ensuring income and livelihood securities of farmers of Karnataka.

It is pertinent note that except for cash crops, the MSP declared at the national level during 2009-10 was inadequate even to cover the cost of production of majority of crops in Karnataka.

On an average, the MSP could only cover 55 percent of the cost of production in pulses and 71 percent in oilseeds. Even in paddy, where, government undertakes direct procurement,

the MSP could cover 95 percent of the cost of production in Karnataka. The inadequacy of the government's MSP program in this regard is due to aggregation of the cost estimates at the national level that falls short to reflect the reality at the local/ground level. In addition, the time lag between the cost estimation and actual implementation of MSP that may extend up to two to three years, constrains the effectiveness of the market intervention program.

Intervention through MSP to enhance the stability of farm income is a notional program. What really matters is the ultimate price that the consumers pay for the farm products and the legitimate share that has been passed on to the farmers. This crucial issue is dealt with in the next section.

c. Market gap: In a perfectly competitive market the price differential between the initial producer at the farm gate and the ultimate consumer or retail level should correspond only to the cost of transportation, other costs of marketing functions plus a legitimate margin to the intermediary who performs the marketing activities. The legitimate margin should be opportunity cost (i.e. return from the next best alternative) of the efforts of the intermediary. The market interest rate is normally considered as the opportunity cost of the investment in a competitive market set up. The economic reforms are supposed make a marked impact here. If the farmer doesn't receive a fair and legitimate share of the consumer's rupee, one can infer that there exists a 'market failure' and 'institutional failure' in agriculture.

The Table 7 gives the estimates on the 'market gap' for 19 principal crops considered for the study. The information on price received by the farmers at the APMC or farm gate level is available for most of the commodities. The value of the final product from a quintal of primary output is taken as the consumers' payment for these commodities. In the case of sugarcane, oil seeds and tobacco, the value of the end products is worked out by considering the recovery percentage in the processing and other value addition process as mentioned in the Table 8. The market gap is worked out as the difference between the value of the end product and farmers' price for 19 agricultural commodities. The finding is equally disquieting.

Table 8: Value of the end products from agriculture

Sl. No	Crops	Recovery / output from one quintal	price
1	Sugarcane	10 kg sugar	Rs. 30 / kg
2	Ground nut	50 kg oil	Rs. 85 / kg
3	Sun flower	45 kg oil	Rs. 85 / kg
4	Safflower	35 kg oil	Rs. 130 / kg
5	Soybean	20 kg oil	Rs. 80 / kg
		60 kg meal	Rs. 70 / kg
6	Cotton	250 mts cloth	Rs. 50 / mt
7	Tobacco	60 kgs processed	Rs. 200 / kg

On an average, farmers producing the main agricultural commodities could realize hardly 35 percent of the payment made by the ultimate consumers. This point to a huge 65 percent of the 'market gap' exists in the agricultural sector of Karnataka.

As the intermediaries' role is relatively less in tobacco, onion and pulses, the farmers growing these crops could realize relatively higher share (of around 45 %) of consumers' rupee. The repercussion of the market gap on farmers' income depends on the quantum of marketable surplus that explains how much of his / her produce a farmer sells to others. The marketed surplus ratio (MSR) of the principal crops of Karnataka / All India, as mentioned in the latest Government report is given in Table 9. Commodities like ragi, bajra and jowar are grown mainly for home consumption and hence, the marketed surplus is lower in these crops.

Thus, the farmers of Karnataka would get an additional income of 30 percent from agriculture, if they receive a fair and legitimate share of at least 60 % of what consumers pay for the agriculture commodities.

If value addition to an agriculture commodity takes place in various forms, the consumers would make much higher payment than what is indicated above. For instance, in the case of sugarcane, consumers' payment, mentioned above is considered for sugar. From one ton of sugarcane, in addition to 100 kgs of sugar (at 10 % conversion), 150 units of electricity (from Bagasse) and 25 liters of rectified sprit (from molasses) are

also manufactured. In addition, the press mud is used as organic fertilizer.

Table 9: Marketed surplus of principal crops in Karnataka

Sl. No.	Commodities	Marketed Surplus (%)
1	Rice	95
2	Maize	98
3	Jowar	77
4	Bajra	67 (India)
5	Ragi	26
6	Red gram (Tur / Arhar)	87
7	Bengal gram (Gram)	87 (India)
8	Black gram (Urad)	64 (India)
9	Green gram (Moong)	82 (India)
10	Groundnut	93
11	Soybean	96 (India)
12	Sunflower	99
13	Safflower	55
14	Sugarcane	100
15	Cotton	99
16	Onion	97

The value of all end products resulting from one ton of sugarcane is Rs 10, 000 rupees! However, the farmers' share is a paltry Rs. 1300 per ton which is a paltry 13 % of the total value and 87% is garnered by the value addition.

The government is contemplating on a methodology to pass on 70 percent of the total ex-factory realization from the sale of not only sugar but also its primary by-products (molasses, bagasse and pressmud) to formers. (The Hindu Business Line 2012). However, the recommendations of the Prime Minister's Economic Advisory Council to totally do away with the levy system be viewed with utmost care and concern.

Plugging of the yield and market gaps is crucial to enhance income from agriculture to the farmers. Whether the farm income so enhanced is adequate enough to ensure livelihood security depends on the farm size that determines the quantum of marketable surplus. Table 6 indicates that nearly 50% of

farmers belong to marginal category whose holding size is less than one hectare.

The additional income that can be realized though plugging of yield and market gaps is in sufficient to lift 50% of farm population above the poverty line.

d. Policy gap: The Land Reform laws address the issues related to agrarian relationship covering, inter alia, ownership, ceiling and redistribution of agricultural lands in India. Administered Pricing is an 'intervention' mechanism that looks into the pricing and distribution of principal agricultural commodities so as to safeguard the interests of both producers and consumers in the country. These are the two most comprehensive policy initiatives. In addition, the system of institutional finance to farmers that comprises both co-operatives and nationalized banks is also an inclusive one.

In order to address the issue of income, livelihood and welfare of the farmers directly, the governments have been framing policy initiatives and implementing programs periodically. Some are directly aimed at productivity enhancement in agriculture through provision of subsidies to credit, inputs, seeds, irrigation and machinery. A few are in the form of 'mission mode' such as National Horticulture Mission, National Food Security Mission and Rastriya Krishi Vikas Yajana (RKVY). The rural employment guarantee scheme such as MGNAREGS is also a prominent equity oriented scheme aimed directly at the livelihood of rural poor including the small and marginal farmers. The governments have been coming out with occasional programs and packages such as loan waiver, special package of assistance to farmers in distress and so on.

The Government of Karnataka has also put in into operation a direct income transfer program called Suvarna Bhumi Yojane, in which direct transfer of Rs. 10,000 is envisaged to a farm family. There are welfare schemes that are intended to consider the health, old age, accidents and such other eventualities of farmers. A study by Sowndarya (2012) assessed the reach out and monitory benefits accruing to farmers from 43 such programs listed in the line departments of the government and the results are presented in Table 10.

Table 10: Reach-out of government programs to farmers in Karnataka 2010-11

Particulars	CIA (n=35)	GIA (n=35)	RFA (n=35)
Number of programs listed in line departments of the government	43	43	43
Number of programs benefiting per family	6 (14%)	5 (12%)	7 (16%)
Average benefit received (Rs per family per year)	**5039**	**8499**	**7682**

Note: CIA=Canal Irrigation Area, GIA=Ground Water Irrigation Area, RFA=Rain Fed Area.
Source: Soundarya, (2012).

Hardly 16 percent of the government programs initiated by the line departments of the State Government reached the farmers, with an average monetary benefit of rupees 7000 per annum accruing to them.

Farmers with ground water irrigation facilities could reap relatively higher benefit of around rupees 8500 per annum. As seen in Table 4, such a meager monetary benefit from the government scheme could hardly make any dent (less than 2 % of total income) in strengthening the livelihood of farmers.

Conclusions and policy implications

From the foregoing analysis it is evident that agriculture in Karnataka has been recording abysmally poor performance in the cultivation of principal crops. An analysis of cost of cultivation of these crops indicates that agriculture is emerging as not only a high cost venture but also "high labor cost enterprise", eroding seriously, the profitability and livelihood security of farmers in the State. Our agriculture has also become "externally labour dependant" as the hired human and mechanical power has dominated costs in all the crops studied.

The phenomenon of increased cost of cultivation has long been noticed in Indian agriculture, the reason for which has been attributed mainly to the excessive use of external modern agri-inputs like agro-chemicals, energy and so on (Nadakarni, 1988). However, human labor as a cause of serious concern in a labor-surplus country is a recent phenomenon and also disquieting one.

Use of animal labor that had given stability to traditional agrarian system for centuries has been declining over the years. Contrary to expectation, mechanization has failed to be a panacea in reducing the labor costs for the farmers cultivating field crops in Karnataka. This has started compeling them to shift towards perennial commercial crops, impinging upon supply of food grains in the future. This may seriously affect food security in India.

It is found that fourteen out of nineteen principal crops yield negative (loss) or very low return if all the costs are considered. By and large, agriculture couldn't contribute more than half of the average income of majority of farmers in the State. Though dairying has emerged as an important 'buffer' source in sustaining the income and livelihood of farmers, it goes with the holding size. As a result, farmers with higher holding size could derive more income from dairying than the small and marginal farmers. It is also found that the average per capita income of the farmers from agriculture is pitiably low and is hardly enough to lift them above poverty line (of Rs. 12,000 per capita). Even in the case of the big farmers, the total income from all the sources is nowhere close to the state per capita income (of around Rs. 70,000)

Sources of despair to the farmers emanate from various forms 'failures' in the R & D, extension education, government interventions, market and policy issues. These failures are captured in terms of 'gaps' that exist in realizing the potential yield, intervention by the government to provide remunerative prices, markets to pass on fair shares of the consumer's rupee to the producer and the failures on the part of governments to generate adequate income to the farmers.

Even if these gaps are plugged, the additional income that can be realized is barely sufficient to lift half the population above the poverty line. Various policies, programs and measures initiated by the governments could hardly make any dent in this regard. Therefore a thorough overhaul of agrarian policies, with strong institutional reforms coupled with R & D efforts to provide a structural change to the farm sector is required immediately.

Measures needed:

The need of the hour is to address directly the issues of surplus, adequacy and stability of farm income so as to a evolve farmers' income and livelihood centric agricultural development policy paradigm. The measures needed are:

a. Institutional reforms are necessary to generate collective actions through co-operative avenues to overcome the development deadlock created due to small and uneconomical holding sizes. This is essential not only to enhance collective bargaining power of the farmers but also to inculcate the spirit of submerging the personal interests in collective welfare. Earlier system of co-operative farming, emerging group approaches such as the self help groups (SHGs) and prospects of creating farmers' corporations need to be explored thoroughly.

Israel-model of collective farming needs to be assessed thoroughly so as to visualize a new 'institutional entrepreneur' in our agriculture. It should aim at harnessing of the market possibilities in the globalised atmosphere on the one hand and drawing of sufficient government support on the other.

Dr Ashok Mehta, a veteran socialistic thinker and ideologue, constructs his thesis forcibly on co-operative farming not only as a means of emancipation of rural life but also to find the very meaning and purpose of life by engaging in an associative agriculture (Prakash, 2011).

Such an atmosphere of collective existence is so essential to elevate the spirit of our peasantry that is desperately needed to prevent them from putting an end to their precious lives and bringing them out of suicide tendency.

b. Administered pricing and total procurement of most essential agricultural commodities including cereals (wheat, rice, maize, jowar), millets, pulses, potato, onion and a few vegetables and fruit is necessary. Envisage a system, as followed in the case of petro products, of total procurement of these essential food commodities by the government and a decentralized method of distribution involving private bodies, corporate sector, farmers' organizations, workers unions, consumers' societies, NGOs and others. The proposed Food Security Bill, 2011 needs to be reoriented towards this end.

The public sector institutions including commercial banks must ponder over the issue of market intervention not only to benefit the farmers but also for guaranteed recovery of the huge lending that these banks make to promote production of these commodities.

Involvement of corporate bodies and commercial agents in such areas like storage and distribution of food grains so as to benefit the farmers may also enable the government to negotiate with the process of globalization amicably.

c. Measures of strategic importance: Government of Karnataka is in the forefront in bringing about various policies and programs in agriculture. In fact, it was the first state to bring out an exclusive State Agriculture Policy, as early as in 1995. Again, in 2006 the state brought out its "New Agricultural Policy - 2006" followed by a Report of the Official Group of Government of Karnataka for "Improving the Economic Condition of Farmers" headed by Mr. M.R. Srinivas Murthy, Principal Secretary Finance, GoK in 2007. The report focused exclusively on several measures of strategic importance that are likely to have an immediate and widespread impact on the economic conditions of the farmers in the State. Its recommendations aimed mainly at maximizing the incomes of farm households and minimizing risks faced by them by resting on the following programs:

a) Diversification of farming for sustainability.
b) Group farming to enhance viability of small farms
c) Integrated multi-disciplinary extension services including marketing and financial services.
d) Universal access to credit for farmers.
e) Partnership with agri-business firms for value addition and marketing.

The recommendation of the Official Group that the policy thrust of State Government should be on diversification of agriculture with a motto that there shall be "no field with one crop, and no farmer with one income" is a far reaching and radical one.

d. Exclusive focus on labour use in agriculture: Research and Development (R&D) efforts should be strengthened to evolve

technologies that help farmers in not only saving labor but also reducing the costs associated with them especially in field crops. Innovative labor saving machines and equipment will have to be affordable and as well as sustainable and equitable in the long run.

Reinvent animal power as a sustainable source of labor power for agriculture with increased focus on indigenous cattle breeds like Amrithmahal and Khilari that were bred exclusively for draught purposes in different parts of India.

A comprehensive policy is needed to provide timely services of heavy machines such as combiners, harvesters, crushers, etc at an affordable price through custom hiring from farmers' co-operative or self help groups of farmers or by promoting entrepreneurship from among the rural youths with liberal support and subsidy programs. Equally crucial is to enhance the skill and efficiency of agricultural labor to use modern implements, undertake processing, value addition, packing and grading of agricultural commodities.

Self Help Groups of agricultural labors / marginal farmers should be provided training along with finance facilities to acquire tools, tackles and machinery to take up works on 'group contract' basis.

An Index of Farmers' Livelihood Security to be constructed to gauge regularly the changes in income and livelihood status of farmers consequent upon changes in agricultural prices as well as output and non-farm sources of income. The index needs to be constructed preferably at disaggregated levels that encompass a group / community of farmers cultivating a particular crop or belonging to a geographical region or an agro ecological zone of the State. The government's interventions inter alia direct income transfer to be pressed into immediately as and when farmers' livelihood security index goes below the threshold levels, say, the Below Poverty Line.

Set up Farmers' Income Commission with statuary powers in line with the Pay Commission for government employees, immediately so as to plan, enforce and oversee all aspects of income and livelihood security of farmers.

And finally, Supplementary Sources of Income to the farmers need to be created by developing adequate infrastructure along with massive investment in rural areas on the following:

a) Processing and value addition including grading, standardization and packing of agricultural produces.
b) Production and supply of agro-inputs, quality seeds, vermi-composts, bio-fertilizers, bio-pesticides etc.
c) Supply and servicing including custom hiring of machinery and equipments
d) Production, grading, standardization, certification and packing of organic products and products of agro-biodiversity as well as the traditional food items.
e) Promotion of production and sale of village products / handi crafts, cottage and small scale industries, microenterprises and so on that can complement but NOT compete with, agriculture, local environment and rural culture.
f) Restoration of local environment, Common Pool Resources: rehabilitation of tanks, aforestation, watershed development, soil and water conservation.
g) Promotion of eco-tourism, heritage / cultural excursion, local recipe / traditional / organic food hubs in rural areas without damaging local culture and environment.
h) Government should launch a separate Rural Enterprise Mission by emulating the Chinese model of Township and village Enterprises (TVEs) or Japan model of household enterprise to augment farmers' income in Karnataka

In conclusion, it is asserted once again that a new deal needs to be formulated and put into action for the crisis ridden agriculture of the State to accomplish not only an accelerated development of the sector but also for realization of welfare of the farmers with a clear focus on surplus, adequacy and stability of their income . Rather than allowing operation of free and unfettered market forces, more government interventions coupled with institutional reforms are needed in agriculture to break the deadlock and resolve the crisis faced by the farmers. It is hoped that this epistle that made a modest attempt to shed light on these issues would be useful for policy makers, academicians, researchers, farmers organizations and others concerned with the development of agriculture and well being of farmers of Karnataka.

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Appendix I A: Cost of cultivation of principal crops of Karnataka 2009-10

Crop	TC	TVC	TFC	Labour	Physical Inputs	Land costs	ManagerialCost	Others	Total
Paddy	22250	11771	10479	7662	3344	6339	2910	1994	22250
Ragi	9182	5610	3572	4100	1287	1858	1198	739	9182
Maize	13094	7198	5896	4641	2176	3327	1708	1242	13094
Bajra	5895	3568	2327	2543	645	1280	769	658	5895
Jowar	7776	4610	3166	3584	851	1740	1014	587	7776
Wheat	9099	5175	3924	3149	1056	2368	1187	1338	9099
Red gram	9228	4512	4716	2788	1491	3248	1203	498	9228
Bengal gram	8488	4872	3616	3145	1549	2204	1107	483	8488
Green gram	6396	3594	2802	2642	758	1687	834	475	6396
Black gram	8856	4501	4356	3243	1090	2834	1155	535	8856
Horse gram	6769	4037	2732	3451	295	1524	883	616	6769
Soybean	9487	6280	3207	4065	2057	1437	1237	692	9487
Groundnut	8777	5570	3208	3338	2016	1594	1145	684	8777
Sunflower	6047	3968	2079	2538	1255	989	789	476	6047
Safflower	5827	3630	2196	2154	1132	1174	760	608	5827
Sugarcane Planted	45622	24034	21589	11862	8102	12362	6231	7065	45622
Cotton	15153	8170	6984	5233	2829	4258	1976	858	15153
Tobacco	31304	14634	16670	8733	3174	10318	4083	4996.4	31304

Source: Government of Karnataka, Department of Agriculture

Appendix I B: Cost of cultivation of principal crops of Karnataka 2009-10

Crop	TC	TVC	TFC	Labour	Physical Inputs	Land costs	Managerial Cost	Others	Total
Paddy	18346	13126	5219	8441	2647	4808	1668	782	18346
Ragi	10534	7997	2537	5438	1308	1741	958	1088	10534
Maize	9143	6609	2534	4053	1529	2176	831	554	9143
Bajra	3791	3124	667	2186	462	535	345	264	3791
Jowar	5584	4254	1330	3114	453	982	508	527	5584
Red gram	8545	5558	2986	3229	1339	2743	777	458	8545
Bengal Gram	7101	5376	1725	2606	1937	1415	646	497	7101
Green gram	4382	3187	1195	1944	752	966	398	321	4382
Groundnut	8381	6337	2043	3197	2153	1600	762	668	8381
Sunflower	4507	3586	922	2056	950	676	410	416	4507
Safflower	3618	2531	1086	1697	372	831	329	389	3618
Onion	12449	8917	3532	5445	2087	3288	1132	498	12449
Sugarcane	40559	23230	17328	13917	4605	16791	3687	1558	40559
Cotton	10146	7314	2833	4419	1711	2479	922	616	10146

Source: Government of India, Directorate of Economics and Statistics, Ministry of Agriculture.

Appendix II: Labour use pattern in three principle crops of Karnataka 2009-10

Particulars	Cotton						Red gram						Paddy					
	Irrigated			Dry land			Irrigated			Dry land			Irrigated			Dry land		
	Own Labour	Hired Labour	Total	Own Labour	Hired Labour	Total	Own Labour	Hired Labour	Total	Own Labour	Hired Labour	Total	Own Labour	Hired Labour	Total	Own Labour	Hired Labour	Total
I. Labour Use																		
Human Labour (Man days)	16 (28)	41.45 (72)	57.6 (100)	10 (22)	34.45 (78)	44.3 (100)	5.12 (20)	18.34 (80)	23.5 (100)	3.27 (20)	13.22 (80)	16.5 (100)	12.08 (39)	19.17 (61)	31.25 (100)	10 (40)	15 (60)	25 (100)
Animal Labour (Days)	4.16 (74)	1.45 (26)	5.61 100	0.95 (49)	1 (51)	1.96 (100)	1.08 (64)	0.97 (36)	2.05 (100)	1.05 (64)	0.6 (36)	1.65 (100)	2.57 (40)	3.86 (60)	6.43 (100)	2.87 (41.)	4.07 (59)	6.93 (100)
Machine Labour (Hours)	0.02 (13)	0.14 (87)	0.16 (100)	0.48 (29)	1.2 (71)	1.68 (100)	0 (0)	3.12 (100)	3.12 (100)	0.01 (0.36)	2.7 (99)	2.71 (100)	0.80 (17)	3.95 (83)	4.75 (100)	0.24 (5)	4.48 (95)	4.72 (100)

Note: Figures in parenthesis are in percentages

Wage rates: Human labour: Rs. 130 -170/day, Bullock Pair: Rs. 500-700/day, Tractor: Rs. 600-1200/Hour

Appendix III: Labour use for different operations in three principal crops of Karnataka 2009-10

SN	Operation	Cotton						Red gram						Paddy					
		Irrigated			Dry land			Irrigated			Dry land			Irrigated			Dry land		
		HL	AL	ML	HL	AL	ML	HL	AL	ML	HL	AL	ML	HL	AL	ML	HL	AL	ML
1	Land Preparation	6.95	26.69	56.25	6.09	40.82	41.67	3.68	29.38	40.51	7.29	18.18	40	12.98	68.31	57.22	21.24	94.81	63.79
2	Sowing	4.41	31.14	0	4.51	26.02	0	4.21	16	0	6.68	13.33	0	16.58	3.82	0	17.67	0	0
3	Fertilizer & FYM Application	6.95	8.9	15.62	13.53	13.01	23.81	8.42	12.5	12.82	13.37	12.12	20	6.7	14.38	0.54	10.88	3.65	27.8
4	Irrigation/water management	8.69	0	0	0	0	0	9.47	0	9.62	0	0	0	15.01	0	0	8.11	0	0
5	Weeding, thinning & Inter-cultivation	26.06	26.69	0	33.84	19.9	0	28.21	25	0	27.34	24.24	0	32.07	0	0	17.17	0	0
6	Spraying	5.39	0	21.87	8.57	0	29.76	8.42	0	22.05	6.08	0	12	2.16	0	0	2.4	0	0
7	Harvesting & threshing	40.83	4.8	0	33.84	0	0	35.79	15.25	15	36.45	30.3	16	14.04	13.48	42.23	22.54	0	8.41
8	Marketing	0.96	1.78	6.25	0.11	0.71	4.76	1.79	1.88	0	2.82	1.82	12	0.46	0	0	0	1.54	0
9	**Total (%)**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

*HI: Human Labour, AL: Animal Labour, ML: Machine Labour

Note: Directorate of Economics and Statistics (DES), Ministry of Agriculture, Government of India

Agricultural Policy: A Relook

R. S. Deshpande

Initially Indian agriculture policies were aimed at food distribution and then followed by food production and resource management. After stabilising the food production, later policies were focused on pricing, market, insurance and further liberalizing the agriculture sector. Interestingly till 1999, India had no agriculture policy. Whatever existed as agricultural policies were only a few page 'do good' statements. Even the 1999, agricultural policy was more a collection of gobbledegooks and niche phrases, with no suggestions for any concrete policy steps. However, what existed all through is a maze of schemes covering various aspects of agricultural sector. These were designed more as fire-fighting measures. And, many a time our schemes failed at the threshold of implementation. The recommended technologies by the scientific community had little direct connection with the farmers. Therefore, these were all supply push technological interventions with a little demand exiting for them. The diversity and plurality of Indian agriculture is one of the major factors which constrained success and had to be overcome by micro specific policy interventions. To move forward, India needs to take up the good points from our history which include, Land Reform Policy advocated by J C Kumarappa in his Congress Working Committee report as also the reports like Royal Commission on Agriculture or Deccan Riots Commission. We need to learn from these historical documents which provide enough through an 'Error Learning Model'.

We can take the example of crop insurance. Initially, when Dr Rajendra Prasad, the first Agricultural Minister of Independent India presented the Crop Insurance Bill in the parliament, the bill included individual farmer based insurance. Later on, it was felt difficult to administratively implement and the country adopted 'area approach' as against 'individual

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approach' to crop insurance. The failure of 'crop insurance' to reach to most needy is now well documented. Hence what we need to consider seriously is insuring the individual farmers of the country. It is quite simple as number of vehicles in Bangalore city is more than the number of farmers in Karnataka. When we have developed a system of insuring all the vehicles and receiving the insurance claim within 14 days after any accident why we cannot have policy for insuring individual farmers in India? In this direction the individual insurance scheme proposed by Dr Rajendra Prasad can still take effect in the country. This is what I call learning from history.

Marginalisation of the size of operational holdings is considered as one of the major policy issues. There should be strong efforts to organise the small and marginal farmers together as small groups so that their bargaining power in factor market and product market can be strengthened. In such group arrangement, if they buy fertilizers together, the supplier cannot dictate them the prices and if they sell their farm product together, the purchaser cannot under-value their produce.

With reference to innovations in policies we need to address the following four policy platforms:

- Diversity in land and landholdings: Diversity of land refers to the different agro-climatic zones in India like rainfed area, dry land, upland etc and the landholdings include small and marginal and large holdings. Further, (land and landholdings) this diversity should be utilised by making the groups of farmers to work together.
- Diversity in cropping pattern v/s monoculture: India needs to spread risk and optimisation of income through diversification of cropping rather than monoculture. This should be achieved through proper incentives and that will bring down the aggregate risk.
- Diversity of climate: Currently our generation is struggling to adjust to the changing climate, frequent floods and droughts. We need to develop mitigation and amelioration policies in the country. For instance, drought is not a problem it is only a climatic events but the problem is our incapability and unpreparedness to address the issue of drought in the country despite years of experience.

- Adoption of area-specific policy: we need to adopt the area-specific policies in India like utilising the diverse agro-climatic zones and b. taking up the good in past policies.

As discussed earlier some of the important policies and their key points such as Land Reform Policy of 1948 (J C Kumarappa), individual insurance policy, Price Insurance policy need to be integrated in the Indian agriculture policies for the betterment of this sector. We have done precious little to think, draft and provoke serious policy debates in Indian agriculture. We need to proceed towards that end for achieving success.

Innovative Policy Initiatives of Central and State Governments for Promoting Agricultural Developments in India

H. S.Vijay Kumar

It's time we look back at the important policies pursued in agriculture sector in India after independence. Among these some policies such as, Land reforms policy, setting goal for enhancing agriculture production for next 10 or 15 years and the Price policy stand out. In this country farmers know how to grow the crop but they want to know how to make it profitable. The Minimum Support Price (MSP) adopted was found useful only to two and half states in India, Punjab, Haryana, and Western UP. Unfortunately this is not successful in Karnataka because not accompanied by procurement policies. All these policies need to be complimentary to each other and not stand alone.

In India achieving 4% agriculture growth seems to be difficult at the national level. Interestingly many states like Bihar, Jharkhand, UP and Gujarat have achieved this target due to good agriculture policies. In 2011, Karnataka was able to achieve 5.9% growth in agriculture while the national average was only 1.5%.

In India while forming policies, we need to place emphasis on what farmers require in different agro climatic zones. In Karnataka, it was observed waiver of loans is implemented at times but not all farmers can benefit from it. We are good in forming excellent policies/ plans but we often fail during implementation of these plans and policies.

As far as labour policy is concerned we need to bring in second generation reforms**.** Labour availability is more problematic than fertilizer availability. For a farmer, even in his own family, labour is not available. Because of this all the operations are getting delayed and not able to get what he expects at the end. Minimum wages act is not yet in practice that

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is simply a law on paper. In view of this, any policies that must be farmer as well as labour friendly and which can be implemented easily at various levels.

Similarly, any future policy for pricing needs to be farmer's friendly. Price policy should not focus on just announcing the MSP for commodities. Other than major crops all crops should have policy. Stable policy for pricing and procurement is essential in India. Further self triggering mechanism policy for pricing is required. In addition, we need to have sustainable insurance policy for farmers. The comprehensive policy relating all weather, crop, price insurance should be included in this.

With regard to price policy, from 1960 onwards, several policies were implemented by Government of India in one form or other. If we look at MSP and market intervention schemes in India. The market intervention scheme may come from open market operations by Food Corporation India wherever we have to fill the food basket. It started in 1971 where a committee recommended that Indian economy needs about 21 MT of food grains as buffer stock. Today we have close to 80 MT of buffer stock. This has become important from two angles, whether it is supporting the farmers or our consumers that is in terms of Public Distribution System. The State Government has come up with their own policies in terms of distribution of essential commodities at by very low subsidised prices. The MSP has been successful only in few States like Punjab, UP and Haryana. For the simple reason that whatever produced in these States is contributed to food basket of our country. Where as in other states if we look at the research studies like what is marketable surplus of the food commodities, doesn't exceed 30 to 35 %. Which means about 60% of food produced is detained by the farmers themselves. When we talk about pricing policy, question is how far it penetrates into our farming system.

Similarly, in the case of policies related to land tenure, India had series of land reform measures. In Karnataka Government under late Shri. Devaraj Urs was a forerunner in state in implementing land reforms. In 1977, the land was acquired and handed over to landless. The principle is: the tiller is the owner of land. This to a large extent changed the social fabric of farming in Karnataka. West Bengal, Maharashtra, Andhra Pradesh also

did well. But unfortunately what happened was that farmers were given ownership of land but resources for tilling land were not accompanied. They did not have money to till, to buy fertilisers and seeds for cultivation. As a result most of the land given to farmers was left fallow during the first ten years of the reforms. In those days we were not talking of converting agriculture land to non agriculture lands. But the unfortunate thing is complementing policies were not available, only during mid 90s we started implementing by those policies. The land reforms policy can be into 4 phases. The Urban Land Policy in 1983 introduced by Shri Ram Jethmalani then Union Minister for Urban Affairs and Employment and he was the one who said that India's land reforms and land ceiling act must change. If you want to bring in cooperatisation of farming we have to bring in changes in these acts. We have to bring in liberal policies where the cooperates or even farmers can come together to form cooperates in own any amount of land and make farming a viable operation. The basic problem in farming is that the farming has become unviable because of small holdings and fragmented holdings. The solution to this is farmers making cooperate bodies without losing their land title work together and participate in production of specific crops. When co-operative organisations purchases or sell in bulk, then their bargaining power would improve in the market. This is what is lacking with farmers and basically we have to come up with specific policies in this regard.

Coming to labour policy, the Minimum Wages Act has been more in paper than it is practiced. Gone are those days when the labourers in agriculture sector were being paid less or overworked. Today it is the other way round; instead it is the farmers have started complaining that labourers are not working up to their expectation, they don't come for the wages for which they are prepared to and not available during the crucial farm operations time. If we go to any plantation like coconut or arecanut plantations in Kerala, farmers have started thinking about partial mechanisation. Mechanisation is simply not tractorisation, which is suitable for small and marginal farmers. Issues related to labour include inadequate availability of labour and exorbitantly increased wages. These have made our farming operations more unviable than earlier. Currently at least 50% of farmers' earnings is paid to labourers. Now agricultural engineers should come out with those machines/

farm tools which help the farmers in the country. As an example, if we go to areas of paddy cultivation, transplanting takes away atleast 30 % of total labour. If we can save on this we can save at least 20% of the cost of labour. More importantly, the timeline of operation can be followed. Now scientists have come up with paddy transplanter, which can cost around Rs.90,000/- can be owned collectively by 3 or 4 farmers whereas a tractor costs Rs.7 lakh.

Seed policies in India started with 1960's that coincides with High Yielding Variety programme. Seed to be supplied to the farmers need to come from some source so Government started National Seed Corporation of India, State Seed Corporations followed by then State Seed Certification Agencies for good quality seeds to the farmers. So we had many policies and finally come up with National Seed Policy 2002. The private sector is there in agriculture research and public sector through National Agricultural Research System (NARS). The privatised sectors produce seeds with a low volume and high value. For instance like in case of vegetable, if we sell 100gm of Bhendi seeds we can get Rs.4000 where as if we sell one quintal of jowar seed to a farmer you will hardly get Rs.700/-.

The private sector will not concentrate on low volume or high volume seeds, for this we again need National Seed Corporation, State Seed Corporations, agriculture universities, and ICAR institutions. They go in for breeder seed production, foundation seed production and later certified seed production. There is criticism that National Seed Corporation (NSC) has not been able to contribute more than 15% of seed production in the country. We have to think in terms of increasing contribution to seed basket in the country. It is more of a scientific activity than commercial activity .The seed replacement ratio which we try to keep at 30 %, even today it is only at 12%. If we have to reach this 30 % you look at the volume of business. NSC has to increase its volume of operation, whether we have the capacity to do that is a question. The seeds act does bring in a number of restrictions on seeds to private sector, however they are intelligent, they have the scientific staff or this private sector is provided by NARS, so the NARS system is Important. Even today we can see long queues before the Raita Samparka Kendra during sowing season, there are incidences of lathi charges and firing, this is because

farmers' don't get quality seeds which they want to. The demand is quite high and the supply is unable to match the demand of the farmers yet. So we have to expand our operations in seed sector.

Regarding the issues related to water, farmers in irrigated areas often flood their fields with water because water is available in plenty and almost free of cost. Water is available in the Krishna Raja Sagar dam whenever they want they go and pressurise the executive engineer to get the water. Water can be conserved for a longer duration within your area by following drip irrigation techniques which are already available. The Karnataka Government is giving 75 % drip irrigation subsidy to the farmers who are interested in installing this in their fields. When we go to Northern Karnataka the same sugarcane crop is grown differently by conserving the water. In North Karnataka farmer had benefit of irrigation only in the last 20 years. Earlier there was no irrigation facility. Now more than 60% of farmers in North Karnataka adopt drip irrigation method thereby conserving water. It is done for conserving water for longer duration thereby going for a second crop rather than having single crop. The participatory irrigation management system which is called as Water Users Cooperative society is helping in conserving the water in their areas.

In addition to the Insecticides Act 1968, there is fertiliser control order and very recently Government has now changed subsidy policy to a nutrient based policy earlier this was a full fertiliser policy. As far as the fertiliser producers are concerned, only nine major producers are there in India. If we do not absorb some of cost which we incur in production and distribution, if we simply transfer it out to farmers, the farmers have to pay more that they cannot withstand and good production will suffers. Distribution cost is much higher than production as far as fertiliser is concerned because we have to distribute it throughout the country and there are only 9 production centres. Now government is caught in a Catch-22 situation. The Government is needed to reduce the fiscal deficit by reducing the subsidy but if they do that almost one lakh crore is going as subsidy every year and if they withdraw then farmers will stop using fertilisers and our production will suffer. The issue flagged here is subsidies given to the agro inputs and as far as

insecticides are concerned it is a big lobby. Currently insecticides are of 6500 crore industry. Whenever an alternative chemical are suggested, there is a resistance. Similarly other alternative means are through biotechnological options ie., gene transformation, gene expression and gene silencing etc.

Credit policy is equally important issue in Indian agriculture. Now we have a series of measures taken by Central Government as well as State Government but what stands out is the nationalisation of bank after which a series of policies like the Lead Bank Scheme which is still operational, Differential Rate of Interest Scheme, then the onset of rural banks and interestingly now we are going in the backward direction. For instance, now there is suggestion to have rural banks in every district so that we can combine the virtues of cooperative sector and banking sectors. Now we are aware that they cannot remain viable if they just remain rural banks, so within Karnataka we have reduced them from 13 to 4, at all India level they are thinking of only two rural banks, so policies we had were changed from time to time based on experience. We have had most important experience is mounting of Non Performing Assests in the banks. The main question asked is that banks give OTS: One Time Settlement to big industrialists ie., of 500 crores written off. Why don't we give it to farmers? The bankers simply points at Government level, Government come up with a policy we will implement it. Of course the onset of National Bank for Agriculture and Rural Development was a big thing for financing farmers and then now we have credit card scheme, which is a good initiative, ATM farmers will be given a credit limit and they can go to any bank and draw money.

Regarding National Insurance Policy 2000, the Government has to come out with a program which would help the farmers. The credit policy of 2004 in which Mr.Chidambaram, then Finance Minister, Government of India, made an announcement that agriculture credit will be trebled in the next 3 years and they did it as well, now the question is whether they have brought in new borrowers or they have extended credit to existing borrowers. If we increase the number of borrowers the penetration is more but unfortunately the penetration had never increased more than 20%. We expected a 100% increase, but this policy is even continued today. Giving money is not a problem, but whether we

have the capacity policy to end the given money is the question. We need to specify the credit card used for the pay charges for irrigation, land levelling, buying fertilisers, buying seeds. Make an estimate of how much we want, so it is not just credit expansion but the credit absorption policies should go hand in hand with it. The basic objective is not just protection from the prices but it is from the bad effects of consumption. So we have a series of acts which have come in and now we have Food safety and standards Act 2006 which is the mother of all acts. This act should help our farmers to go for good agricultural practices.

Good agricultural practices are important not just in the case of WTO but also important in the case of domestic consumption. Next important policy is tariff policy, which came up for revision in 1995 because we are a signatory of WTO. Now we are trying to reduce our duties on import continuously because we have to meet the obligation and now we are standing at an average of 7.5%, but at the same time we have the liberty of announcing bounded trade policy. One simple example is we are going to impose a tariff of 300 % on edible oils this is our bounded policy but actually we are implementing only 75% but can go up to 300%, such things are happening and because of politics and not due economics criteria. Only tariff measures policy is possible here because free market access is to be granted. Many a times the trade policy is more of a type of flip-flop policy. When price of commodity increases in the market the government restricts import, other-wise the Government will fall in next election whereas when the price crashes in market nothing will happen for the simple reason farmers are not organised to handle this issue. Unfortunately farmers never think alike whereas consumers think alike.

Impact of Economic Reforms on Production and Productivity of Agriculture

H. Basavaraja, T. N. Sachinkumar and S. B. Mahajanashetti

Indian agriculture has undergone tremendous change since independence. The orientation to agriculture has shifted from subsistence agriculture to commercial agriculture. A country with recurring food shortages and dependence on food imports is now not only self sufficient but also a net exporter. Agriculture continues to be a major contributor to the national income, although its share has declined from 50 per cent during independence to 14 per cent in 2012. Nearly two-thirds of the population of the country depends on agriculture for their livelihood and growth of the overall economy depends largely on the performance of this sector.

Our economy remained largely closed until the early 90's. The initiation of economic reforms in 1991 has brought out major changes in the policy frame work. These reforms are broadly classified in to three areas as 1) Liberalization, 2) Privatization and 3) Globalization. Essentially, the reforms sought to gradually phase-out government control of market (Liberalization), privatize public sector organizations (Privatization) and reduce export subsidies and import barriers to enable free trade (Globalization). There was a considerable debate in the country at the time of introducing these reforms. Although no direct reference was made to agriculture, it was argued that new policies like change in exchange and trade policy, devaluation of the currency, gradual dismantling of industrial licensing system and reduction in industrial protection would benefit agriculture trade by turning the terms of trade in favor of agriculture. This in turn was supposed to promote export leading to agricultural growth. The economic reforms period further coincided with the establishment of WTO which made obligatory for the member countries to re-orient their domestic and external trade polices consistent with WTO agreements. Thus the new economic policy

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had to meet the twin objectives of adjusting to the domestic needs and changes in the international scene.

The export-import policy underwent a sea change since 1992; the main feature of the policy was that the trade was made free except for a short negative list of import and exports. The agricultural imports and exports in the country used to be regulated through quantitative restrictions such as quotas and licenses. As result of the new policy most of the quantitative restrictions on the agricultural trade flow have been removed. There was some reduction in tariff and channeling of trade through the Government has been stopped except for export of onions and import of cereals, pulses and edible oil.

The new economic reforms have focused mainly on industry. Nevertheless the agriculture sector has been affected by the reforms through adjustments in exchange rates, which would affect agricultural exports. Many argued that agricultural sector should not be kept outside the purview of the economic reforms for several reasons. India has as strong comparative advantage particularly in high value crops like fruits, flowers, vegetables, basmati rice and cotton.

On the other hand some argued that economic reforms would destabilize the prices and expose Indian markets to the violent fluctuations in the international markets. Some feared that economic reforms would change the crops pattern away from the food crops. It was also feared that the new reforms would result in hike in food grain prices and population below poverty line cannot afford to buy adequate food grains and thus jeopardize the food security. In the light of these issues it is important to examine the impact of economic reforms on production and productivity of the major agricultural commodities in the country. Therefore, the objective of this paper is to analyze the changes in the production and productivity of major agricultural commodities due to economic reforms.

Impact analysis is a systematic examination of short term and long term implications of economic reforms on production, productivity and composition of different agricultural commodities. The effects may be positive or negative, intended or unintended, short term or long term. Such an analysis helps

better understanding of the extent and magnitude of the effects. Choosing appropriate methodology for impact analysis is an important component of the analysis.

There are essentially two approaches to impact analysis. 1) Impact parameters are compared before and after the economic reforms and 2) Impact parameters are compared with and without economic reforms. Some researches may employ a combination of both, depending upon the seriousness of the analysis, availability of time and cost. In this analysis, the production and productivity of major crops during pre-economic reforms period are compared with those during post economic reforms period. The percentage changes, coefficient of variation around the trend and compound growth rates were computed and compared to analyze the impact of economic reforms on production and productivity of major crops. The time series data on area, production and productivity of major crops for the period from 1974-75 to 2009-10 was used for the analysis. The study period is divided in to two sub periods as 1974-75 to 1991-92 (pre economic reforms period) and 1992-93 to 2009-10 (post economic reforms period).

Although the economic reforms in the country were initiated in June 1991, the process of liberalization, privatization and globalization was implemented gradually and it would be difficult to assess the full impact of these reforms. Nevertheless, an attempt is made to discuss the impact of these measures in terms of agricultural production and growth.

Impact of economic reforms on food grain production

The average area under food grain (Table 1) during the pre reforms period was 126.29 million hectare whereas the same during the post reforms period was 122.29 million hectare. Thus, there was a reduction in the area under food grains. The area under food grains decelerated at a mild annual rate of -0.02 per cent. It was interesting to note the rate of deceleration was slightly more during post reforms period. The area under rice and wheat which are the two major cereals of the country recorded a positive growth. The rate of growth in area under these two crops was however slightly less during the post reforms period when compared to that in pre reforms period. Maize was another cereal which registered a substantial positive growth during the post reforms period.

Table 1: Growth in area under food grains

Crops	Area (Million hectares)				CGR		
	Pre ER	Post ER	Over all	% change	Pre ER	Post ER	Over all
Total food grains	126.29 (2.35)	122.29 (2.00)	124.29 (2.25)	-3.17	-0.02	-0.06	-0.14
Rice	40.44 (2.43)	43.39 (2.92)	41.91 (3.89)	7.28	0.50	0.09	0.30
Wheat	22.56 (4.41)	26.50 (2.88)	24.53 (3.70)	17.46	1.01	0.60	0.80
Coarse cereals	40.12 (2.91)	29.98 (3.40)	35.05 (3.96)	-25.29	-0.10	-9.52	-1.00
Jowar	15.70 (5.00)	9.91 (9.73)	12.81 (7.14)	-36.84	-0.90	-2.96	-2.37
Bajra	10.98 (6.65)	9.49 (6.55)	10.23 (6.70)	-13.55	-0.50	-0.50	-0.70
Maize	5.85 (2.12)	6.88 (3.62)	6.37 (7.10)	17.75	-0.40	2.12	0.90

Figures in the parenthesis indicate the respective coefficient of variation around the trend

Pre Economic Reforms (1974-75 to 1991-1992), Post Economic Reforms (1992-93 to 2009-10) Overall (1974-75 to 2009-10)

It was interesting to note that jowar, bajra and coarse cereals registered a negative annual growth rates in both the periods. However the rate of deceleration was much faster during the post reforms period. The production of the food grains was increased at an annual rate of 2.02 per cent (Table 2) during pre reforms period while it increased at 1.21 per cent during post reforms period. The production of all the major cereals barring jowar registered positive annual growth during pre and post reforms periods. However, the rate of growth in production was much higher during pre reforms period as compared to that of post reforms period with an exception of maize.

The productivity of food grains (Table 3) recorded a positive annual growth rates during pre as well as post reforms period. However, the productivity growth was much higher during pre reforms period for most of the cereals. The productivity of

rice and wheat grew at around 3 per cent per annum during pre reforms period while, the productivity growth was around only one per cent during post reforms period. Thus the growth in the food grain production in the country was a result of the growth in productivity. In fact the area under food grains has registered a negative growth.

Table 2: Growth in production of food grains

Crops	Production (Million tonnes)				CGR		
	Pre ER	Post ER	Over all	% change	Pre ER	Post ER	Over all
Total food grains	139.46 (6.42)	202.55 (5.24)	171.01 (6.21)	31.15	2.02	1.21	2.02
Rice	56.99 (8.15)	85.77 (6.33)	71.38 (8.07)	33.56	3.36	1.11	2.33
Wheat	41.08 (5.25)	70.14 (5.35)	55.61 (6.78)	41.43	4.50	1.51	3.05
Coarse cereals	29.45 (9.28)	33.13 (10.20)	31.29 (9.94)	11.12	0.20	0.90	0.60
Jowar	10.92 (11.19)	8.35 (12.73)	9.64 (13.61)	-30.73	-0.17	-18.13	-1.49
Bajra	5.35 (24.66)	7.55 (22.78)	6.45 (23.65)	29.10	1.11	1.51	19.48
Maize	7.14 (12.37)	12.94 (9.69)	10.04 (15.11)	44.81	2.12	4.19	3.25

Figures in the parenthesis indicate the respective coefficient of variation around the trend

Pre Economic Reforms (1974-75 to 1991-1992), Post Economic Reforms (1992-93 to 2009-10) Overall (1974-75 to 2009-10)

Impact of economic reforms on pulse production

There was no substantial change (Table 4) in the area under pulses in the country during the study period. The pulse area appeared to grow at a very mild rate during both pre and post reforms period. Bengal gram recorded a positive growth of 0.60 per cent per annum during post reforms period from a negative growth rate during pre reforms period. The rate of growth in the area under tur was no doubt positive but was much less during the post reforms period when compared to that in the pre reforms period.

Table 3: Growth in productivity of food grains

Crops	Productivity (Kg/ha)				CGR		
	Pre ER	Post ER	Over all	% change	Pre ER	Post ER	Over all
Total food grains	1103.92 (4.99)	1655.77 (3.74)	1379.85 (5.15)	49.99	3.05	1.21	2.22
Rice	1402.20 (6.72)	1975.12 (4.30)	1688.66 (6.15)	40.86	2.74	1.01	1.92
Wheat	1804.12 (4.11)	2641.72 (3.54)	2222.92 (5.90)	46.43	3.36	0.80	2.12
Coarse cereals	736.98 (8.34)	1110.30 (8.45)	923.64 (9.46)	50.66	1.41	2.02	2.12
Jowar	696.50 (9.63)	844.85 (10.63)	770.68 (10.81)	21.30	0.70	0.16	0.90
Bajra	485.50 (20.82)	791.87 (17.37)	638.69 (19.46)	63.10	1.61	2.12	2.53
Maize	1220.50 (11.00)	1863.15 (7.11)	1541.83 (8.77)	52.65	2.12	1.92	2.22

Figures in the parenthesis indicate the respective coefficient of variation around the trend

Pre Economic Reforms (1974-75 to 1991-1992), Post Economic Reforms (1992-93 to 2009-10) Overall (1974-75 to 2009-10)

Table 4: Growth in area under pulses

Crops	Area (Million hectares)				CGR		
	Pre ER	Post ER	Over all	% change	Pre ER	Post ER	Over all
Total Pulses	23.16 (3.83)	22.42 (4.25)	22.79 (4.16)	-3.20	0.02	0.01	-0.11
Gram	7.16 (8.25)	6.99 (11.41)	7.07 (10.97)	-2.37	-1.19	0.60	-0.18
Tur (Arhar)	3.05 (2.77)	3.48 (3.15)	3.27 (6.28)	14.10	2.22	0.10	0.80
Lentil (Masur)	1.00 (5.37)	1.37 (5.86)	1.19 (5.97)	37.00	1.61	1.11	1.61

Figures in the parenthesis indicate the respective coefficient of variation around the trend

Pre Economic Reforms (1974-75 to 1991-1992), Post Economic Reforms (1992-93 to 2009-10) Overall (1974-75 to 2009-10)

Gram and tur are the major pulses grown in the country. The total pulse production increases from 11.95 million tonnes during pre reforms period to 13.51 million tonnes during the post reforms period (Table 5). Most part of this increase came from gram. The annual rate of growth in pulse production during post reforms period was less by about half of that during pre reforms period. The decelerating annual growth in the production of gram in the pre reforms period was turned out to be a positive growth during post reforms period. The annual growth in the tur production was much low during post reforms period when compared to that during pre reforms period.

Table 5: Growth in production of pulses

Crops	Production (Million tonnes)				CGR		
	Pre ER	Post ER	Over all	% change	Pre ER	Post ER	Over all
Total Pulses	11.95 (10.20)	13.51 (8.20)	12.73 (9.07)	13.05	1.01	0.50	0.70
Gram	4.79 (15.40)	5.63 (15.46)	5.21 (16.32)	17.54	-0.50	1.31	0.77
Tur (Arhar)	2.20 (10.29)	2.42 (11.67)	2.31 (11.97)	10.00	2.02	0.30	0.70
Lentil (Masur)	0.56 (11.54)	0.90 (9.89)	0.73 (11.89)	60.71	4.60	1.21	2.84

Figures in the parenthesis indicate the respective coefficient of variation around the trend

Pre Economic Reforms (1974-75 to 1991-1992), Post Economic Reforms (1992-93 to 2009-10) Overall (1974-75 to 2009-10)

The productivity of pulses in general and gram in particular was slightly better during post reforms period (Table 6). However tur registered a mild fall in the productivity. The growth rate of productivity of pulses during pre reforms period was 1.01 per cent per annum, while that during post reforms period was 0.30 per cent per annum. Contrary to this the performance of gram and tur in terms of their productivity was better during post reforms period.

Table 6: Growth in productivity of pulses

Crops	Productivity (Kg/ha)				CGR		
	Pre ER	Post ER	Over all	% change	Pre ER	Post ER	Over all
Total Pulses	514.83 (7.53)	601.90 (5.48)	558.37 (6.59)	14.47	1.01	0.30	0.80
Gram	667.94 (9.90)	802.49 (6.72)	735.22 (8.23)	16.77	0.60	0.70	0.90
Tur (Arhar)	721.56 (8.22)	695.34 (10.09)	708.45 (9.18)	-3.77	-0.20	0.20	-0.15
Lentil (Masur)	548.89 (8.06)	659.50 (6.78)	604.19 (9.99)	16.77	2.94	0.10	1.21

Figures in the parenthesis indicate the respective coefficient of variation around the trend
Pre Economic Reforms (1974-75 to 1991-1992), Post Economic Reforms (1992-93 to 2009-10) Overall (1974-75 to 2009-10)

Impact of economic reforms on oil seeds production

The average area under oil seeds during post reforms period was higher by about 6.23 million hectares (Table 7). Most of this increased area has come from the increase in the area under soybean. It was interesting to note that the area under total oil seeds in general, soybean, sunflower, rapeseed and mustard and groundnut in particular recorded a positive growth in area during pre reforms period but during post reforms period the area under groundnut, rapeseed and mustard and sunflower recorded negative annual growth rate.

There was a substantial increase (10. 76 million tonnes) in the average annual production (Table 8) of total oil seeds. The increase in the production of soybean, rapeseed and mustard and sun flower contributed to the increased oil seeds production in the country. The annual compound growth rate in the production of total oil seeds in general and soybean and sun flower in particular were positive during pre reforms period. The production of groundnut and sunflower decelerated during post reforms period. Only the production of soybean recorded the high positive growth rate (5.5 % per annum) during the post reforms period.

Table 7: Growth in area under oilseeds

Crops	Area (Million hectares)				CGR		
	Pre ER	Post ER	Over all	% change	Pre ER	Post ER	Over all
Total oilseeds	19.27 (6.70)	25.50 (7.11)	22.39 (8.69)	32.33	2.22	0.18	1.41
Groundnut	7.46 (6.44)	6.80 (5.49)	7.13 (10.15)	-8.85	1.01	-2.08	-0.50
Rape seed & Mustard	4.19 (11.95)	6.10 (13.64)	5.14 (15.83)	45.58	3.05	-0.29	1.92
Soybean	1.08 (25.51)	6.60 (6.97)	3.84 (16.25)	511.11	23.37	4.92	12.75
Sunflower	0.74 (39.12)	1.86 (21.66)	1.30 (36.19)	151.35	15.02	-0.70	7.25

Figures in the parenthesis indicate the respective coefficient of variation around the trend

Pre Economic Reforms (1974-75 to 1991-1992), Post Economic Reforms (1992-93 to 2009-10) Overall (1974-75 to 2009-10)

All the oil seed crops registered a better productivity during post reforms period (Table 9). The productivity growth rate was positive for total oil seeds as well as all for the individual oil seed crops. Thus the increased production in oil seeds has come from the increased productivity of all the oil seed crops.

Table 8: Growth in production of oilseeds

Crops	Production (Million tonnes)				CGR		
	Pre ER	Post ER	Over all	% change	Pre ER	Post ER	Over all
Total oil-seeds	12.26 (14.94)	23.02 (13.49)	17.64 (15.15)	87.77	4.29	1.41	3.46
Groundnut	6.41 (16.17)	7.19 (19.163)	6.80 (19.66)	12.17	1.82	-1.49	0.40
Rape seed & Mustard	2.87 (22.19)	5.94 (17.38)	4.40 (20.06)	106.97	7.04	1.71	4.39
Soybean	0.84 (39.95)	6.76 (15.51)	3.80 (28.39)	704.76	23.00	5.55	13.88
Sunflower	0.36 (50.11)	1.07 (24.28)	0.71 (37.19)	197.22	12.75	-0.18	7.68

Figures in the parenthesis indicate the respective coefficient of variation around the trend

Pre Economic Reforms (1974-75 to 1991-1992), Post Economic Reforms (1992-93 to 2009-10) Overall (1974-75 to 2009-10)

Table 9: Growth in productivity of oilseeds

Crops	Productivity (Kg/ha)				CGR		
	Pre ER	Post ER	Over all	% change	Pre ER	Post ER	Over all
Total oilseeds	626.33 (9.61)	899.53 (9.39)	762.93 (9.69)	43.62	2.02	1.29	1.92
Groundnut	854.94 (11.76)	1056.84 (17.34)	955.89 (15.36)	23.62	0.80	0.50	1.21
Rape seed & Mustard	659.11 (12.29)	974.32 (9.68)	816.72 (11.23)	47.82	3.77	1.92	2.43
Soybean	791.28 (18.05)	1014.87 (11.90)	903.07 (16.11)	28.26	-0.60	0.50	1.01
Sunflower	510.61 (15.25)	578.29 (10.99)	544.45 (10.16)	13.25	-1.88	0.53	0.38

Figures in the parenthesis indicate the respective coefficient of variation around the trend

Pre Economic Reforms (1974-75 to 1991-1992), Post Economic Reforms (1992-93 to 2009-10) Overall (1974-75 to 2009-10)

Impact of economic reforms on commercial crops production

Cotton and sugarcane are the major commercial crops grown in the country. There was an increase in the area under these two crops during the post reforms period (Table 10). The growth in area under cotton which was negative (-0.20 % per annum) during pre reforms period but turned out to be positive during post reforms period. The growth in area under sugarcane was similar during pre as well as post reforms period. The area under tobacco and jute and mesta appeared to decline during pre and post reforms period.

Cotton registered a high annual growth rate in production of 4.7 per cent during post reforms period against 2.2 per cent per annum during pre reforms period (Table 11). The annual growth rate in the production of sugarcane was no doubt positive during post reforms period but was much less when compared to that during pre reforms period.

The productivity of cotton has improved during the post reforms period and the annual growth rate was 3.67 per cent (Table 12). Thus the increased cotton production in the country during post reforms period has come from increased area

and increased productivity during post reforms period. The productivity growth of sugarcane which was 1.51 per cent per annum during pre reforms period turned out to be negative during post reforms period. The increased sugarcane production in the country has come mainly from the increased area under sugarcane during post reforms period.

Table 10: Growth in area under commercial crops

Crops	Area (Million hectares)				CGR		
	Pre ER	Post ER	Over all	% change	Pre ER	Post ER	Over all
Cotton	7.54 (5.92)	8.68 (7.43)	8.11 (7.71)	15.12	-0.20	0.90	0.60
Jute and Mesta	1.10 (14.35)	0.98 (7.13)	1.04 (11.43)	-10.91	-0.30	-0.30	-0.50
Sugarcane	3.08 (6.45)	4.18 (8.45)	3.65 (7.13)	35.71	1.41	1.21	1.51
Tobacco	0.42 (10.60)	0.39 (13.79)	0.40 (11.89)	-7.14	-0.30	-0.50	-0.44

Figures in the parenthesis indicate the respective coefficient of variation around the trend

Pre Economic Reforms (1974-75 to 1991-1992), Post Economic Reforms (1992-93 to 2009-10) Overall (1974-75 to 2009-10)

Table 11: Growth in production of commercial crops

Crops	Production (Million tonnes)				CGR		
	Pre ER	Post ER	Over all	% change	Pre ER	Post ER	Over all
Cotton	7.71 (13.79)	14.86 (23.77)	11.34 (26.89)	92.74	2.22	4.71	3.36
Jute and Mesta	7.94 (15.86)	10.44 (7.08)	9.25 (11.43)	31.49	2.02	1.41	1.01
Sugarcane	176.06 (8.52)	281.84 (10.81)	231.12 (11.34)	60.08	3.05	1.11	2.43
Tobacco	0.47 (11.58)	0.55 (16.20)	0.51 (15.65)	17.02	1.61	-0.60	1.71

Figures in the parenthesis indicate the respective coefficient of variation around the trend

Pre Economic Reforms (1974-75 to 1991-1992), Post Economic Reforms (1992-93 to 2009-10) Overall (1974-75 to 2009-10)

Table 12: Growth in productivity of commercial crops

Crops	Productivity (Kg/ha)				CGR		
	Pre ER	Post ER	Over all	% change	Pre ER	Post ER	Over all
Cotton	174.00 (10.92)	287.50 (21.75)	231.92 (21.71)	65.23	2.53	3.67	2.63
Jute and Mesta	1306.82 (6.18)	1929.78 (3.50)	1628.17 (4.97)	47.67	2.43	1.71	2.12
Sugarcane	56906.24 (3.80)	67379.28 (4.75)	62397.28 (6.16)	18.40	1.51	-0.10	0.80
Tobacco	1121.59 (4.06)	1416.59 (7.25)	1275.96 (8.22)	26.30	2.02	-0.05	1.11

Figures in the parenthesis indicate the respective coefficient of variation around the trend

Pre Economic Reforms (1974-75 to 1991-1992), Post Economic Reforms (1992-93 to 2009-10) Overall (1974-75 to 2009-10)

The results presented so far indicated that the area under most of the crops registered an increase during the post reforms period compared to that during pre reforms period. However, the area under jowar, bajra, coarse cereals and groundnut registered a decrease. The production of food grains except bajra, oil seeds, pulses and commercial crops has registered an increase during the post reforms period. The productivity of all the crops also registered a positive growth. However, the rate of growth in productivity of food grains, pulses, oil seeds and commercial crops was generally low as compared to the productivity growth of these crops during pre reforms period.

The production of food grains grew at the rate of 1.21 per cent per annum during post reforms period against 2.02 per cent per annum during pre reforms period. Some of the important reasons for the slow growth in food grains production during post reforms period are that there was no major breakthrough in the development of new high yielding verities during this period which was evident from the productivity analysis and in some cases marginal lands have brought under cultivation which has reduced the marginal productivity of strategic inputs like fertilizers and improved seeds. Due to the fact that rice and wheat are distributed through public distribution system, the demand for jowar, bajra and other coarse cereals has reduced

and their prices remained almost stagnant. As a result the area, production and productivity of these crops have declined during the post reforms period. Further rice in general and basmati rice in particular found a place in the export basket of India which has resulted in higher production and productivity during the post reforms period.

There was no much change in the scenario of pulse production in the country. There was a marginal increase in the production of total pulses in general and gram and tur, the two major pulses in particular. The productivity growth was also not much encouraging. The growth in oilseeds production during the post reforms period was also not encouraging. The only notable impact in oil seed production was that there was a substantial increase in the area under soybean which contributed for the increased production of oil seeds. The introduction of technological mission on oil seeds has helped to reduce the fluctuation in production of oil seeds during post reforms period.

The increased area under sugarcane and cotton has contributed for the increased production of these two crops during the post-reforms period. Cotton production has increased at a phenomenal rate of 4.71 per cent per annum which was mainly due to the positive growth in the productivity (3.6 % per annum). In general it was noticed that the input subsidies during post reforms period has increased. However, the benefits of these subsidies have accorded to only certain classes of farmers in some regions cultivating irrigated crops. Further, highly subsidized prices of inputs such as irrigation water and electricity have encouraged cultivation of water intensive crops which has resulted in over use of water and ground water depletion in many areas. Subsidy for nitrogen has resulted in imbalances in the nutrient supply and discouraged the use of organic manures.

Conclusion

The analysis indicated that the agricultural sector has started responding to economic reforms initiated in the country. The crop pattern is getting diversified with a shift away from food grains crops towards high value, in some cases export oriented, crops. This has implications for food security in the country. The growth rate in food grain production in the post economic reform period has slowed down. This development

is depressing when viewed in the light of existing nutritional intake and future demand for food grains. There was a significant change in cropping patterns during post reforms period, both in terms of area allocation and share in total output. The most important change was a significant decline in the share of area under coarse cereals and an increase in the share of area under higher value crops brought about because of changes in relative prices and productivity. During the post reforms period the shifts occurred mainly towards plantation and condiments and spices, and towards remaining crops have continued. The diversification towards oilseeds has slowed down considerably. In short, economic reforms and trade liberalization have failed to hasten the process of diversification in agriculture.

Policy Measures for Revitalizing Indian Agricultural Research

Nirmalya Bagchi

Food prices in India have risen considerably amidst high degree of volatility in the last five years. One of the long term solutions to control food price volatility and reduce the gap between supply and demand is to reengineer the agricultural R&D and innovation engine in India to make it more robust. Today a National Agriculture Research System (NARS) exists in the country which is a collaboration of national and state level R&D organizations and State Agricultural Universities (SAU). This system is the core of the innovation engine in agriculture in the country. In the past, this system has had some remarkable successes like hybrid development and technologies for higher milk, meat, poultry, and fish production. However, more is expected from the research and innovation engine. This paper proposes a set of policy measures that are required for improving the productivity of agricultural research and innovation in the years to come.

After two decades of relative neglect, agriculture is back in focus in India. The immediate trigger is of course, rising food prices, which globally, have shown considerable rise and volatility in the last five years (OECD, 2011; Huchet-Bourdon, 2011; Martini, 2011). Several domestic factors are responsible for this high food price inflation and are causing concerns for policy makers. The long term solution to this problem is innovation and greater research output from our agricultural institutions. Higher research output will result in solution of many supply sides and also demand side issues in the longer term. Even though India has a rich tradition of good quality R&D in agricultural sciences, its productivity in recent years has not been able to keep pace with the fast changing dynamics of the economic environment in the country. The research establishment needs to develop a lot more varieties of seeds, more pest resistant crop varieties, new farming equipments, better cropping techniques, etc. Than it is

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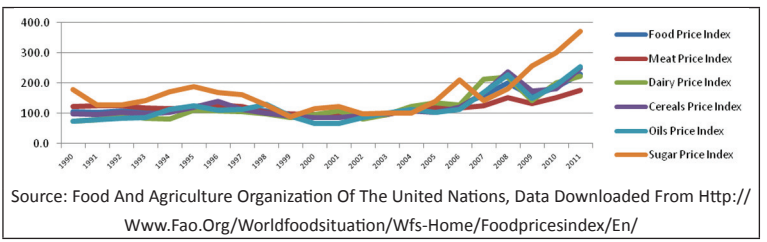
developing at the present to enable the country to achieve 4% growth in agriculture as envisaged by the government.

The context

Even though India is to an extent insulated from global food price shocks, several factors are causing high inflation of food prices.

High global and domestic food price inflation

Unlike the global food crisis of 2007-08, this time in 2011, food inflation is high in India. Figure 1, given below is a plot of the global food price indices for the last 21 years. It shows the two spikes in prices in 2007-08 and in 2011. In fact, almost all the indices have more than doubled in the last five years.



Source: Food And Agriculture Organization Of The United Nations, Data Downloaded From Http://Www.Fao.Org/Worldfoodsituation/Wfs-Home/Foodpricesindex/En/

Figure 1: Annual food price indices (2002-04=100) over time

The situation in India is no different even though India is somewhat insulated from global food price shocks and follows a policy of controls on food price. The issue of food inflation is now being given very serious attention at the highest level in the government. An Inter-Ministerial Group (IMG) on inflation was constituted on 2nd February, 2011. On the basis of research carried out at the behest of the IMG and under the supervision of the chairman of IMG, two important issues have been highlighted. One relates to the issue of high margin between farm gate prices and retail price and the other relates to the creation of enabling competitive environment at the local level to stop cartelization by reforming the Agricultural Produce Market Committees (APMC) act.

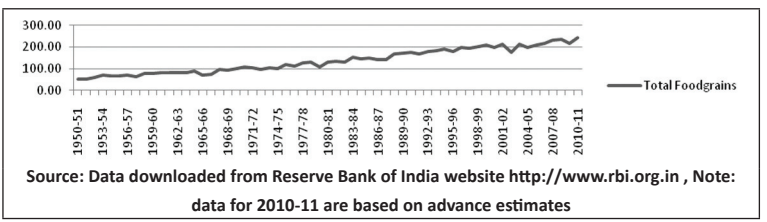
India has been self sufficient in meeting its food demands since the days of the "Green Revolution" in the 1960's and agriculture still accounts for 13.9 percent (at 2004-05 prices) of the GDP of the country (Government of India 2012) and employs around half of its population[1] (Government of India 2011)

[1] 58% of the population according to Census 2001

and hence it remains a very important sector for the country. However, the long term outlook for this sector does not look good. The analysis of official data shows that the growth rates of production of key food-grains in India have declined with each passing decade since the 1950's. In fact, the growth rate of wheat and rice production has reached below 1% in the 2000's, which is a cause for concern.

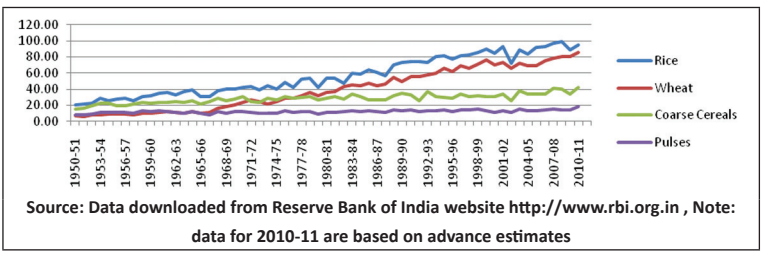
Domestic factors that drive food price inflation

The official data show that the growth rate of food grain production is going down over time (Figure 2 and Figure 3), area under cultivation (Figure 4 and 5) and yield (Figure 6) is going down, while population is rising exponentially (Figure 7) and poverty rates are dropping (Figure 8). While fertilizer consumption is going up (Figure 9), irrigation projects are limited. These factors are together creating an impact on demand and supply that is leading to food price inflation. The long term solution to these issues is to reengineer the R&D and innovation engine in agriculture in India to make it more robust so that it can deal with these problems in the years to come.



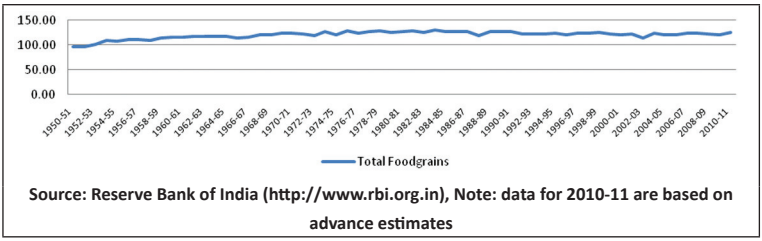
Source: Data downloaded from Reserve Bank of India website http://www.rbi.org.in , Note: data for 2010-11 are based on advance estimates

Figure 2: Total food grains production from 1950-51 to 2010-11 (in million tonnes)



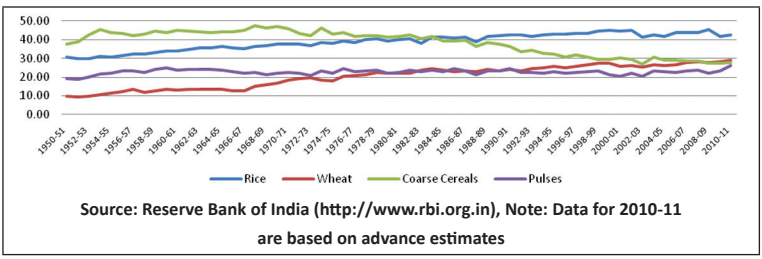
Source: Data downloaded from Reserve Bank of India website http://www.rbi.org.in , Note: data for 2010-11 are based on advance estimates

Figure 3: Key food grain production in India from 1950-51 to 2010-11 (in million tonnes)



Source: Reserve Bank of India (http://www.rbi.org.in), Note: data for 2010-11 are based on advance estimates

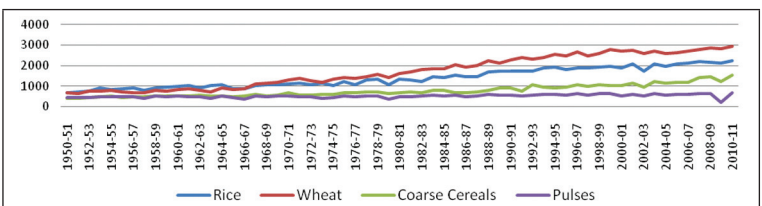
Figure 4: Area under food grains cultivation from 1950-51 to 2010-11 (in million hectares)



Source: Reserve Bank of India (http://www.rbi.org.in), Note: Data for 2010-11 are based on advance estimates

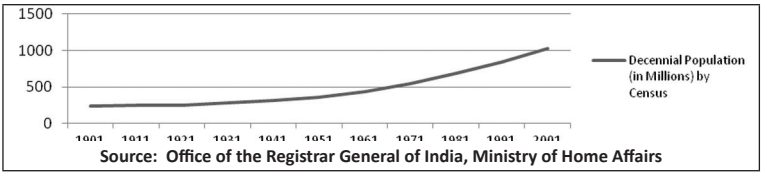
Figure 5: Area under food grains cultivation from 1950-51 to 2010-11 (in million hectares)

Figure 4 shows the plot of the total area under food grains cultivation in the last 60 years. It is evident that in 50′s and 60′s the area under food gains cultivation increased rapidly and then stagnated in the late 70′s in the 80′s and 90′s there is a decline and again stagnation in 2000′s. Figure 5 shows the area under cultivation for the four major food gains in the last 60 years. As is evident from the figure, the area under cultivation for coarse cereals has been steadily declining since the 70′s till date. The yield of food grain in the last 60 years is shown in figure 6.



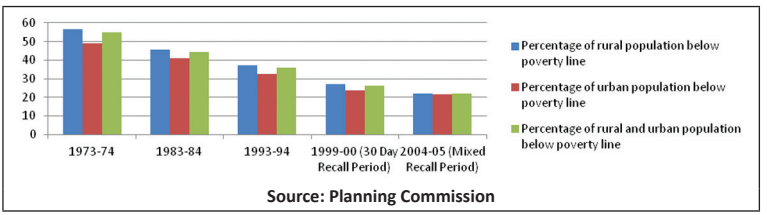
Source: Data downloaded from Reserve Bank of India website http://www.rbi.org.in , Note: Data for 2010-11 are based on advance estimates

Figure 6: Yield of key food grains per hectare from 1950-51 to 2010-11 (in kg/hectare)



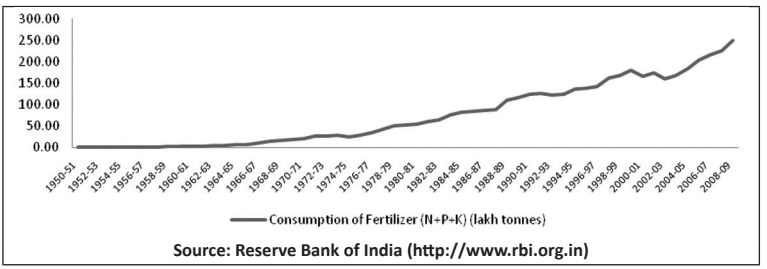
Source: Office of the Registrar General of India, Ministry of Home Affairs

Figure 7: Decennial population of India



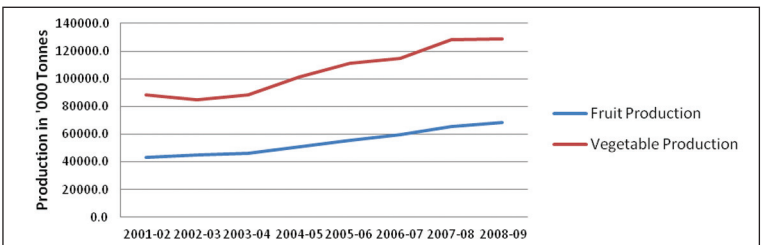
Source: Planning Commission

Figure 8: Percentage of people below the poverty Line



Source: Reserve Bank of India (http://www.rbi.org.in)

Figure 9: Consumption of fertilizer in India from 1950-51 to 2008-09



Source: Ministry of Statistics and Programme Implementation, data downloaded from http://mospi.nic.in/mospi_new/site/india_statistics.aspx?status=1&menu_id=14

Figure 10: Production of vegetables and fruits from 2000-01 to 2008-09

A brief overview of the structure of agricultural research and higher education in India

Research efforts in agriculture began in India with the establishment of a few organizations in end 19th century under the British Raj. Today a National Agriculture Research System (NARS) exists in the country which is a collaboration of National and State level R&D organizations and State Agricultural Universities (SAUs). This system is the core of the research and innovation engine in agriculture in the country and in the past, this system has had successes like hybrid development in number of fields and horticultural crops, technologies for higher milk, meat, poultry, and fish production.

Indian Council of Agricultural Research (ICAR) is the apex organization of centrally funded Agricultural Research Institutes in India. Agricultural universities have also been set up in all the states. At the time of independence India had only 17 agricultural colleges. The country now has 45 ICAR institution devoted to research, 17 National Research Centres, 60 State Agricultural Universities (SAUS) conducting both research and education, 6 National Bureau, and 25 Directorates. There are 5 institutions with deemed university status. Four Central Universities have departments in agricultural sciences and there is one exclusive Central Agricultural University. About 620 colleges impart agricultural and related education. The existing education system produces approximately 24,000 graduates per year. The objective of agricultural education in these Institutions is to create trained research and extension professionals. The agricultural education system also produces 7,000 diploma holders annually. According to a study conducted by National Academy of Agricultural Research Management, Hyderabad in 2011, on assessment of future human capital requirement, only four percent of people trained in the agricultural education system go for research or a career in academics. The future requirements of human resource as worked out in the aforementioned study are given in table 1.

Table 1: Human resource, by education level in 2010 (actual supply) and 2020 (projected requirements)

	UG		PG		Phd		Total	
	2010	2020	2010	2020	2010	2020	2010	2020
Manpower	17316	40188	5553	10638	920	2805	23788	53630

Source: Report on Human Capital Requirements in Agriculture and Allied Sectors, 2011

In keeping with this tradition of policy research, the first step in this study was analysis of data from various sources including comparison of the Indian scenario with similar countries like Brazil, China and South Africa. This gave some preliminary insights into the issues plaguing agricultural research in India.

The data sources for the study were:

1. Agricultural Science and Technology indicators (data downloaded from http://www.asti.cgiar.org/data/)
2. Food and Agricultural Organization (data downloaded from http://www.fao.org/corp/statistics/en/)
3. Agricultural Research Data Book 2011 (published by Indian Agricultural Statistics Research Institute. Data downloaded from http://www.iasri.res.in/agridata/11data/home_11.html)
4. Agricultural Statistics At A Glance 2011 (downloaded from the website of the Directorate of Economics and Statistics, Department of Agriculture and Cooperation from the url - http://eands.dacnet.nic.in/latest_2006.html)
5. Reserve Bank Of India (downloaded from http://www.rbi.org.in)
6. Planning Commission
7. Office of the Registrar General of India, Ministry of Home Affairs.

Following the data analysis, a draft set of issues and possible policy measures to address them was prepared. This was then discussed with the top functionaries in the government. Following these meetings, it was decided that the views of experts in this field was an important ingredient in preparing a good quality policy document. Agricultural and related department heads identified a set of experts and also agreed to give their own views on the matter. By experts we mean in this study, any individual, who has substantial information and knowledge in the field of agricultural research and who by virtue of his rank is in a position to make value judgments on the merits and more importantly the applicability of possible policy measures to address issues pertaining to the improvement of productivity of agricultural research and who has been identified as one by a departmental head.

The issues that were prepared after preliminary analysis of data then became the starting points for discussion with fourteen experts in a series of interviews. These interviews were conducted as per the standard practices of conducting qualitative research based on interviews (Hennink *et al.,* 2011) and particularly on interviewing experts (Bogner *et al.,* 2009). Each interview lasted from between one hour to three hours. Each expert's view was carefully documented and not shared with another. This ensured that with each interaction, we were validating our results without biasing the experts in anyway by informing them of other expert's opinion. It should point out here that the qualitative technique of interviewing experts was more meaningful to get insights into the solutions of the problems than analysis of vast amounts of data from various sources. In fact, after most interviews, more data analysis was carried out to validate the expert suggestions on the potential policy measures to improve the productivity of Indian agricultural research. In some cases, based on the opinion of the expert, some more data analysis was conducted, which was shared with the expert. This resulted in fine tuning the policy measures proposed in this paper.

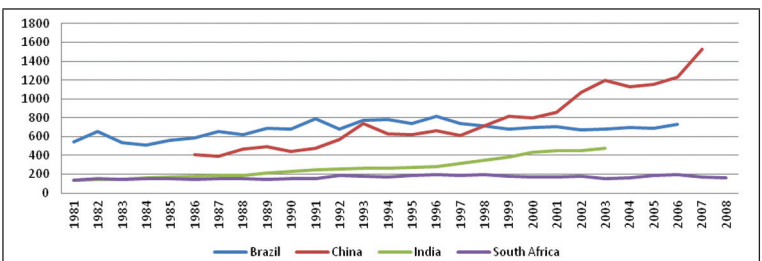
A brief overview of the literature on agricultural research

Economists have since long used established supply and demand models to measure agricultural research impacts (Schultz 1953, Griliches 1958, Petersen 1967, Duncan *et al.,* 1971, Akino *et al.,* 1975, Alston *et al.,* 1995). Also, agricultural research benefits from spillovers (Alston 2002, Evenson *et al.,* 1973). Evidence from the field (Pardey *et al.,* 2006b) suggests less variability in agricultural R&D spending and intervention by the government is beneficial. However, innovation in agriculture remains a challenge (Spielman *et al.,* 2009), mainly due to attitudes, practices, absence of linkages in research (the World Bank 2007). While agricultural R&D in developing countries in mostly public sector driven that in developed countries is driven by the private sector. Intellectual property rights and its protection regimes in countries are known to improve private sector participation in agricultural R&D. Wright *et al.,* (2006) lay out the different forms of intellectual property protection used in agriculture worldwide. The rate of return on agricultural R&D has been very high (Alston 2010, Evenson 2002, Fuglie *et al.,* 2007). Even then agricultural R&D is concentrated in a few countries.

India along with China and Brazil are the better performers among developing countries but about half the 27 African countries who depend on agriculture are spending less in agricultural R&D than in 1981(Beintema *et al.,* 2004). The investment in Indian agricultural R&D has also yielded high returns (Everson *et al.,* 1999). The impact of Indian agricultural R&D has been very high even when measured from different perspectives of total factor productivity, internal rate of return, benefit-cost, and also socio-economic impact factors (Pal *et al.,* 1997). India also has a huge public sector agricultural R&D infrastructure (ICAR 2012). However, the research engine in agricultural sciences requires a policy push to keep pace with the growth of the country.

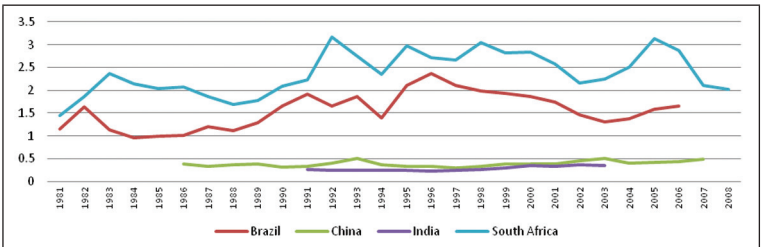
Results

An analysis of data on R&D spending in India, China, Brazil and South Africa (Figure 11 and Figure 12) shows that Indian investments in agricultural R&D is almost less than one third that of China and is even less than Brazil. In terms of number of research staff in Full Time Equivalents (FTE), we find that India employs (Figure 13, Figure 14, Figure 15, Figure 16) about four times the number of agricultural researchers than Brazil or South Africa. Also, most of these research staffs are in government sector in Brazil, South Africa and China, whereas the majority of agricultural research staff is employed in the higher education sector in India.



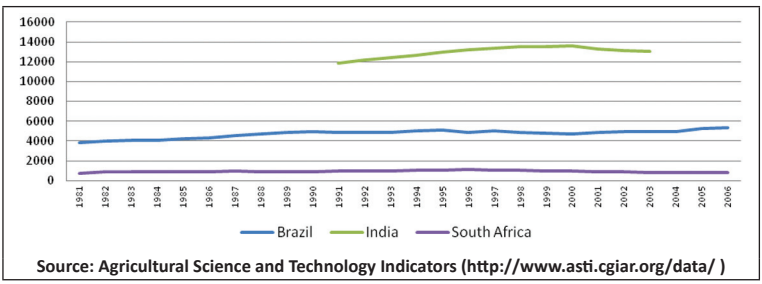
Source: Agricultural Science and Technology indicators (http://www.asti.cgiar.org/data/)

Figure 11: Pattern of total agricultural R&D spending (in million US dollars) in Brazil, India, China and South Africa



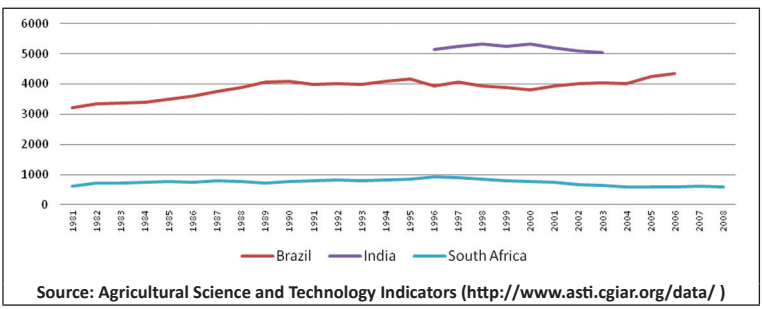
Source: Agricultural Science and Technology indicators (http://www.asti.cgiar.org/data/)

Figure 12: Public R&D expenditure as a percentage of agricultural GDP of Brazil, India, China and South Africa



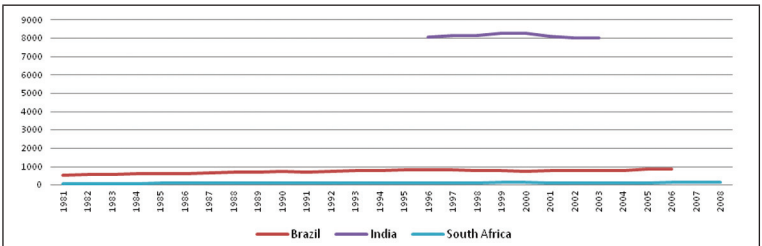
Source: Agricultural Science and Technology Indicators (http://www.asti.cgiar.org/data/)

Figure 13: Number of research staff (FTE) in agricultural sciences in Brazil, India and South Africa



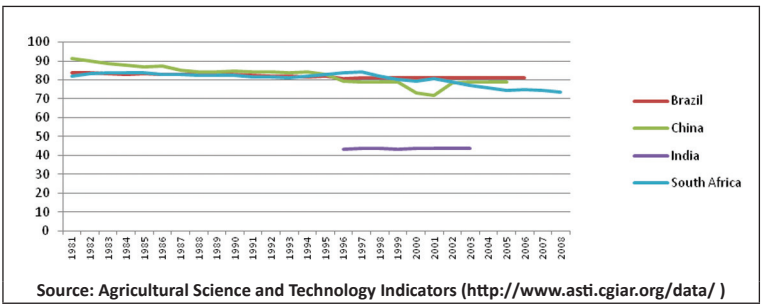
Source: Agricultural Science and Technology Indicators (http://www.asti.cgiar.org/data/)

Figure 14: Number of research staff (FTE) in agricultural sciences and the government sector in Brazil, India and South Africa



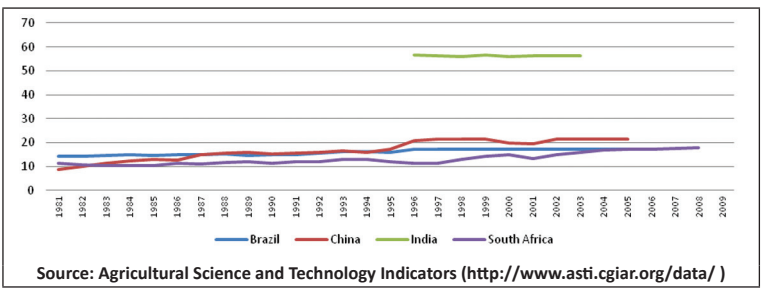
Source: Agricultural Science and Technology Indicators (http://www.asti.cgiar.org/data/)

Figure 15: Number of research staff (FTE) in higher education in agricultural sciences in Brazil, India and South Africa



Source: Agricultural Science and Technology Indicators (http://www.asti.cgiar.org/data/)

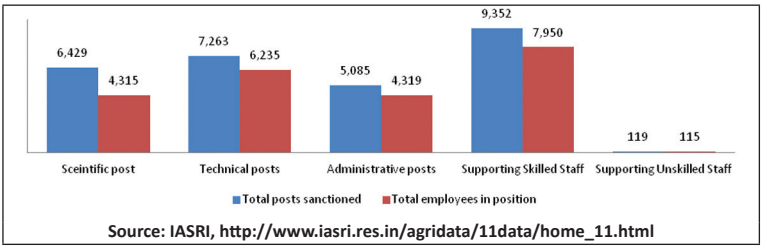
Figure 16: Share of government sector in total FTE public agricultural research staff in Brazil, China, India and South Africa



Source: Agricultural Science and Technology Indicators (http://www.asti.cgiar.org/data/)

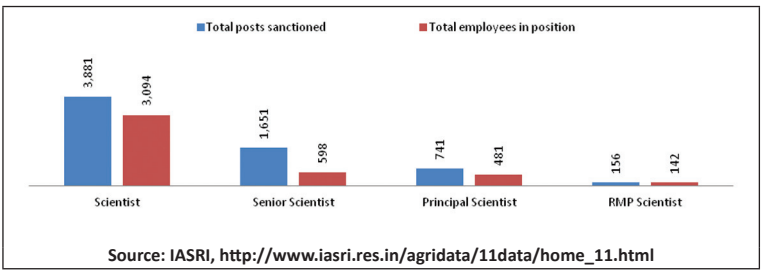
Figure 17: Share of higher education sector in total FTE public agricultural research staff in Brazil, India, China and South Africa

As Figure 18, Figure 19 show, there are a large number of vacancies in the ICAR institutes and the main deficit is in the senior scientist grade.



Source: IASRI, http://www.iasri.res.in/agridata/11data/home_11.html

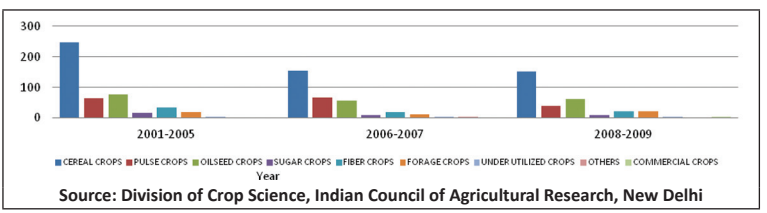
Figure 18: Staff positions in ICAR and its research institutes



Source: IASRI, http://www.iasri.res.in/agridata/11data/home_11.html

Figure 19: Scientific cadre in ICAR and its research institutes

The performance of ICAR in developing field crops since 2001 onwards is depicted in Fig. 20.



Source: Division of Crop Science, Indian Council of Agricultural Research, New Delhi

Figure 20: Number of field crops varieties released by ICAR during 2001-2009

Issues that constrain the growth of agricultural research and their policy prescriptions

Based on the analysis of the quantitative data and qualitative data from the interviews with the experts the following broad issues that constrain the productivity growth of agricultural research in the country have been identified and their policy prescriptions given below:

a) Human resource issues

i. Analysis of data on manpower at the apex level and in SAUs shows that there are more than 25% vacancies in some scientific cadre positions. Data also indicates that the number of agricultural scientists in India in the government sector is the lowest amongst similar countries like Brazil and China. Also the per capita and per agricultural worker number of agricultural scientists in India is among the lowest among similar countries like Brazil and China.

ii. India has many agricultural researchers in the higher education sector, but then, their time is divided into teaching and research and only limited R&D output can be expected from them.

iii. Most of the institutions are top-heavy i.e. More scientists are at a higher age bracket and at higher grade. The pyramidal structure of organization in which more people are at the bottom and less at the top has given way to an inverted pyramid structure in most agricultural research organizations. Research has shown that the productivity of an individual reduces after a certain age (Skirbekk, 2008) and hence the heavier the top of the pyramid, the less the number of productive people at the lower levels of the pyramid, and consequently less the productivity of the organization in terms of research output. This problem has happened due to earlier recruitment happening in bursts and also due to the policy of age based promotions.

- ***Policy prescription 1:***
  - *A fast track mechanism to fill in the vacancies in ICAR and SAUs at the different levels. A plan to attract bright researchers working in other parts of the world may also yield some short term results.*
  - *In the long term, a manpower plan has to be developed for ICAR and SAUs so that recruitment does not happen in phases (as that would result in a step wise age pattern in labs) and instead happens regularly so that the pyramidal structure of the organization remains intact. A comprehensive recruitment policy that supports the manpower plan and that leads to*

infusion of fresh ideas from young minds at a regular interval in research organizations while keeping a suitable ratio of junior and senior scientist needs to be prepared.

b) Issues regarding the quality of research output:

i. In terms of pure agricultural research output, the country is falling behind other countries. India's share in agricultural sciences in the world was 7.8% in 1981, which has now decreased to 6.2% in 2010. Countries like Brazil (9.6%) and China (9.3%) have gone ahead of India in the same period.

ii. The citation impact of the country has however improved from 0.3 in 19981-85 to 0.55 in 2006-10. However, this is still lower than those of China at 1.07 (2006-10).

iii. The number of varieties that are required to be developed is also not keeping pace with the fast changing requirements of a growing economy

- ***Policy prescription 2:***
  - *Incentivize excellence in research by monetary and non-monetary rewards and create disincentives for poor quality research.*
  - *Age based promotion policy should give way to research excellence based promotions only in research organizations. Moreover the culture of research institutions needs to be improved that encourages young scientists to focus only on transparent research outputs for furthering their careers rather than by other means. The culture of the research institutions needs to be made less bureaucratic so that it facilitates communication and exchange of ideas. More internal democracy needs to be promoted. This will also require changing the recruitment policy of scientists and also directors (heads) of institutions to more transparent and objective research output based criteria for selection.*

c) Issues relating to the lack of world class research infrastructure – In many agricultural research institutions of the country affect the quality of research. The situation is particularly bad in SAUs where there is in some cases

only skeletal infrastructure for research. High load of maintenance research also constrains researchers

- ***Policy prescription 3:***
  - *A large infusion of capital is required to improve the research infrastructure in NARS. This can be taken up as an objective under the 12th plan.*

d) Funding issues

i. As is evident from the figures 11 and 12, India spends much less than other similar developing countries on agricultural research. There is a case for increasing funding for agricultural research, more so, because of the high rate of return of such research. Lack of private sector involvement is also another factor for low funding of agricultural research.

ii. Too much focus on funding research on crop sciences and that too on research only on wheat and rice. This creates a situation in which the major chuck of agricultural research funds go into funding research on wheat and rice, whereas, other crops and domains of agricultural research do not get their due funding.

iii. One of the main issues plaguing higher education and research in agricultural sciences in state government run institutions like SAUs is the lack of funding available for research and infrastructure development for research in such institutions as the state governments in general do not consider this their priority. Even many faculty positions and scientific positions (for which ICAR provides 75-100% support) are not filled up for lack of availability of funding for these SAUs. The analysis of data from planning commission indicates that the government expenditure on agricultural research and education (in both Central and State Governments) was Rs. 6343 crore in 2009-10. Also, agricultural research intensity is improving from low levels of 0.45 in the nineties. The agricultural research spending grew by 6% in the eighties and then slowed down to 3 percent in the nineties and has again improved in the last decade.

- ***Policy prescription 4:***
  - *There is enough evidence in literature to suggest that the return on agricultural research is very high, even in India. Hence funding has to increase for agricultural research. However, along with funding, the manner in which the research is taken from the lab to the field also needs to be fine tuned. The Agricultural Extension Services are not working at peak efficiency and hence some structural changes are required.*
    - *An agency may be created for funding agricultural research on the lines of a venture capital fund, but with early stage research focus.*
    - *Allocate research funds in an open, transparent and competitive process much like the European Commission funding programme for research. This will enable funds to flow to the most productive research ideas.*
    - *Encourage private participation in agricultural research by giving tax concessions and encouraging entrepreneurs in this field.*

e) **Issue of lack of collaborative research –** is affecting the quality of research output. Modern agricultural research requires collaborative efforts with different disciplines of science. More efforts at collaboration with other scientific organizations will yield better results.

- ***Policy prescription 5:***
  - *As a policy the funding agencies should fund such proposals on a priority so that others are encouraged to apply. Mechanisms must also be created to bring the agricultural scientists closer to scientists from different other scientific departments. All manner of networking between scientists of NARS and other domestic and even international scientific organizations needs to be encouraged. An institution that facilitates this can be created under ICAR.*

f) **Lack of market-led extension support –** is making the Agricultural Extension System less efficient.

- ***Policy prescription 6:***
  - *Create a central level organization for promoting technology commercialization in agricultural science.*

g) **Issue of lack of special focus on developing varieties-** in recent times NARS has been more keen on focusing research time on publishing scientific papers rather than on developing varieties

- ***Policy prescription 7:***
  - *The funding agencies that give grants for conducting agricultural research must take a policy decision that the research output for funded projects is not just academic papers but results in new and improved varieties of agricultural produce that helps the country.*

h) **Issue of centre-state cooperation –** many times the lack of cooperation leads to delayed results of research as there is delay in funding for joint research or similar other delays in coordination.

- ***Policy prescription 8:***
  - *Partnering with states and nudging them to create a Department of Agricultural Research in each state will go a long way in improving the research output from State Agricultural Universities. The department can then work closely with the Department of Agricultural Research and Education at the centre for any partnership. Also the states can be impressed upon to pass the model Agricultural Universities Act 2009 prepared by ICAR for better governance of agricultural universities, which will ultimately improve their research efficiency.*

Conclusion

This paper is based on a study carried out for the government of India. It is anticipated that some of the measures suggested in this paper would be adopted by the government. It must be pointed out that India has a very good track record in agricultural science and the policy measures are only to improve the productivity of agricultural research. The policy measures are intended to fix constraints and provide an environment for researchers to develop world class research outputs.

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Integrated Farming System Approach for Sustainable Agriculture

G. N. Nagaraja, B. M. Chitra and R. Bharath

One of the most spectacular achievements of the Indian economy is self-sufficiency in food grain production. But our food security is likely to be a big concern in the near future due to heavy population pressure. The only way out is to diversify the economic activities in an interdependent and integrated manner at micro level within the available resources. It is the integration of two or more enterprises like crop, dairy, piggery, fishery, poultry, bee keeping, etc for each farm according to the availability of resources to sustain and satisfy the necessities of the farmer. The Integrated Farming System approach has helped the farmers to re-organize the farm business through reallocation of available resources to get sustained stable returns from the entire farm. Further, the small and marginal farmers would need support in training, demonstration, extension services, credit, market support as well as supply of inputs must be as part of the integrated farming system. Hence, it is high time for the scientists, administrators and planners to think on such lines and provide adequate facilities and encouragement to the farmers to go ahead with the integrated farming systems with a sense of total commitment. This will not only enhance their income and living standard of their families but also reduce hunger and poverty from the society. Therefore, research initiatives have to be undertaken for developing site-specific farming systems incorporating two or more feasible and appropriate enterprises for different categories of farmers based on their resource endowment.

Use of high yielding varieties, extension of irrigation facilities and greater application of fertilizers and pesticides contributed to rapid enhancement of food grains production in the mid 60's and 70's of the last century which is known as green revolution. However, the green revolution concentrated only in a few crops

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(more specifically wheat, rice and maize). Although, later on, developments were ushered in in other enterprises like dairy, poultry, piggery, fishery etc, the achievements were limited. There is need to diversify agriculture and allied activities in an interdependent and integrated manner at micro level within the available resources. In other words, it is the integration of two or more enterprises like crop, dairy, piggery, fishery, poultry, bee keeping, etc for each farm according to the availability of resources to sustain and satisfy the necessities of the farmer. The system thus developed will be termed as integrated farming system approach. It is possible even for a resource poor farmer and for him integrated system is more important to maximize the profit through proper utilization of scarce resources in a farming system approach.

Integrated farming system (IFS) is an innovative and unique approach to promote integrated land use and animal management technologies as well as resource management capabilities among the farmers, more particularly small and marginal farmers of rural populace. It is a micro approach and the entire farm of an individual farmer is considered as a unit. This approach calls for concerted educational efforts with farmers with primary focus of maximizing the net income of farmers over a period of time. This is closely related to realistic planning of farms of selected farmers in order to help to generate maximum family employment and to get sustained stable net income. Such planning and implementation requires identification of potential for development, needs, interests and capabilities of farmers, availability of resources and also training them in farm management techniques. The different enterprises not only compete for scarce resources such as land, labour and capital on the farm but also exhibit inter-dependence due to supplementary or complementary relationship. This also helps in recycling of farm wastes and residues without polluting the environment and degrading the resource base.

Further, IFS gained popularity with a view to augmenting the income of farmers. It assumes great importance to evolve sound management of farm resources to enhance farm productivity, reduce the degradation of environmental quality, improve the quality of life of small and marginal farmers and above all to maintain sustainability in farm production and productivity.

In short, the overall objective of the approach is to evolve technically feasible, economically viable, environmentally sound and socially acceptable farming system models by integrating crops with appropriate supplementary and complementary enterprises for rainfed and irrigated areas. This helps in generating sustained stable income and higher employment from the entire farm.

Characteristics of integrated farming system approach

1. **It is farmer-oriented -** IFS approach targets small and marginal farmers as the clients of agricultural research and technology development. Consequently, its basic objective is to make technology generation more relevant to their goals, needs and priorities. Several mechanisms are commonly employed in the approach to attain this objective. Farmers are made an integrated participant in the research process.

2. **It is system-oriented -** The IFS approach views the whole farm and farm household and the interrelation and interaction between farm enterprises. This is necessary for understanding the complexity and functioning of small and marginal farm agriculture and for the diagnosis of farm crop production problems.

3. **It employs problem-solving strategy -** It is essentially operational research, which first identifies technical, biological and socio-economic constraints at the farm-level for major types of farming systems. It endeavors to develop technologies that are meant to overcome those constraints.

4. **It is interdisciplinary and multidisciplinary -** Collaboration among agricultural scientists of various disciplines and farm management specialist is needed to understand the conditions under which small and marginal farmers operate. This is aimed at accurately diagnosing constraints and transferring improved technologies suitable to those conditions.

5. **It tests technology in on-farm trials -** On farm experimentation establishes the context for collaboration

between farmers and researchers, and encourages a deeper understanding of the farming systems among researchers. It also provides for the evaluation of new technologies under the environmental and management conditions in which it will be used.

6. **It provides feedback from farmers -** IFS provides feedback on farmers' goals, needs, priorities and criteria for evaluating new technologies to zonal/agricultural research stations and regional policy makers.

Objectives of IFS approach

The specific objectives of this approach are:

1. To encourage farmers to take up improvement in all the crops grown by them in different seasons by demonstrating new agricultural technologies,
2. To assist farmers in introducing other subsidiary enterprises like dairy, poultry, fisheries, sericulture, piggery etc., to utilize all the available resources more efficiently,
3. To educate farmers to make them account conscious,
4. To help farmers improve their standard of living by working with them over a period of time, and
5. To develop Integrated Farming System Units as centers of agricultural development in the local areas so that other farmers will be able to use them as sources of new agricultural technology leading to rapid spread of farm innovations.

Important steps in IFS approach

1. Collection of bench mark information on the existing cropping pattern and other enterprises, farm resources and potentialities and also the socio-economic condition of the family.
2. Preparation of appropriate and feasible complete farm plan based on the type of land, irrigation facilities and other such physical as well as financial resources at their command.
3. Farm plans include introduction of new crop varieties/ hybrids, practices, methods, and technologies along with related enterprises.
4. Farm plans guide the farmers to follow dry farming practices for soil and water conservation.

5. Helping farmers to secure required financial assistance from financial institutions for purchase of inputs, animals, farm machinery and equipment, etc.
6. Working with farmers for a period of three or four years to achieve stable net income at regular periodic intervals.
7. Involvement of selected farmers in planning, implementation and evaluation of the programme.
8. Using IFS units as centres to educate other farmers through educational activities like field visits, field days and interaction sessions, etc.,

Advantages of integrated farming system (IFS)

1. **Productivity:** IFS provides an opportunity to increase economic yield per unit per time by virtue of intensification of crop and allied enterprises.
2. **Profitability:** The system as a whole provides opportunity to make use of the produce/waste material of one component as input on another component at the least cost.
3. **Sustainability:** Of late with an enthusiasm to produce more and more within the land area available to meet the requirement of additional population recorded at 2.2 per cent every year huge quantum of inorganic fertilizers, pesticides, fungicides, herbicides etc, are dumped. Thus there is every likelihood of soil and environment becoming polluted. Once when we lose larger area by virtue of the problem indicated, the productivity of the soil would automatically be reduced in the years to come. In IFS, organic supplementation through effective utilization of byproducts of linked components as manures is possible and thus it will certainly provide an opportunity to sustain the potentiality of the production base viz., soil for much longer periods.
4. **Balanced food:** In IFS, we link components of varied nature enabling to produce different sources of nutrition viz., protein, carbohydrate, fat, minerals, vitamins etc., from the same unit area. This will provide an opportunity to solve the mal nutrition problems that exist in the diet of the Indian farmers.
5. **Recycling:** IFS establishes its stability due to effective recycling of produces/waste material of any one of the component as input on the other component linked in the system. Thus by way of recycling their own material

at the farm level, the farmer could able to reduce the cost of production which enables ultimately to increase the net income of the farm as a whole. Moreover it also helps in reducing the environmental pollution expected out of decomposition of organic residues of the farm activity.

6. **Cash flow round the year:** Unlike conventional crop activity where the cash is expected only at the time of disposal of the economic produce received after three to fifteen months depending upon the duration the crop, the IFS provides flow of cash to the farmer round the year by way of disposal of eggs, milk, edible mushroom, cocoons etc.
7. **Adoption of modern technology:** Most of the big farmers are fully aware of the impact of new technologies included in the package. But more than 66 per cent of the farmers who have been grouped under small and marginal category are not able execute the advanced technology proposed for want of cash. But to the farmers, because of the linkages of different crops and allied enterprises, cash revolves round the year gives a sort of inducement to the small and marginal farmers to go for the adoption of technologies like fertilizer application, pesticide and herbicide application etc., given in the package which otherwise is not possible under conventional farming due to paucity of funds.
8. **Solve energy crisis:** In IFS by way of effective recycling technique, the organic waste available in the system can be utilized to generate biogas. Though this may not be a source for complete supplementation, at least to certain extent the energy crisis anticipated can be solved.
9. **Solve fodder crisis:** In IFS each and every piece of land area is effectively utilized. Growing of perennial fodder legume trees in the borders through protective irrigation. This practice not only helps in supplementing legume fodder but also enriches soil nutrient by fixing the atmospheric nitrogen.
10. **Employment generation:** Combining crop enterprises with livestock enterprises to take advantage of complementary and supplementary relationships between them, would increase the labour requirements tremendously and can help in solving the problem of under employment to a great extent. It provides enough scope to employ family labour round the year.

Conclusion

The integrated farming system approach has helped the farmers to re- organize the farm business through reallocation of available resources to get sustained stable returns from the entire farm. There is a great need for this approach to improve managerial ability of the farmers. Further, the small and marginal farmers would need support in training, demonstration, extension services, credit, market support as well as supply of inputs must be as part of the integrated farming system. Hence, it is high time for the scientists, administrators and planners to think on such lines and provide adequate facilities and encouragement to the farmers to go ahead with the integrated farming systems with a sense of total commitment. This will not only enhance their income and living standard of their families but also reduce hunger and poverty from the society. Therefore, research initiatives have to be undertaken for developing site-specific farming systems incorporating two or more feasible and appropriate enterprises for different categories of farmers based on their resource endowment.

Integrated Pest Management in Indian Agriculture: Achievements, Challenges and Opportunities

O. P. Sharma, Someshwar Bhagat and J. B. Gopali

Agriculture still is a cornerstone of our economy as it has significant support for economic growth and social transformations of the country. It contributed 14.5 per cent of gross domestic product (GDP) in 2004-05 and in 2010-11 as compared to 14.7 per cent in 2009-10. It is a key sector providing employment opportunities for majority of the population. According to some estimates presently agriculture sector provides employment to about 52% of the workforce of the country. Presently over 200 million Indian farmers and farm workers have been the backbone of India's agriculture and that, despite having obtained national food security today; over 800 million people do not have sufficient food for a healthy active life. The Food and Agriculture Organization (FAO) of the United Nations estimates that 22% of India's population is undernourished (FAO, 2011). Some progress has been made in this regard, but in the absence of a coordinated intervention, malnutrition continues to undermine the lives of hundreds of millions of people in the coming years. India needs to produce additional 5-6 million tons annually to keep pace with ever-increasing national food requirements, which is an ardent task.

Agricultural growth in India is still very volatile as its high annual variation is often determined by rainfall and weather conditions, as much research. To increase yields from the available land, which cannot be and has not increased significantly during last two decades, requires good crop protection against pre- and post-harvest losses. While on the one hand productive land is contaminated with pesticide residues and on the other hand, significant amount of loss due to crop pests and diseases. In several parts of the country, such as Andhra Pradesh, Maharashtra, Uttar Pradesh, Punjab and Haryana, human and soil health are in danger due to excessive use of pesticides and chemical fertilizers.

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The ill effects of chemical pesticides are not visible. However they cannot be ignored and pesticide residues in soil and resistance to pesticides have surpassed previous records and are the bane of the Indian farmer. There are ample number of cases, wherein exports have been rejected on account of unregulated usage of pesticides and their residues. As a result of pest resistance to multiple sprays, the consequent destruction of successive cotton crops had led to mass suicides in states like Andhra Pradesh at a times and violent agitation in Punjab. Hence, the wellbeing of the farming community continues to be a matter of grave concern. Present agricultural policy has given due importance to IPM, along with other aims:

- A growth rate in excess of 4 per cent a year
- Growth, based on efficient use of natural resources and conservation of soil, water and biodiversity
- Growth with equity, in other words, wide spread across regions and resource poor farmers
- Growth that is demand driven and caters to domestic markets and maximizes benefits from exports.
- Modern science and technology and support to research and technology development , and
- Growth that is technologically, environmentally and economically sustainable

Revolution in agriculture

Like in other developing countries, both agricultural production and fertilizer use in India increased by almost 42.0 percent, the latter from an average of 63 Kg per hectare of cropland. Although the use of pesticides increased more than 30 times between 1950 to 2010, pest menace is still responsible for the loss of enormous quantity of farm output annually in India. Based on calculation at 18% loss by Singh and Sharma (2001), the current loss of output works out to be Rs.2,40,000 crore per annum. World over more species are lost and lot of weeds, diseases and insects are becoming resistant, up from under 100 in the 1950s to more than 700 today (Dubey and Sharma, 2004), for which nobody seems to be keeping account. The use of chemical pesticide led to dramatic improvements in the production of crop plants. However, with passage of time their impact has waned and the pests have become an increasingly serious menace. The consumers have now become concerned about both

food quality and the effects of modern farming methods on the natural environment. Prior to the 19th century, farmers relied almost exclusively on natural cultural methods such as crop rotation, healthy seed and altered date of sowing in their efforts to manage pests. Chemical controls began in the 1870's with the development of arsenic and copper-based pesticides. Pest control strategies changed dramatically as a result of the development of DDT in the late 1930s and its increasing use during and after the Second World War. It was effective at low application levels and was relatively inexpensive. Hence Indian industries also joined the race and farmers enthusiastically started using it and later with greed to produce more injudiciously (Table 1).

Most of early pesticides were originally based on toxic heavy metals such as arsenic, mercury, lead or copper. Chemical companies rapidly expanded their research on synthetic organic insecticides as well as chemical approaches to the control of pest. However, the problems of negative externalities were encountered shortly after the introduction of DDT and chemists then turned to the much more toxic, organophosphate (OP) and pyretheroid insecticides, which resulted in development of resistant strains apart from other maladies (Dubey and Sharma, 2003). Most of early pesticides were originally based on toxic heavy metals such as arsenic, mercury, lead or copper. Modern pesticides, however, are organic compound, safe to the environment, highly effective and required in smaller quantities.

Table 1: Transition phases in pesticide usage

Decade	Emphasis
1960	Introduction, Protection without consideration
1970	Products with better performance – Efficacy, Environment and Toxicology
1980	Shift from efficacy to environment & non-target effects Late 80's-Resistance management
1990	Shift to clean environment, IPM and Resistance management
2000	Alternatives to chemicals
2002	Transgenic cotton became commercialised
2005	New group of green label insecticides made their way to fields.

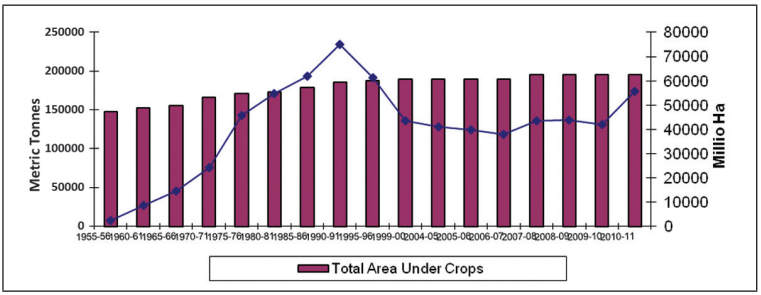

Figure 1: Trend of presticide consumption in relation to cropped area

A declining trend has been observed in the consumption of chemical pesticides till 2009-10 (Figure 1). It is partially due to all-out initiation of IPM and substitution with new molecules obtained from microbials (spinosad, emamectin benzoate, rynaxypyr and flubendiamide), which are highly effective and required in much smaller amounts. Of late, the use of pesticide has increased on two counts. First, due to shortage of farm workers use of herbicides has increased and secondly there is come back situation of pesticide use in transgenic cotton. The transgenics are able to provide protection against pod borers, however there is resurgence of sucking pests, which requires application of insecticides. Total use of pesticides is still increasing in many states like Andhra Pradesh, Maharashtra, Punjab and Uttar Pradesh, which needs investigations. Injudicious use of pesticides has lead to residues

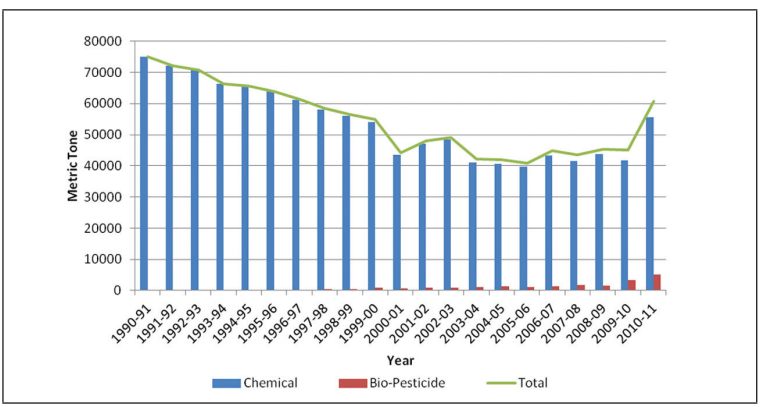

Figure 2: Trend in consumption of chemical pesticides and bio-pesticides in India

in soils, air (evaporation), leaching into ground water, causing contamination of food and the environment, and endangering human health (Dubey and Sharma, 2001).

In the early 1990s, the World Health Organization estimated that 3 million people a year suffered from acute pesticide poisoning with as many as 200000 of them dying. More are in the developing world, where village conditions virtually prohibit the safe use of dangerous pesticides. Groundwater contamination is particularly serious, as it is long-lived and expensive or impossible to remedy. Spray drift into streams and rivers, and contamination from spillages, tanks washings or discarded pesticide containers are also present a real threat to watercourses. It has been estimated that majority of citizens may be drinking polluted water and reducing pesticides in public drinking water supplies to a precautionary level of 0.1 micrograms per litre is estimated to be in excess billions. Despite the efforts of chemists to design products which bind to soil or crop surfaces, water contamination appears to be unavoidable. Some pesticides are also persistent organic pollutants (POPs), including DDT, hexachlorocyclohexane, toxaphene and dieldrin, and are transported through the atmosphere to be redeposited in cooler regions (Dubey and Sharma, 2004).

Agricultural chemicals and environmental pollution

The use of chemicals as agricultural and urban pesticides has been of critical importance for the development of today's society and has contributed to the current prosperity in large parts of the world including India. The authentic data on crop loss estimates are scarce, however the best documented information, Oerke *et al* (1995) estimates that about 42 % of the global output is lost due to pests despite use of various plant protection tactics. In addition to all the benefits, the use of chemicals also contributes to the downside of prosperity. Pesticide use has increased rapidly over two decades (1960-90), at the rate of 12% a year. Cotton and rice production alone accounts for two–thirds of pesticides use in agriculture while about 30% of uses are for public health projects (Figure 2). There are evidences that despite heavy reliance on pesticides and rapid innovation in chemical sciences, pest management systems are barely keeping pace with the capacity of pests to adapt new environment.

Resistance to pesticides is a serious concern the world over and proving a uphill task. Although the use of pesticides increased manifolds between 1950 and the end of the 2005, pest still cost billion of rupee annually in lost agricultural production, and more pests are becoming resistant. The application of pesticides inevitably led to residues in soils, which has contaminated food and environment and endangered human health. Pesticides and their residues can be transported by erosion and runoff to off-site areas in ways similar to those operatives in the case of nutrients. Their widespread injudicious use has been and still is a serious threat to the environment and human health. The full effects of these chemicals in future generations are yet to be revealed, but certainly children are particularly vulnerable. Over the last 50 years, evidence has mounted on the threat of synthetic chemicals to wildlife and humans alike. Wherever scientists look – in the tropics, marine systems, industrial regions, and the Arctic – they find the impact of toxic chemicals. No person, region or species can and has escaped the reach of these insidious pollutants. Whether they are pesticides or industrial chemicals like poly-chlorinated biphenyls (PCBs) or the phthalates used in plastics, or by products such as dioxins and furans, chemicals are a part of our lives – in more ways than one.

Worldwide, approximately 80,000 chemicals have been introduced into the environment over the last 50 years, but virtually none has been tested for the full range of reproductive, neurological or endocrine effects. Research and regulation of synthetic chemicals has historically focused on the dangers of genetic mutation, cancers and gross birth defects. Of late scientists have started investigating a hazard known as 'endocrine disruption'. Endocrine-disrupting chemicals interfere with the activity of hormones within the body as they mimic natural hormones and send false messages. Other synthetic compounds block the messages and prevent genuine ones from getting through. Whatever the mechanism, the bottom line is the same: any chemical that interferes directly or indirectly with hormones can scramble vital messages, derail development and undermine health; hence lack of knowledge of the long-term effects of chemicals should make us much more careful when using them. Mercury and certain other heavy metals and their compounds are known to be transported over long distances around the world and can be found far from the site of their

origin. Global action on mercury is called for and the Indian Government., has already banned its use as seed dresser against seed borne diseases. Similar assessments are needed on other heavy metals.

The scientific understanding of heavy metals and their compound sources, transport and pathways, as well as their socio-economic effects needs attention. Over the years, DDT, chlordane, hexachlorbenzene (HCB), mirex, endrin, aldrin, eldrin/dieldrin, heptachlor, and toxaphene have been used to defend crops, vectors, and to protect infrastructures from destructive pests. Although use of pesticides has dramatically decreased, several of them are still in use. Indian experience indicates higher residues in foodgrains, fruits, vegetables, fish, milk and water than the acceptable limits (Dhaliwal and Kalra, 1977; Kalra and Chawla, 1981; Agnihotri, 1983: ICMR, 1993). The poisonous effects of pesticides like DDT, BHC (banned), Endosulfan (banned), Malathion, Methyl-Parathion, Monocrotophos, Quinalphos, Dimethoate, Phosphamidon, Cypermethrin and Fenvalerate have been reported even in blood samples of human beings and a significant increase in chromosomal aberrations was observed (Rupa *et al.,* 1989; Srivastava *et al.,* 1995). The farm workers are reported to suffer from one or more symptoms of acute pesticide poisoning such as tightness around the chest, headache, numbness, lethargy, allergies, dermatitis, epigastric pain or blurred vision (Rupa *et al.,* 1989a).

In South India, 36 workers in an industry manufacturing Malathion, Monocrotophos and Dimethoate found to have significant lower level of pseudo-cholinesterase as compared to 36 other workers without a history of similar exposure. But their level rose significantly back to the normal range, when transferred to unexposed area (Peedicayil *et al.,* 1991). Inhibition of cholinesterase activity was observed in 34 spray men working in mango orchards, using Monocrotophos, Phosphamidon, Dichlorvos, Oxydemeton-methyl, Malathion, Endosulfan, Parathion-methyl, Dimehtoate or Carbaryl throughout the year (Srivastava *et al.,* 1991). Increased levels of organophosphorous pesticides (dialkyl phosphate compounds) have been found in children living close to gardens, where these chemicals are sprayed. The children's exposure to the pesticides has also

resulted to childhood cancer. Tissues, organs, biological systems and detoxification mechanisms of children are undergoing rapid growth and development, predisposing them to potentially more severe consequences of toxic chemicals (Anon., 2001).

Arial spraying of a deadly pesticide, for years, in Kerala by the Public Sector Company Plantation Corporation of Keralam has affected the health of families working in cashew plantation. Apart from human beings, the cattle fed with contaminated fodder, also get affected with pesticide residue in their milk. The toxicity of quinalphos, dichlorvos, monocrotophos, fenitrothion and phorate to buffalo calves is described (Bal *et al.,* 1996). Tanabe *et al.,* (1998) studied the persistence of organochlorines (DDT), HCH isomers, chlordane compounds, hexa-chlorobenzene (HCB) and ploy-chlorinated biphenyls in whole body homogenates of resident and migratory birds from southern India during 1995. Resident birds were found to contain relatively greater concentrations of HCH (14-8,800 ng/g wet wt) than DDTs and PCBs concentrations. In contrast, migrants exhibited elevated concentrations of PCBs (20-4,400 ng/g wet wt).

Pollutants enter ground water, rivers and other water bodies unchecked ending up being used for consumption (Ali, 1998). Studies carried out in Delhi indicate presence of high level of pesticides (organo-chlorines) in potable water (Aggarwal *et al.,*1986, Agarwal A., 1997). Similar reports have been made by Dua *et al.,* (1998) and Murlidharan, (2000) from the water samples belonging Uttranchal and Rajasthan. Water samples from wells in Bhopal showed residues of total HCH (4640 mg/l) and total DDT (5794 mg/l) (Bouwer, 1989). Organo-chlorines and organo-phosphorus residues were also detected in canals used for irrigation and drinking purposes in Aligarh (Ray, 1992). Similar problems have been reported from different rivers in India (Mohapatra *et al.,* 1994; Agnihotri, 1993). The contamination of fish pond with as little as 0.005 ppm of chlorpyriphos can significantly reduce the zooplanktons and dissolved oxygen level and can increase the free carbon dioxide level (Ali, 1998; Mani and Konar, 1988). Apart from residue problems soil contamination causes mortality and also makes soil unfit for cultivation.

Consequences of injudicious use of chemical pesticides.

The injudicious use of chemical pesticides has led to development of super weeds and resistant insects. At present the number of weed species resistant to herbicides rose from 48 to 273, and the number of plant pathogens resistant to fungicides grew from 100 to 150. Resistance to insecticides is so common that more than 700 species have acquired resistance and currently nobody is really keeping score. In most of the epidemic situations like the episode of Guntur (A.P.) which occurred during 1992, it has been found that the excessive use of insecticide has led to development of insecticidal resistance in *Helicoverpa armigera* which, due to its polyphagous nature, has caused havoc in all the cropping systems available in the vicinity. Review of Indian literature indicates that 33 insect pests and 9 plant pathogens (Table 2) have developed resistance against various pesticides.

Table 2: List of insect pests which has developed resistance against chemical insecticides in India.

Field Crops : Year reported	Pesticides
Singhara Beetle (*Galerucella birmanica*) (Jacoby) : 1963	DDT, HCH, Aldrin, Dieldrin, Chlordane, Malathion
Tobacco Caterpillar (*Spodoptera litura*) (Fab.): 1965	DDT, HCH, Endosulfan, Malathion, Monocrotophos, Fenitrothion, Methyl parathion, Pyrethrum, Lindane, Pyrethriods, Cypermethrin, Fenvalerate, Methomyl, Deltamethrin
Gram pod-borer (*Helicoverpa armigera*) (Hubner): 1982	Organophosphates, Synthetic pyrethroids, Cypermethrin, Fenvalerate, Deltamethrin
White flies (*Bemisia tabaci Gennadius*) (Gennadius):	DDT, Cypermethrin, Fenvalerate, Endosulfan, Methomyl, Monocrotophos, Quinalphos
Diamond back moth (*Plutella xylostella*) (linnaeus): 1966	Pyrethriods, Cypermethrin, Deltamethrin, Fenvalerate, DDT, Parathion, Ethyle parathion, HCH, Endrin, Fenitrothion, Quinalphos, Cartap hydrochlorides, Carbosulfan, Monocrotophos, Chloropyriphos, *Bacillus thuringiensis*, Malathion, Endosulfan, Dichlorvos
Jassid *(Empoasca kerri Pruthi)*: 1986	Organophosphates, Carbamates

Field Crops : Year reported	Pesticides
Aphid (*Aphis craccivora Koch , Myzus persicae* & *Lipaphis erysimi*) : 1986 , 1992 & 1970	Methyl parathion, Dimethoate, Malathion, Lindane
Pink bollworm (*Pectinophora gossypiella*) : 1992	Cypermethrin, Fenvalerate, Deltamethrin, Monocrotophos
Blister beetle (*Mylabris* spp) : 1992	Phosphomodon, Cypermethrin, Fenvalerate, Deltamethrin, Carbaryl
Stored Grain Pests	
Red floor beetle (*Tribolium castaneum*) : 1971	DDT, Malathion, Lindane, Phosphine, Dichlorvos, Cypermethrin, Deltamethrin, Lambdacyhalothrin
Rice Weevil (*Sitophilus oryzae*) : 1973	Malathion, Lindane, Phosphine, Pyrethrum
Gram Beetle (*Oryzaephilus surinamensis*) : 1976	Lindane, Malathion, Phosphine
Lesser grain borer (*Rhyzopertha dominica*) : 1976	Malathion, Lindane, Phosphine, Dichlornes
Cigarette Beetle (*Lasioderma serricerne*)	Phosphine
Leather Beetle (*Dermestes maculatus*) : 1978	Lindane
Kapra Beetle (*Trogoderma oranarium*) : 1979	Phosphine
Tribolium confusum : 1988	Malathion

Table 3: List of plant pathogens, which has developed fungicidal resistance

Pathogen (Host)	Fungicides
Apple *(Venturia inaequalis)* Grapes *(Gloeosporium ampelophagum)* Groundnut *(Aspergillus flavus)* Sugarbeet *(Cercospora beticola)*	Carbendazim
Rice *(Dreschlera oryzae and Pyricularia oryzae)*	Edifenphos
Grapes *(Plasmopara viticola)* Potato *(Phytopthora infestans)*	Metalaxyl
Potato *(Phytopthora infestans)*	Oxadixyl
Grape *(Unicinula necator)*	Triadimefon
Apple *(Venturia inaequalis)*	Mancozeb

Stepping off the pesticide thread mill

Concern over losing effectiveness of conventional pesticides and their residues led to the development of integrated pest management (IPM) - the use of a variety of controls including the conservation of existing natural enemies, crop rotation, intercropping, and cultivation of pest-resistant varieties. Pesticides may still be used, but selectively and in greatly reduced quantities (Dubey and Sharma, 2001).

The reasons for pesticide residues are:

- Indiscriminate use of chemical pesticides and non adherence to pesticide labels
- Non-observance of prescribed waiting periods
- Use of sub-standard and sub-lethal doses of pesticides
- Tank mixing of pesticides
- Wrong disposal of left over pesticides and cleaning of equipment, and
- Pre-marketing pesticides application/treatment of fruits and vegetables.

IPM is more complex for the producer to implement than spraying the pesticide, which appears not only easy but also readily available off shelf on credit basis. IPM technology requires education, skill in pest monitoring and understanding of pest dynamics, and it often involves cooperation among producers en mass for effective implementation (Sharma *et al,* 2000). At the time IPM began to be promoted as a pest control strategy in the 1960's, there was very little IPM technology available to be transferred to farmers. By the 1970's, sufficient research had been conducted to provide the knowledge to successfully implement IPM programs in important crops, such as rice, cotton, pulses, sugarcane and vegetables. However, exaggerated expectations about the possibility that dramatic reductions in pesticide use could be achieved without affecting crop yields as a result of adoption of IPM could not been realized because of availability and quality issue of critical inputs. IPM is an in-built component of crop improvement research and its various disciplines are incorporated in the Crop Research Institutes with the aim at evolving environmentally sound pest management.

Status of IPM technology and its implementation

Thus IPM has proved to be an important principle on which the technology of sustainable crop protection can be effectively

relied and based. IPM has increased in Indian subcontinent also, but with less vigour due to strong competition with well-established network of chemical pesticide distribution system. Though the concept was first mooted in late 60s at IARI by then late Dr. Pradhan it has taken India more than 40 years to show results through IPM. A rapid adoption of IPM as wide area pest management strategies is now called for, so that the goal to achieve long-term sustainable systems of crop protection and healthy production can be achieved before it is too late and the international market is captured by envy neighbouring countries. Over the decade of research at ICAR and SAUs, sufficient location specific IPM technologies have been developed and validated at research farm level. Unfortunately due the limitation of 1 acre FLD did not yield desired results. Over-burdened with cost of import, the Department of Agriculture and Co-operation under the ambit of National Food Security Mission has launched and validated Integrated Pest Management Strategies in 13 major pulse growing states to produce additional 2 million tons of pulses. The programme was initiated in the farmers' participatory mode with the help of State Department. of Agriculture and NCIPM, Delhi with the objective to demonstrate plant nutrient and IPM centric technologies and management practices in 1000 compact blocks of 1000 hectares each for five major pulses crops namely Gram, Urad (black gram), Arhar (red gram), Moong (green gram), and Masoor (lentil) in major pulses growing States with the following strategies:

- **Cluster approach for impact**:
  The program promoted the cluster approach of promoting package of production and protection technologies to all the pulses growers in the selected blocks. This approach ensured delivery of kits of critical inputs to the farmers as also it ensured regular knowledge exchange through dedicated extension officials. Logistics of moving the inputs and technical monitoring of the crops improved significantly.

- **Input kits including nutrients and plant protection chemicals**:
  A combined kit of critical inputs including gypsum, micronutrients, Rhizobium culture, Phosphorous solublising bacteria (PSB), microbial pesticides (HaNPV),

botanicals (Neem oil), plant protection chemicals and weedicides were provided to each farmer in the A3P units, free of cost for a maximum area of 2 hectares. Seed minikits of locally suited improved crop variety was provided so that the farmer multiplies the same to ultimately cover his entire holding with improved variety.

- **Hand holding approach**:
  One of the key constraints contributing to low productivity of pulses crops is inadequate extension services at the farm level. In order to address this issue, need based additional technical manpower was provided at sub district level (one/each unit) and at the Directorates of Crop Development level (two/each Directorate) on contractual basis to provide on the spot technical support to the farmers in a hand holding manner.

- **Institutional support for pest surveillance**:
  Pulses are highly vulnerable to insect pests and diseases that cause an estimated yield reduction on an average of about 33% every crop season. In order to address the problem, National Centre for Integrated Pest Management (NCIPM) of Indian Council of Agriculture Research (ICAR) was engaged for rigorous pest surveillance, real time monitoring of crop health and for capacity building of the farmers as well as state extension workers for effective management of pests and diseases in eco-friendly manner in the A3P units.

- **Unique pest surveillance mechanism**:
  Under A3P, an elaborate capacity building program for correct identification of the pests at different stages of their life cycles was implemented. NCIPM provided training to the master trainers in the States on pest surveillance and the master trainers in turn imparted training to the extension officials designated as pest monitors and to the chosen farmers tasked to perform the job of pest scouts in the units. A work flow for reporting pest incidence was developed for the pest scouts and the pest monitors. Each chosen farmer was required to collect the data through static field surveillance over a period of one week to report the pest incidence. The information thus collected was transmitted

regularly to the centralized data repository (http://www.ncipm.org.in/A3P/UI/HOME/Login.aspx) in the dedicated servers created and maintained by NCIPM.

Trained dedicated pest experts with the help of computer professionals sieved the information and created real time pest scenario for each unit and prepared weekly appropriate advisories for managing the pests. These advisories were then disseminated to the extension officials and farmers in the local language using multiple channels of communications including the SMSs on their mobile phones. District Disaster Management Committees were constituted under the technical guidance of District Plant Protection Officers who were tasked and equipped to ensure that appropriate pest control measures as per the advisories were applied by the farmers and be prepared with contingency plans. This mechanism, missing so far in the pest management system across the country, ensured timely action to reduce pest incidence which was crucial for achieving higher production of pulses (Sharma *et al.,* 2011).

Reduction of chemical pesticides use could be brought about through promotion of Integrated Pest Management, which involving following steps:

- ✓ Pest surveillance and real time monitoring of the pest
- ✓ Adoption of cultural and mechanical practices
- ✓ Use of traps (light, sticky, yellow and pheromone)
- ✓ Use of resistant (conventional/ transgenic) /tolerant crop varieties
- ✓ Use of bio-pesticides including botanicals and microbials
- ✓ Spray of chemical pesticides as last resort based on Economic Threshold Level (ETL).

However, there are some constraints "most of the plant protection techniques used in IPM is not very attractive to the pesticide industry". It is being viewed (IPM promotion) as a threat but not a lucrative proposal for business. Secondly, a number of chemicals or their specific formulations, which have been banned or restricted in other parts of the world, are still available. Chemical control is still seen as a 'progressive' approach by the farmers with convenience to cover larger areas. The chemical companies, who push their products much more aggressively, provide further impetus such as credit facilities.

There is ample need for improvement for education, effective information dissemination system, making quality critical inputs available under single window and mass adoption of the IPM programme needs to be strengthened and implemented on war level.

Keeping in view the global concern about harmful impact of pesticides in the environment, the Government of India as well as ICAR system has recognized the benefits of Integrated Pest Management (IPM) programme as early as 1985 and adopted IPM as the cardinal principle and main plank of plant protection strategy in the overall crop production strategy. The Food and Agriculture Organization (FAO) of the United Nations has been at the forefront of promoting and defining food security as a concept that could guide development. They have given expertise and material to Directorate of Plant Protection, Quarantine and Storage (DPPQ&S), Faridabad as a result a number of state has been covered up for primary food crops especially rice.. The collective efforts at various level has resulted in downward trend in consumption of pesticides (technical grade 41,021 M.T) in year 2004, which has now increased to (55,540 MT) in 2010-11 (Fig 1).

The increase in pesticide consumption is due to several factors, which include resurgence of sucking pests in transgenic cotton, increase in pod bug infestation, increase in climatic change led foliar diseases of field crops, awareness and more use of fungicides to protect horticultural crops promoted by Horticulture Mission of India and dependence on herbicide in absence of labours.

Pest-resistant / tolerant varieties

Advocating use of pest-resistant/tolerant varieties is an important component of IPM. Plant breeding programmes place heavy emphasis on the updating of genetic resistance to insect pests and diseases as has been successfully demonstrated in wheat, rice, pulses, oilseeds, cotton and few horticultural crops. Despite success in one front there are failures on other fronts indicating that not all pest problems could be solved by breeding alone. Contribution made by resistant material in avoiding yield losses is quite significant and cannot be written off especially in case of cereals, oilseeds and pulses (pigeonpea and chickpea)

as has been demonstrated in pulses. In order to evade / reduce incidence of Sterility Mosaic Disease of Pigeonpea in Gulbarga district the susceptible Gullyal has been replaced in over 2 lakh ha (52%) with TS3-R variety under NFSM initiatives. Similarly large scale adoption of Bt-I and Bt-II in the Maharashtra has helped in bumper crop by minimizing losses caused by *Helicoverpa* and *Spodoptera* alone. In case of pulses large scale adoption of Sterility and wilt varieties in pigeonpea and chickpea has helped minimizing plant mortality and increase productivity level.

Surveillance and crop monitoring

Crop monitoring is an important tool and it aims to determine WHEN and WHAT action is to be taken. Management of any crop needs routine inspections to assess how well plants are growing and what actions need to be taken on cultivations, pest and disease control. Primarily Central Integrated Pest Management Centres (CIPMCs), Faridabad is dedicated to plant protection and quarantine aspects of nation. It has 31 dedicated centres and related infrastructures in 28 States and one Union Territory and during 2008-09 has carried out monitoring of pests in 789 thousand ha followed by field release of bio-control agents (1662 million) covering 661 thousand ha. Monitoring for pests is an important part of the need to "walk" through a crop, which is not practical if land holdings are very large.

The community approach of crop health and pest monitoring is lacking, hence NCIPM has demonstrated use of "e-Pest Surveillance Mechanism" to solve the real time pest information in Maharashtra under Crop Pest Surveillance and Advisory Project (CROPSAP). The online real time pest monitoring system (http://www.ncipm.org.in/cropsap2012/login.aspx) was initially developed under CROPSAP to take timely plant protection measures to counter the epidemics of Spodoptera affecting Soyabean crop in Maharashtra. Timely information has helped in savings of Rs1500 crores alone in single crop. Based on success a similar programme was initiated under NFSM to cover Maharashtra, Andhra Pradesh, Karnataka, Uttar Pradesh and Madhya Pradesh. The online real time pest monitoring and decision making system (http://www.ncipm.org.in/A3P/UI/HOME/Login.aspx) has helped in keeping track of pest population as well as disseminating plant protection related advisories to famers. The later part has helped more than 50,000 farmers of 82 talukas (Sharma *et al.,* 2011).

Availability of pheromones offered interesting possibilities and enthusiasm among farmer as a podborer monitoring tool. At national level currently it is widely used for certain key pests such as pod borer, Pink and spotted bollworm, Potato tuber moth, white grub, leaf folder, etc. Besides selective trapping techniques to monitor the movement of pests or changes in populations during the season, pheromones are also used in "lure and kill" strategies to attract the pest to localised insecticide deposits (as being done in white grub) and reduce the need for overall crop spraying (as demonstrated against PBW in Punjab).

Other tools, such as pheromone traps, mating disrupting lures (*Helicoverpa* and Pink Boll Worm), diagnostics and forecasting systems for pests (*Helicoverpa*, apple scab and late blight of potato disease) have proved their effectiveness and are now available to assist in timing of management operations. They need to be promoted so that the unwanted spray of pesticides can be reduced down. The Department of Agriculture & Cooperation (DAC) in the Union Ministry of Agriculture has notified the inclusion of "Mating disruptants" pheromones (HP-Rope, HL-Rope, Z-11-Hexadeceal and PB-RopeL) in the Schedule to the Act by Notification No. GSR 10(E) dated 3.1.1996.

Bio-pesticides

Examples of natural insecticides of commercial importance are the pyrethrins, azadirachtin containing preparations, certain essential oils and phyto oils. Among the relatively few weed control agents and plant growth regulators are Indole Acetic Acid, cytokinins, brassinosteroids, triacontanols and some essential oils. Of the 59 plant families shown by Simmonds *et al,* (1992) to have potent anti-insect activity, the Meliaceae have received most attention, particularly the neem tree, *Azadirachta indica*. Its active constituent, azadirachtin, is a limonoid with antifeedant, growth regulatory and reproductive effects (Mordue & Blackwell, 1993). Our ancestors have known the use of neem as insecticide. It has reference in vedas but the practice was neglected due to lack of faith and scientific knowledge and easy availability of "quick action" pesticides. Use of locally available neem seeds (Neem Seed Extract 5%) as a pest repellant and anti feedant has not only reduced dependency of chemical pesticides against *Helicoverpa* but has also created employment through neem seed collection by unemployed rural youths while the womenfolk are engaged

for its preparation. Some neem products have been found to induce resistance in pea against the powdery mildew (*Erysiphe pisi*) in field conditions.

Recently, the extract of giant knotweed (*Reynoutria sachalinensis*) has emerged as potential source of fungicide against powdery mildews. Advancements have improved scientific understanding and the adoption as well as transfer of technologies can further increase the capacity for sustainable agriculture and development. The Registration Committee has so far registered two insecticides of plant origin viz. Pyrethrum from Chrysanthemum and neem based pesticides from neem kernel and neem oil for the control of insect pests of various crops. Two formulations of Pyrethrum i.e., Pyrethrum 0.2% dusts and Pyrethrum 1% EC are registered for use against insect pests in vegetables. Pyrethrum is also used in combination with other insecticides/synergists for the control of household pests.

Another pesticide of plant origin viz., Nicotine sulphate extracted from tobacco plant has also been registered for export purposes only. The registration of neem based biopesticides was initiated during 1991. Neem based biopesticides (300 PPM, 1500 PPM, 50,000 PPM) have been granted registration on regular basis under Sec. 9(3) and 9(4) of the Act; whereas a number of neem based products (3000 PPM), 10,000 (PPM) have been registered on provisional basis under Section 9(3B). Following extracts concentrates and formulations have been registered and produced.

(a) Neem Extract Concentrate (Tech.) -10% (min.), 15% (min.) & 25% (Min.)
(b) Neem formulation containing minimum Azadirachtin contents

0.03% (300 ppm)	2.0% (20,000 ppm)
0.15% (1500 ppm)	2.5% (25,000 ppm)
0.3 % (3000 ppm)	3.0% (30,000 ppm)
1.0 % (10,000 ppm)	5.0% (50,000 ppm)

BIS specifications for neem products viz. IS: 14299-1995 (for Technical), IS: 14300-1995 (for formulation) have been published. "Karanjin" (*Pongamia glab*ra) and extract of *Cymbopogan* species (botanical pesticides), Eucalyptus oil formulation and *Hirsutella*

spp. fungi (biopesticides) have also been included in the schedule of the Insecticides Act, 1968. There is a need for emphasis on its efficient and cost-effective production, processing and marketing of not only neem but other less known botanicals also such as pongamia, palmrosa, annona seeds, nuxvomica, and tobacco.

Biological control

Despite various initiatives the share of bio-pesticides of total pesticide (Fig 2) hovers around 8%, of which major proportion is from *Trichoderma*. Biological control is an integral part of IPM and DPPQ&S has established 30 bio-control laboratories spread over the country. National Bureau of Agriculturally Important Insects (NBAII), Bangalore and a number of SAUs have perfected the technique and protocols for mass production for 26 Egg parasitoids ; 06 Egg larval ; 39 Larval / nymphal parasitoids ; 26 Predators and 07 Weed feeders. The technology generated by ICAR and SAUs has enabled private sectors to produce *Trichoderma*, *Trichogramma*, HaNPV and BTK and create job opportunities for rural youths. Primarily they are meant to meet the local need but not able to do so due to inherent problems. Further, the effectiveness under high temperature, absence of storage technology and need for timely availability of *Trichogramma*, *Chrysoperla, Cryptolaemus, Leptomastix, Bracon* and *Epiricania* opened opportunities for small entrepreneurs to take up mass production of these bio-agents on a small scale. Since the bioagents can not be stored for long, ensuring stability of supply and meeting demand are key elements in successful implementation of IPM programmes. Being unorganized sector the entrepreneurs are landing up in debt grips which is playing bad role for IPM practices. Efficient regional markets are also needed to match increasing demand with the supply of quality critical IPM inputs.

Insect pathogens play a key role in nature for controlling the pest population. Most of these (Table 4) are host-specific, self perpetuating and high productivity in the host body apart being safe to man and animals. Numerous viruses belonging to 14 different families are known to infect insects; however focus is restricted to members of family Baculoviridae, which includes NPV and GV. Baculovirus are known to infect more than 600 species of insects, mostly Lepidoptera and also some from Hymenoptera (31 species), Diptera (27 species) and Coleoptera

(5 species). The important crop pests attacked by NPV and GV are *H. armigera* and *Spodoptera* spp., and *Cydia pomonella* and *Plutella xylostella,* respectively.

Table 4: Entomofungal pathogens and protozoans recorded from India

Pathogen	Target Pests
Entomofungi	
Beauveria bassiana	*Helicoverpa armigera, Spodoptera litura, Chilo partellus, Scripophaga incertulas, Myllocerus sp., Lymantria obfuscate*
Entomophthora aulicae	*Lymantri obfuscate*
Erynia neoaphidis	*Lipaphis erysimi*
Hirsutella spp.	*Nilaparvata lugens, Tetranychus sp*
Metarhizium anisopliae	*Pyrilla perpusilla, Oryctes rhinoceros, Holotrichia consanguinea*
Neomourea rileyi	*H. armigera, S. litura, Achaea janata, Plusia sp.*
Paecilomyces sp.	*Bemisia tabaci, Aleurocanthus woglumi*
V. aphidicola	*Aphis spiraecola, Lipaphis erysimi, Brevicoryne brassicae, Myzus persicae*
Verticillium lecanii	*Cocus viridis, Archips termias, Emposca sp., Aphis gossypii,.*
Protozoans	
Bacillidium sp.	*Thrips flavus*
Farinocystis tribolii	*Tribolium castaneum*
Mattesia dispora	*Ephestia cautella*
Microsporidium sp.	*Spodoptera litura, S. exigua, Utethesa pulchella*
Nosema sp.	*Anadevidia peponis, Spilarctia oblique, Adisura atkinsoni, Crocidolomia binotalis*
Tetrahymena sp.	*Chilo partellus*
Vairimorpha sp.	*Helicoverpa armigera, Spodoptera litura, S. exigua, etc*

The search for the "right" habitat is imperative because like all living organisms, insect parasitoids and predators have requirements for resources, other than hosts. However, these other sources may or may not be found in the same habitat in which hosts are found. Optimal microclimatic conditions for a given parasitoid, nectar sources, and shelter may exist in some host habitats (crop systems) but not others. One assumes that the habitats in which parasitoids find hosts

also provide other needed requisites at optimum levels. There is little empirical or experimental data, to support this to be true, even for unmanaged eco-systems. Conservation of bio-agents through habitat management is not getting enough attention and need to be promoted. Many natural enemy species require food sources in the form of pollen, nectar, or innocuous arthropods that are not present in particular crop habitats or artificially created crop architecture. These food requirements if provided by deliberate development of certain wild vegetation (aromatic) habitats near plantings of the primary and secondary crop can play tremendous role. These are used for careful management of farm land margins, as well as growing tree crops (pomogranade) or hedges (compositae family), as they provide suitable habitat cover and refuge for beneficial insects and other animals (e.g. in rice paddies. Field bunds provide important refuges for predatory spiders which help control several important rice pests; and for snakes which help control rats) is required.

In the case of rainfed cotton, growing of maize and cowpea on border increases the population of coccinellids which migrates to cotton in search of aphids and jassids. Success stories have filtered down from a number of states making IPM a potent tool for smooth transition from a high input unsustainable agriculture to low input sustainable agriculture. Of more than 100 million farms in India, three quarters are one hectare or less in area and scattered across a wide range of environment and it is this group which will be most benefited from this technology. Also as environmental problems know no boundaries; we must honor and be committed to responsibility as custodians for conservation of the Earth's natural resources while accepting the challenge of securing food for all.

The Department of Agriculture & Cooperation has notified the inclusion of following biopesticides in the schedule to the Act by Gazette notification No. G.S.R. 224 (E) Dt.26.3.99.

Antagonistic fungi and bacteria:

a) *Bacillus subtillis*
b) *Gliocladium* species
c) *Pseudomonas fluorescens*
d) *Trichoderma* species: *Trichoderma viride* - 1% WP (CFU 2

x 10^6 g/ml), 0.5%WP, 5%WP and *Trichoderma harzianum* – 0.5%WS

Entomogenous fungi :

a) Beauveria bassiana (1.15% WP)
b) Metarrhizium anisopliae
c) Nomuraea rileyi
d) Verticillium lecanii (1.15%WP)

Microbial biopesticides

a) Granulosis viruses (GV)
b) Nuclear polyhedrosis viruses (NPV) of *H.armigera* (0.43%AS, 2.0% AS) and NPV for *Spodoptera litura* (0.5%AS)
c) *Bacillus thuringeinsis*-k, Bt. *Serovar Kurstaki* (3a, 3b, 3c) 5% WP, Bt.var. *israelensis* WP

As a National policy the Government of India and the Indian Council of Agricultural Research (ICAR) are fully committed to the promotion of the IPM concept. The "Development of Integrated Pest Management practices to optimise plant protection" is under the "Priorities and Thrust Areas" for the Tenth Plan of the Department of Agricultural Research and education of the Ministry of Agriculture, Government of India also. The Government is also fully seized of the need for an effective and pragmatic National Pesticide Policy. Various steps have been taken in this direction and specific expert committees have been formed to advise the government on the various aspects of pesticide usage in the country. Integrated approaches to disease management involving host resistance, fungicides and cultural practices are much more common and gave effective results. It has been scientifically acknowledge that IPM is a viable and effective solution, which will form basis for sustainable agriculture. The greatest challenge is to do this without harming the environment and depleting the limited resource base for future generations.

Effectiveness and impact of IPM in measurable terms

- Reduction in consumption of chemical pesticides from 65,462 MT during 1994-95 to 55,540 MT during 2009-10.
- Increase in use of bio- pesticides from 683 MT during 2000-01 to 1267 MT during 2009-10.

- Increase in yield in the range of 6.17% to 42.14% in Rice IPM compared to non-IPM fields
- Increase in yield in the range of 20.7% to 26.63% in Cotton IPM compared to non-IPM fields.
- Increase in yield in the range of 14.8% to 27.7% in Pigeonpea IPM compared to non-IPM fields.
- Increase in yield in the range of 20.06% to 25.70% in Chickpea IPM compared to non-IPM fields.

Pesticides consumption declined from 56 to 100% in rice, from 29.96 to 50.50% in cotton and from 50.00 to 78.0% in pulses. Our efforts and implementation of areawide IPM in Gulbarga, the average number of sprays could be reduced from 9.8 times to 3.5 times and thereby reduced pesticide load in the environment as well as cost by 50 per cent. With the introduction of novel eco-friendly insecticides in the past 4-5 years, pigeonpea pod borer management now appears to be very promising. An IPM package, consisting of new molecules, botanicals (NSKE5%) and microbial agent (HaNPV) has been understood for the management of podborer. It has made the farmers aware of usage of many new molecules such as Spinosad 45SC (0.1ml/l), Indoxacarb 14.5SC (0.3ml/l), Emamectin benzoate 05SG (0.2 g/l), Flubendiamide 48SC (0.075ml/l), Rynaxypyr 18.5SC (0.1 ml/l) and IGR's for the management of pod borer. The new molecules and the insect growth regulators are selectively more effective on Helicoverpa and less toxic to beneficial insects as compared to all the conventional insecticides. Further farmers acquired the knowledge on right usage chemicals at right dosage and at right time using right spray equipment. The usage of ULV sprayer decreased from 57.3 to 34.9% whereas usage of high volume sprayer increased from 15.2 to 61.3%. There was drastic reduction in usage of dust formulations from 24.6 to 0.6%.

There is shift in type of insecticides used by farmers from conventional insecticides to new molecules to an extent 70.5% against pod borer. Per acre dosage used by the farmers is as per the recommendation. The quantity of water increased from 50 to 200 liters per acre resulting uniform distribution of chemical for effective management pod borer. Majority of the farmers (>95%) understood the concept of rotation of broad spectrum insecticides with new molecules. Farmers interest in organic farming and use of botanicals and HaNPV. Farmers themselves (0.1 to 0.8%)

understood the know-how about HaNPV production technology and usage for the management of pod borer. The results of farmer participatory approaches have been found to be very encouraging and apparently farmer awareness is undergoing massive sweep as evident through the enormous reduction in the usage of pesticides in Gulbarga districts by implementing the rapid roving survey programme.

Challenges and opportunities

In the absence of clear cut IPM policies at national level, we are still struggling to increase the area under the IPM from current 4 to 10 % in comparison to USA with 27% of its arable area under IPM. Apart from various technological constraints, consensus and confidence among field workers is lacking. Despite Government of India initiatives and establishment of infrastructures, and registration of more than 600 *Trichoderma* formulations the bio-agents are not getting popularised. Among other factors, it is due to intricate behaviour of bio-agents, compatibility with native organisms, shelf life and their quality. Following actions are required to make the agriculture sustainable:

- Implementation of Area-wide IPM through KVKs and State Dept on priority Crops.
- Strengthening of "National Plant Protection hub" to serve as National Pest Database for making decisions, based on real time pest scenario, prevailing cropping system and weather parameters.
- To educate and impart training for analysing real time pest status using GIS.
- To develop database on crop losses and pesticide use in different crops across the country.
- Strengthening of Climate resilience programme for detection and monitoring of pest scenario, early warning and devising strategies to mitigate their adverse impacts especially in rainfed areas. Spatial and temporal validation of the pest forewarning models using GIS and GPS.
- Redesigning of research activities for addressing national issues related to Nematode related pest issues, which is on increase.
- Establishment of network of light and pheromone trap at national level to understand changing pest scenario vis-a-

vis their predator and parasitoid population.

- Identification and integration of broad spectrum bio-pesticides (with crop and region specific strains) in IPM module for sustainable pest management.
- To strengthen the extension and social science functionaries available with us with objective of outcomes and adoption of Govt sponsored technologies with especial reference to critical IPM inputs.
- IPM being education based, year round capacity building programmes will be implemented to strengthen manpower available with Centre, State Government Departments, KVKs, Self-help groups and NGOs for effective utilization of resources.
- To develop entrepreneurship in the areas of Bio-agents formulation & production facility for protected cultivation, contract/precision farming involving organic cultivation and Eastern Indian States involved under Rice programme in National Food Security Mission, and
- Impact evaluation of IPM programmes with reference to Economic, Social and environmental aspects.

Pests often exist at low levels but erupt into epidemics rapidly under favorable conditions and of late the climatic changes are conducive for plant diseases. It has been observed that pathogen development as well as insect/vector development is more as a result of climatic changes and in this context we need to be more vigilant. Use of ICT in pest management is a step forward to counter these effects to greater extent. Above proposed challenges will help in expansion of IPM programme with the inbuilt benefits of sustainability and ensure nutritional security.

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Improving the Knowledge Level of Farmers about ICT Tools

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Agricultural development needs sea change to face the future challenges. Better growth always needs better approach. Much experimentation was done in India since green revolution to reach the end-users meaningfully. Even then, there is no single methodology/approach which holds good for ever. In the mean time, farmers' information needs have expanded considerably during last two decades from crop production issues to market oriented aspects. In this back drop, timely and relevant information is crucial for agricultural production in addition to land and capital.

Information and communication technology (ICT) generated lot of hopes to disseminate updated information to farming community, overcoming the barriers of distance, socio-economic status, gender etc. It is unfortunate that the advent of ICT is very limited in the field of agriculture as compared to other sectors. Now, farmers are interested to grow crops which are remunerative, willing to perform good agril practices and ready to extend their market networks even to reach oversea consumers. In this background, ICT will provide need based, accurate, timely and digitalized information to make the farmers more accessible to the day to day development in the field of agriculture. With the help of ICT, agricultural extension is expected to become more diversified, knowledge-intensive, and demand-driven, and thus more effective in meeting farmers' information needs. (Zijp, 1994).

In a comprehensive review of ICTD projects in India and the use of ICTs in the agriculture sector, Chattopadyay (undated) estimates that there are over 200 ICT-enabled development interventions in various stages of implementation across the country. Most of these include some components related to

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agriculture. These projects provide broadly four kinds of services. The first categories of ICT projects (e.g.; Bhoomi, Drishtee, etc.) provide information regarding government schemes and programs to rural people and they provide access points for retail products and services in rural India. (Bhatnagar et al., 2007). In the case of the agricultural sector, these projects provide the latest data on land records, etc. The second group of projects is largely concerned with e-commerce and trading issues (e.g.; e-*Choupal*, Warana, etc.). In such cases, agricultural markets have been computerized and networked to provide commodity prices to farmers. The idea is to leverage ICTs to reduce transaction costs, thereby making agriculture more attractive to small growers (Bowonder et al., undated). The third category of projects (e.g.: *Krishi Vigyan Kendras*/ Farm Science Centres at Baramati, Ahmednagar, etc.) provide off line static content on a package of practices, recommendations, locally relevant technologies, weather information, etc. through strong inter-institutional linkages (Dhawan, 2004). Lastly, projects like *Shiksha,* SEWA address capacity building issues of farmers, rural artisans, women and extension personnel (Chattopadyay, undated). The ICT tools used in these initiatives present an impressive list and include video conferencing, voice activated call centre facility, internet enabled PC based networking, voice and text messaging via mobile phones, internet based crop specific digital video, and interactive community radio (Rajendran et al., 2004; Mittal, 2010)

One of the studies on "Information and communication technologies as agricultural extension tools: "A Survey among farmers" by Anastasios *et al.*, (2011) showed the presence of available ICTs on farms. Further, the study also mentioned that all the respondents had at least one dial telephone and 80.41 per cent of the respondents own a television set. In addition 74.29 & 50.61 per cent of them possess a mobile telephone and DVD player respectively. Few of the respondents had access to sophisticated technologies like satellite television, global positioning systems or beepers. Based on the introduction, this paper is structured to discuss on ICT initiatives of UAS, Bangalore and the study conducted on the analysis of knowledge level of farmers about the ICT tools.

The University of Agricultural Sciences, Bangalore (UASB) located in the IT hub of India, initiated several ICT based

information deliver mechanisms in recent years to keep up with the pace of development in the field of communication, which involves

- Internet based connectivity though UAS website and Portals
- Video conferencing through VRCs/VKCs
- Mobile message services
- Multimedia DVDs
- Information Touch Screen Kiosks

Though internet communication added boost to the development in various sectors, so far the application has been limited in agriculture sector due to non availability of connectivity. UAS Bangalore has emphasized on connecting all its research, extension and teaching units through internet and intranet connectivity. It has started its own connectivity by establishing Agricultural Research Information System (ARIS) in the year 1998 and has also provided the necessary infrastructure in all its associated units to capitalize on the available technology. Through this there is a possibility for effectively sharing scientific information among the various outstation units and centres.

As a result it could explore the advantages of information communication technology by creating knowledge data base with credible source of information having uniformity and accuracy, with minimum errors and enhanced speed of work and cost saving. UASB also has a separate interactive website (www.uasbangalore.edu.in), which was launched during 2007 and it is being regularly updated with all the recent information along with photographs, illustrations, data base etc.

Video conferencing through VRCs/VKCs

The UASB is the pioneer institution in connecting all its KVKs/ TOT centres through two way interactive videoconferencing in collaboration with ISRO from June 2008. Through this network, regular videoconferencing programmes are being broadcasted from the expert centre located at university headquarters. The video conferencing is focusing on themes such as production technologies on crops and livestock, Credit & Insurance facilities, weather updates, market intelligence,

information on post harvest and Agro processing technologies, Schemes & programmes of development departments and so on.

Each VRC center is provided with VSAT connectivity which can also be used for Natural resource database / advisory, Tele-medicine and Tele-education facilities, provide space based remote sensing data and Geographic information system

By realising the success of the initiative, the project entitled "Establishment Of Village Knowledge Centres (Vkcs) In Karnataka" was initiated under RKVY funding to provide interactive video conferencing facilities from the *Krishi Vignana Kendras* and other TOT centres to farming community through *Raitha Samparka Kendras,* which are providing terminal link at *hobli* level. Under this project, 124 VKCs (58 – UASB, 66-UAS, Dharwad) are being established and 16 VRCs of UASB located at KVK/TOT Centres are being upgraded as expert centre and 12 expert centres are being established at UAS, Dharwad.

Through this facility, it can enhance the existing reach of information to the RSK level in an interaction mode and upgrade the knowledge level of farmers and reduce technological gap. This will also help in addressing location specific problems like dry land, hilly and costal issues etc. Further, this initiative will also effectively connect the University to the grass root level organizations such as RSKs. This help in extending limited scientific expertise available at the University to the ultimate users. In this regard, there is also scope to extend this facility to all the RSKs and integrate with other developmental organizations to broaden the information reach base.

Mobile message service

KVKs and TOT centers of the University are providing regular. of the University. Besides, UASB, UAS Dharwad and IKSL (IFFCO – Kisan Sanchar Limited) entered a tripartite MoA in April 2009, to provide farmers with mobile based voice and text messages and help line services. In turn, this can help in exploiting the mobile service for agriculture and rural services, providing advice to the queries, using cooperatives at grassroots level etc.

Multimedia DVDs

The learning become more effective when the number of senses involved in the communication process are more. Further, the retention capacity of the learners is also an important factor to be considered for wide spread adoption of learned information. Considering this principle, it could be observed that Television became an integral part of the masses in seeking information on recent changes which lead to further adoption looking into its local applicability.

The digitalized audio-video gadgets and multimedia services are important communication tools and play a vital role in reaching the farmers effectively. In the similar line, multimedia Digital Video Disc (DVD) would create more précised impact by providing need based technologies with digitalised touch and effectiveness. Depicting the real local situations and problems through DVDs would enhance learning process among the farming community. In addition, the DVDs will serve as reference material for future use of the farmers at the time of its applicability and adoption. More importantly it is a digitalised repository of knowledge and technology. DVDs can be used as education tool in reaching the un-reached section of the agrarian community. They can be used as a means to attend gender issues and over come the social barriers in extension education.

Though there are sporadic attempts by private agencies to bring out multimedia DVDs on production technologies, it has remained confined only to certain areas of farming sector, ignoring interest of the large section of the farming community. Using DVDs as a tool in disseminating farm information becomes major challenge in the process of communication, keeping its quality production matching with the interests and needs of the farmers. Considering the important role played by the DVDs in communication process, in 2009-10, a RKVY funded project has been successfully developed about 25 multi media DVDs on important crops/enterprises and agriculture technologies and others are in pipeline.

Information touch screen kiosks

Communication technology has advanced to the extent where it can enable information communication even without

interpersonal interaction. Information kiosks are a classic example in this regard. University is initiating Information Touch Screen Kiosks with updated technical know how at Agriculture Technology Information Center (ATIC) located at headquarters and further extending it to KVKs under RKVK project. The kiosks are user friendly device which are self directing and explanatory. There is access to all types of information with computerized data base and pictorial depiction. The Kiosks can be easily installed in remote places and round the clock service can be availed.

Knowledge of farmers about ICT tools

The study was conducted in three Talukas viz., Doddaballapur, Chintamani and Srinivasapura of Bangalore rural, Chikkaballapur and Kolar districts of Karnataka respectively. From each Taluka four villages were selected which are closer to KVKs. To measure the knowledge level of farmers about the ICT tools, seventeen statements were framed and the responses were recorded and the analysis was done.

Table 1: Overall knowledge level of the respondents about ICT tools

(n=120)

Category	Score	Frequency	Per cent
Low	<11.14	37	30.83
Medium	11.14-15.85	42	35.00
High	>15.85	41	34.17
	Total	**120**	**100.00**

A considerable percentage (35%) of the respondents had medium level of knowledge about ICT tools, as they possess few important ICT tools and using regularly (Table 1). The present era of globalization and liberalization have brought in competitiveness in agriculture production through adoption of improved technologies by the farmers. A considerable percentage of the respondents know that it is possible to get timely information through ICT tools specially information needed at critical stages of production and marketing information.

Limitations in using ICT tools among Farmers

The results of data analysis presented in Table 2 indicated that more severe problems in using ICT tools among farming community are electricity problems in rural areas because of

frequent load shedding in rural areas. More time and practice required learning the tools because of complexity of few tools and cost is more for few tools like computer, TV and internet connection due to their medium level of income, time of broadcasting and conferencing is not convenient due to time constraint in prime hours especially in TV programme. Since, most of the time farmers spend in field only hence they are unable to watch programmes during day time. Further, there is a lack of locally relevant information and not using local language in few tools.

Table 2: Limitations in using ICT tools

(n=120)

Sl. No.	Statements	Percentage	Rank
1	Electricity problems	95.60	I
2	Lack of ICT literacy among farmers	69.40	II
3	More time and practice required to learn to use the tools	69.40	II
4	Lack of trained man power	67.80	III
5	Clarification is difficult if any doubt arise	67.50	IV
6	Initial cost is more	67.50	IV
7	Time of broadcasting and conferencing is not convenient	67.20	V
8	Recurring expenditure is more	66.90	VI
9	Lack of training centers	65.60	VII
10	Dependency on interpreters	54.20	VIII
11	Problems of foreign language	46.90	IX
12	Lack of locally relevant information	43.90	X

Conclusion

ICT initiatives have opened a whole new set of options for agricultural extension education services to improve the speed and accuracy of communication at relatively lower cost in contrast to traditional extension systems. Application and success of ICT largely depend on availability of necessary infrastructure and the education of users for wider acceptance of the technology. As the proportion of extension worker to the number of farmers is significantly reducing in the recent days, ICT tools can be of great help in future extension system. However, ICT should not remain as a showcasing tool, instead

it should make real contribution towards strengthening the economy of the individual farmers.

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Economic Policies and Programs for Sustainable Horticultural Production

T. M. Gajanana, D. Sreenivasa Murthy and M. Sudha

Considering the importance of horticulture in attaining food and nutritional security, the emphasis on the development of horticulture sector started during the early eighties with establishment of national level institutions like National Horticulture Board (1984) followed by APEDA (1986), and formulation of policies like liberalized seed import policy (1988). However, major thrust was given during the 8th five year plan with a plan allocation of Rs. 1000 millions. New industrial policy (1991), National Agricultural Policy (2000), National Program for Organic Production (2001), National Horticulture Mission (2005), the new Seeds Bill (2010), EXIM Policy (2002-07) and the most recent EXIM Policy (2009-14) have all laid emphasis on development of horticulture sector. The paper discuses some of these polices, their implementation and the role played by these policies in sustainable horticulture production.

Current scenario of fruits and vegetables

World scenario

With the GOI initiatives having started bearing fruits, India is now the second largest producer of fruit and vegetables contributing about 12.40 per cent and 13.30 per cent to the total world fruit and vegetable production, respectively. Among fruits, India ranks first in the production of mangoes (41%), banana (28%), and papaya (30%). Among vegetables, India is the largest producer of peas (30%); second largest in brinjal (29%), cauliflower (29%), onion (18%) and cabbage (8%).

Indian scenario

Horticulture, including plantation and spices crops, has been growing over the years. Horticulture comprising fruits, vegetables and flower crops constitute the major chunk of this

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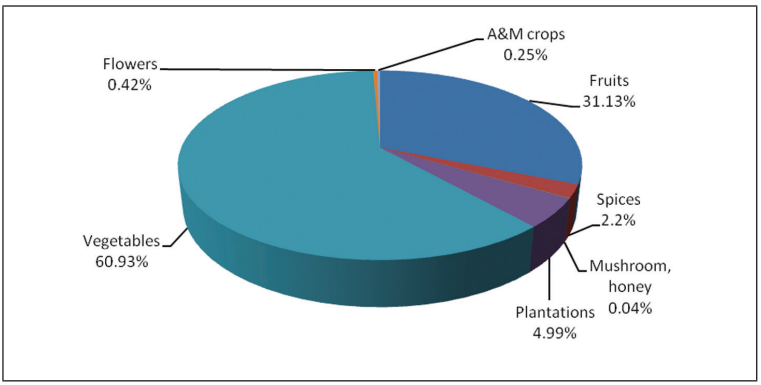
sector accounting for more than 90 per cent. Further, the share of these has also been increasing over the years. Horticulture, with 14 per cent of the net cropped area, contributes about 28.6 per cent to the agricultural GDP and the share of fruits and vegetables in this is to the extent of 25 per cent. Fruits and vegetables also account for about 37 per cent of total agricultural export earnings.



Horticulture scenario - 2010-11

Policies and program for the development of horticulture sector

Several programs and policies have been formulated in the last decade for the development of agriculture in general which lay emphasis on development of horticulture sector in particular.

National agricultural policy (2000)

- A growth rate of 4 per cent in agricultural sector
  - Horticulture sector with >6% growth is the most sought after sector
- Growth with equity
  - Horticulture sector caters to the needs of small and marginal farmers spread across the country
- Major thrust for horticulture sector for augmenting food supply, promoting exports and generating employment in rural areas
  - At present, horticulture accounts for about 30 per cent of agricultural GDP and around 40 per cent of the agricultural exports.

  - Commercial vegetable seed production is labour intensive and provides gainful employment opportunities even to family labour. For example, in vegetable seed production, share of labour accounts for about 50 per cent of the total cost of production. Flower crops like crossandra and jasmine generate employment of 913 man days and 1210 man days respectively as against only 175 man days in case of paddy, 285 man days in case of sugar cane and 105 man days in groundnut.
- Emphasis on market infrastructure and techniques of preservation, storage and transportation to reduce post harvest loss (PHL) and ensure better return to growers
  - Model APMC Act (2003) makes provisions for establishment of private markets, e-trading in horticultural commodities, use of PPP for construction of markets, contract farming etc,.
- Agro-processing units in the production areas to reduce wastage, increased value addition and creation of off-farm employment in rural areas
- Provide a package insurance policy for the farmers – sowing to post harvest operations, price fluctuations etc.
  - The present crop insurance policy follows the area approach but individual approach is preferred.
- Strengthening of data base for planning and policy making
  - Although, some improvements have been seen on data base development, yet, variety wise area, production, productivity, prices, exports are not available for different fruits and vegetables. Further, in case of perennial crops, area and production under bearing orchards are not available.

Growth in production of fruits and vegetables

In India, fruits are grown on an area of 6.45 million hectares with a production of 75.55 million tonnes. During the last decade (2001-2011) fruit production has increased at a compound growth rate of 6.86 per cent. The important fruits are mango, citrus, banana, apple, litchi, guava, pomegranate and sapota. Vegetables are grown on an area of 8.20 million hectares with a production of 141.41 million tonnes. Vegetable production has registered a growth of 6.08 per cent during the last decade. The important vegetables grown are potato, brinjal, tomato, onion, okra, cauliflower, cabbage and green peas. Production of fruits

and vegetables has increased from about 131.62 million tonnes in 2001-02 to 216.63 million tonnes in 2010-11 registering a growth of 6.34 per cent. During the last decade, horticulture sector as a whole has registered a growth of over 6 per cent, major contributions coming from fruits and vegetables [Table 1].

Table 1: Growth rates in fruits, vegetable, flowers and horticulture sector during the last ten years (2001-11) (%)

Crops	A	P	Y	Remarks
Fruits	6.00	6.86	0.81	Area led growth
Vegetables	3.78	6.08	2.21	A&Y led growth
F&V	4.70	6.34	1.57	Area led growth
Flowers	9.92	7.42 (64.49)*	-	-
Horticulture	2.82	6.07	3.14	A&Y led growth

*Cut flowers

During the last five years (2006-07 to 2010-11) fruits and vegetables together registered a growth of 5.21 per cent in production, 2.96 per cent in area and 2.18 per cent in productivity. As regards fruits, production registered a growth 6.26 per cent which was mostly area led (4.17%) rather than productivity led (2.00%). In case of vegetables, production grew at 4.67 per cent with almost equal contribution from area (2.05%) and productivity (2.56%). Horticulture sector as a wholes registered a growth of 4.49 per cent which was the result of both area and yield growth [Table 2].

Table 2: Growth rates in fruits, vegetable, flowers and horticulture sector during the last five (2006-07 to 2010-11) years (%)

Crops	A	P	Y	Remarks
Fruits	4.17	6.26	2.00	Area led growth
Vegetables	2.05	4.67	2.56	A&Y led growth
F&V	2.96	5.21	2.18	A&Y led growth
Flowers	6.98	7.49 (18.57)*	-	
Horticulture	2.16	4.49	2.28	A&Y led growth

*Cut flowers

In the last five years, area under fruits increased from 5.5 mil. ha. to 6.45 mil. ha. registering a growth of 4.17 per

cent. Production of fruits increased from 59.56 mil. tonnes to 75.22 mil. tonnes registering a growth of 6.26 per cent. Major fruits registering increase in area are papaya, litchi, banana, citrus and pomegranate. Significant contributors to increased production of fruits are banana, papaya, pomegranate, sapota, citrus, mango, guava and litchi. Production growth of fruits has been mainly area led as the productivity registered a growth of only 2 per cent. However, in the absence of data base on bearing and non-bearing orchards it would be difficult to generalize that the productivity of fruits is low and its growth is declining.

The area under vegetables increased from 7.58 mil. ha. to 8.2 mil. ha. with a growth rate of 2.05 and production of vegetables increased from 93.17 mil. tonnes to 141.41 mil. tonnes registering a growth of 4.67 per cent. Brinjal, okra and tomato contributed to the increased area under vegetables while onion, tomato, okra and brinjal showed greater increase in the production of vegetables. Productivity of vegetables increased at a rate of 2.56 per cent indicating thereby that production of vegetables has been the result of both area and yield increase in the last five years.

Table 3: Area and production share of fruits and vegetables (%)

Fruits	A	P	Vegetables	A	P
Mango	36.53	21.01	Potato	22.98	27.35
Apple	4.47	2.48	Onion	9.47	9.09
Banana	12.17	37.01	tomato	7.94	9.3
Citrus	15.59	13.47	Brinjal	7.66	7.9
Guava	3.48	3.6	Cabbage	4.14	5.44
Grapes	1.67	1.23	Cauliflower	4.36	4.91
Litchi	1.17	0.67	Okra	5.66	3.59
Papaya	1.52	5.47	Peas	4.57	2.26
Pineapple	1.45	1.94	Tapioca	2.91	6.03
Pomegranate	1.97	1.15	Sweet Potato	1.49	0.81
Sapota	2.51	1.88	Others	28.08	23.31
Others	17.46	10.07			
Total	100	100	Total	100	100

Share of different fruits and vegetables in area and production

As can be seen from Table 3, though area share of mango is the highest (37%), the production share is only 21 per cent. However, in case of banana, papaya, citrus and grapes production share is higher or at least equal to area share. This gives us an indication that productivity, especially in case of fruits- mango, is a matter of concern as there has been stagnation leading to area lead growth in production. This needs to be addressed at the earliest.

Shift in consumption pattern in favour of fruits and vegetable

There has been a shift in the consumption pattern due to urbanization, rising incomes and the emergence of quality and health conscious consumers. Accordingly, consumers now demand high value horticulture produce like fruits and vegetables which are rich sources of vitamins, minerals and are generally nutritious in nature. In fact, the monthly per capita expenditure on fruit and vegetables increased from Rs.21.90 during 1993-94 to Rs.44.50 during 2004-05 for rural households. In case of urban households, the same increased from Rs.37.20 to Rs.70.05 during the period. The share of fruit and vegetables in total food expenditure increased by more than 1 per cent during this period. Due to the high purchasing capacity, they also look for quality, healthy and safe produce. This has resulted in the emergence of markets for safe and nutritious horticultural produce. In order to ensure availability of safe and nutritious produce, pressure has now been shifted towards production of safe produce itself. This is being attempted in the form of integrated pest management (IPM), integrated disease management (IDM), Pesticide residue free IPM, organic farming, export oriented production etc,.

Production of safe and nutritious horticultural produce

Integrated pest management in horticultural crops

Studies on impact of IPM in vegetables revealed that the quantity and the number of chemical spray were observed to be substantially less on IPM farms as compared to non-IPM farms. [Gajanana *et al*. 2004, 2006, 2007]. Further, it was also observed that the pesticide residue was found to be below the MRL on the produce collected from the IPM farms [Sharma *et a*l, 2009].

The pesticide residue free package for vegetables developed at IIHR, Bangalore was found to ensure residue free vegetables [Krishnamoorthy *et al.*, 2004]. Export oriented production of grapes was found to ensure the international standards like Global Gap, MRL and SPS [Sreenivasa Murthy *et al.*, 2011].

Organic farming

Though there is no mention of organic farming in the national agricultural policy (2000), considering the need to provide the safe and nutritious produce, the government formulated the national program for organic production which some states like Karnataka are implementing through mission mode approach.

National program for organic production (2001)

Aims

- To provide the means of evaluation of certification programmes for organic agriculture and products as per the approved criteria.
- To accredit certification programmes
- To facilitate certification of organic products in conformity to the National Standards for Organic Products.
- To encourage the development of organic farming and organic processing

Scope

- Policies for development and certification of organic products
- National standards for organic products and processes
- Accreditation of programmes to be operated by Inspection and Certification Agencies
- Certification of organic products

Opportunities for organic production

India is endowed with various types of naturally viable organic form nutrients across different regions of the country which will be helpful in organic cultivation of crops. With wide diversity in climate and eco-system, India has a strong traditional farming system with innovative farmers, vast dry lands and least use of chemicals. Studies on organic cultivation of fruits and vegetables have shown promise of being less expensive and hence profitable.

[Organic farming in Jharkhand, 2011]. Some other studies have indicated the organic cultivation being profitable but expensive because of the costly organic inputs [Sreenivasa Murthy, 2007]. He observed that the cost of organically cultivated tomato worked out to Rs 1,36,901/ha comprising Rs 68,929 towards production, Rs 51,200 on marketing and Rs 16,722 on fixed inputs and certification. Organic input 'Soleneem' accounted for 29.7%. Cost of organic production was Rs 1.83/kg compared to Rs 1.41 in IPM and Rs 1.64 in conventional farming. Based on 30 % premium price, the gross return was 3,90,000/ha with a net return of Rs 2,53,099. BCR was 2.85 compared to 2.43 in conventional farming and 2.84 in IPM farms. Ravishankar *et al* (2010) observed organic papaya to be profitable. Being eco-friendly and less harmful to health, many countries are showing interest in organically grown produce for consumption. The NPOP standards for production and accreditation system have been recognized by the EC and Switzerland as equivalent to their country standards. Similarly, the USDA has recognized NPOP conformity assessment procedures of accreditation as equivalent to those in the US. With these recognitions, the Indian organic products duly certified by the accredited certification bodies of India are accepted by the importing countries [Reddy 2010]. Though there is no mention of organic farming in the national agricultural policy, some states like Karnataka are promoting organic farming through schemes like organic mission. Overseas, companies like Netherlands based Eosta, Thailand exporters – Swift Company Ltd. are showing keen interest in organically grown horticultural crops especially vegetables and fruits.

Challenges of organic production

An estimated 69 millon hectare is traditionally cultivated without using chemical fertilizers and could be eligible for organic certification under the current practices or with small modifications. However, certification of these farms may be a challenge as many of these are small holdings; the farmers of these tiny holdings may find it hard to meet the cost of certification. Besides, being illiterate, they may not be able to maintain the records required for the purpose of certification. Further, no conclusive evidence to show that organic cultivation is less expensive as organic inputs used for cultivation are costly and sometimes not available in time. Marketing of organically grown produce is different from that of regular marketing as

it requires careful selection and development of large markets and distribution channels. Such marketing requires not only additional costs but also specialized skills, know-how and experience [Reddy, 2010].

Emerging markets for safe and nutritious horticultural produce

Domestic markets

Health and quality conscious consumers are now looking for safe and nutritious horticultural produce and in order to make available such produce, markets, though on a small scale, have emerged in the form of outlets for organic produce, fresh and dried horticultural produce markets, carbide free produce etc,. The recent experience of HOPCOMS selling carbide free mangoes is a case in point. Emphasis on organically produced mangoes in Chittoor being supplied and market for such mangoes is another example of making available the safe and nutritious mangoes to the consumers. Enterprises like Era Organic, Phalada Agro Research Foundation, ISKON, Bangalore are involved in production and marketing of organically grown commodities in their own retail outlets in Bangalore.

International markets

Since the overseas importers of horticultural commodities like fruits, vegetables, medicinal crops are insisting on Global GAP, SPS and MRL, the exporters of these commodities procure them after meeting the required standards which ensures safe horticultural produce in the international markets. Further, organic products with 'Certified Organic' have an overseas market. International importers like the Netherlands based Eosta, Thailand based Swift are showing keen interest in organically grown fruits and vegetables.

The seeds bill 2010

The new Seed Bill 2010 has certain provisions which would be addressing the concerns of farmers to some extent.

- Farmers should have access to quality seed and private sector should have incentives to invest in agricultural R&D to produce quality seed

- Quality seed
  - The standards for quality seed to be defined
  - Adequate infrastructure for monitoring seed quality standards
- Seed price regulation
  - New IP regime and increased transaction cost
  - Increased privatization of seed sector and absence of competition may lead to increased price of the seed
- Promote competition through PPP

EXIM policy 2009-14

Export promotional measures have been proposed in the policy document. The measures relevant to horticulture development are: Infrastructure support to states (ASIDE), - Agribusiness Zones, Market access Initiatives - International trade Fairs, Market studies/surveys, Brand Promotion; Market Development Assistance - Trade Fairs/Traders' Meet/Seminars-Travel Grant; Towns of Export Excellence (TEE) - Up to Rs.150 cr. Assistance, Brand Promotion and equity, Made in India label; Export and Trading Houses: EOU, units in SEZ/AEZ, Agri-infrastructure incentives scrip under VKGUY-10% of FOB for Cold storage units, Pack Houses, Reefer Vans, Other Capital Goods; Export Promotion Capital Goods (EPCG) Schemes - 3% customs duty on import of capital goods; Duty exemption schemes - Duty free import authorization (DFIA) scheme and Advance authorization scheme (AAS).

Challenges ahead for sustainable horticulture production

Supply and demand for fruits and vegetables by 2016-17

With a production growth of 4.67 per cent in vegetables and 6.26 per cent in fruits the total production of fruits and vegetables available by 2016-17 would be 292.88 million tonnes with 184.08 mil. tonnes of vegetables and 109.39 million tonnes of fruits. Considering a population of 1409 million by 2017 and the per capita dietary requirement of 400 g per day, the demand for fruits and vegetables would be 247 million tonnes. Export and seed requirements also to be met and hence the demand will be much higher than 247 million tonnes. Further, in order to meet the demand for horticulture produce, the production of 100 million tonnes which could be produced in the last 10 years are to be produced in a span of just five years during the XII plan.

Major bottlenecks

Despite the research achievements and generous support for the developmental activities by the government of India, Indian horticulture is plagued by several constraints [Prabhakar *et al*, 2011] which need to be addressed at the earliest.

Low and declining productivity: One of the disquieting features of the Indian horticulture sector is the low and declining productivity of fruits and vegetables. Among fruits, with the exception of banana and papaya, the average productivity is much lower (11 t/ha) in India compared to many advanced fruit producing countries (21 t/ha in USA, Brazil). In case of vegetables, the productivity is 17 t/ha in the country which is much below the world productivity (33 t/ha – Spain). Low productivity levels decrease the profitability of farmers, especially the small and marginal growers.

Deteriorating production environment: Indian agriculture is predominantly small holders' agriculture as about 83 per cent of the holdings are small and marginal. The contribution of agriculture in the GDP has declined from about 30 per cent during 1990-91 to about 15 per cent now. The average size of the landholding declined from 2.30 ha in 1970-71to 1.23 ha in 2005-06 with a concurrent increase in the absolute number of operational holdings from about 70 million to 129 million. The holding size for horticulture sector is no different, with the added constraint that it is mostly the marginal lands that is available for horticultural production. Moisture and salinity stress, poor soil fertility etc are characteristic features of such marginal lands to which horticulture has extended recently and have to extent in future. Thus, while striving for increasing the productivity of small and fragmented arable land, it is also imperative to use the degraded and marginal lands as well as places with abiotic stresses for extending the cultivation of horticultural crops. Even in good arable lands, the problems of land and water degradation are to be addressed to sustain productivity.

Post harvest loss and its impact on per capita availability: Despite phenomenal increase in the production of fruits and vegetables, the nutritional status of the population has not improved much, as the per capita availability of fruits and vegetables is still about 104 and 207 g/day respectively, far less

than the recommended levels of 120 and 300 g/day respectively. A main reason for low per capita availability is the enormous losses of fruits and vegetables which are estimated to be 15 to 50 per cent [FAO, 1981; Roy, 1989] that occur at different stages of handling, transport, storage, processing and distribution. India loses fruits worth Rs.12700 - 15876 crore (20-25% loss at average price of Rs.10,000/t) and vegetables worth Rs.12588 crore (20% loss at average price of Rs.5000/t), totaling to Rs.25289 –28464 crore annually. Further, it was observed that an amount equivalent to 1.2 per cent of agriculture GDP goes as loss due to losses in mango, banana and grapes (Rs.7619 crore) [Sreenivasa Murthy *et al.*, 2009].

Changing quality consciousness and global competition: As the consumers are becoming more quality conscious around the globe, improving the quality of horticultural produce is essential to make Indian horticulture globally competitive and to take advantage of the international trade liberalization. Quality is a very broad term including physical appearance, chemical composition with reference to taste and flavour as well as hygiene and health factors, especially pesticide residues and heavy metal contamination and its amelioration is essential for export promotion as well as import substitution.

Climate change and horticulture: Global temperature is predicted to increase gradually leading to more frequent hot extremes, floods, droughts, cyclones, and recession of glaciers. Dynamics of pests and diseases and pollination biology would be altered as a consequence resulting in greater instability in horticultural production and farmers' livelihood security.

Absence of market linkage and price stabilization: Absence of market infrastructure facilities for obtaining information on fluctuating prices poses a major threat for the horticultural producers in realizing higher returns. Effective and efficient market linkages, modalities of market regulation and price support are gaining utmost importance for making horticulture a profitable venture.

Interventions/innovations needed to mitigate the challenges

The second sub group on horticulture for XII plan is contemplating on the following interventions/innovative policies for mitigating

the challenges that lie ahead [Sudha *et al.*, 2011].

- Technology Mission for Rainfed Horticulture
- Quality control labs at district level with facility for fidelity & virus testing (diagnostics tool kits)
- Horticulture Seed and Planting Material Villages
- Horticulture mechanization
- Bee keeping, mushroom and medicinal plant promotion
- Risk assessment & mitigation strategy
- Development of climate resilient technologies to mitigate the effect of climate change in the form of abiotic and biotic stresses
- Strengthening market linkages and establishment of price stabilization fund
- Emphasis on production and marketing of safe and nutritious produce through IPM/IDM and organic farming
- Strengthening of data base for planning and policy making
  - Variety wise A,P,Y; variety wise exports; variety wise prices
  - Data on bearing and non-bearing fruit orchards
- Pest Risk analysis for export promotion

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Significance of Livestock Economy in India's Agricultural Development

Lalith Achoth

The Livestock sector comprises animal husbandry, dairy and fisheries. It plays an important role in the agricultural economy and in the socio-economic development of the country. It supplements family incomes and generates gainful employment in the rural sector, particularly the landless labourers, small and marginal farmers and women's.

According to 17th census of the livestock, their existing population is 4,85,002. It is increasing day by day due to its importance as an alternative source of income and food also. It is an important source of draught power, manure for crop production and fuel for domestic use. Livestock sector is an important source of income to the farmers and rural poor peoples. The livestock subsector has made a significant contribution to poverty alleviation, as the livestock elements are largely concentrated among the marginal and small farmers in rural areas. About 70% of livestock is owned by 67% by small and marginal farmers and by the land less. Thus, Livestock is an important source of income for the rural poor. The livestock subsector plays a very important role in poverty alleviation in rural areas. The livestock sector contributes a little over 4.00 per cent to the total GDP. According to estimates of the Central Statistical Organization (CSO), the value of output from livestock and fisheries sectors together at current prices was about Rs.2,82,779 crore during 2007-08 which is about 31.6 per cent of the value of the output of Rs.8,94,420 crore from agriculture & allied Sector.

Livestock accounts for a quarter of the agriculture gross domestic product (GDP). In 2010-11, it generated outputs worth Rs 3,40,500 crore (at current prices). This is 28 per cent of the agriculture GDP and about 5 per cent of the country's GDP.

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"The total output from livestock is higher than the value of food grains (Rs 3,15,600 crore) and fruits and vegetables (Rs 2,08,800 crore), and this is going to go up substantially," estimates V K Taneja, vice-chancellor of Guru Angad Dev Veterinary and Animal Science University in Ludhiana.

After livestock, paddy is the next highest contributor to the agriculture GDP. In 2009-10, output from livestock was 2.5 times the value of paddy and more than thrice the value of wheat, as per the Central Statistical Office data. Animals are natural capital, which can be easily reproduced to act as a living bank with offspring as interest, and an insurance against income shocks of crop failure and natural calamities.

Livestock output is the fastest growing among the three components. Its contribution to the total output of the agriculture sector increased from 15 per cent in 1981-82 to 26 per cent in 2010-11. The rate of growth of livestock output has, however, slowed down. In 1980s, its growth rate was 5.3 per cent—almost twice that of the crops. This declined to 3.6 per cent in 2000s but is still 1.5 times the rate of growth of the crops component.

Production of milk

India continues to be the largest producer of milk in the world, with 13.1 per cent of the total milk produced in the world. Hence, India has attained the first rank in milk production in the world. At present the first five countries in the world producing maximum milk are India, USA, Russia, Germany and France. At the beginning of planning, the production of milk was only 17 million tonnes (MT) in 1950-51 in India. Now it has increased to 120 million tonnes. However, inspite of high growth rate, the per capita availability of milk in India is 252 grams per day is lower than the norm of 280 grams per day.

Poultry

Poultry is one of the fastest growing segments of the livestock sector in India today. Their growth rate has been rising at 8 to 10 percent per annum. As a result, India is now the world's fifth largest egg producer and the eighteenth largest producer of broilers. Table eggs and broiler meat are the major end products of the poultry sector in India. The organized sector of poultry industry is contributing nearly 70% of the total output

and the rest 30% in the unorganized sector in India. The Andhra Pradesh, Tamil Nadu and Maharashtra producing nearly 70% of the country's egg production. Presently production of eggs is estimated to number about 37 billion, that of broilers 895 million, and that of poultry meat 735,000 tonnes. Egg production has increased from 21 billion in 1990-91 to 51 billion numbers in 2006-07 and 53.5 billion numbers in 2008. India ranks fifth in the world with annual egg production of 1.61 million tones. Poultry exports are mostly to Maldives and Oman. Indian poultry meat products have good markets in Japan, Malaysia, Indonesia and Singapore.

Fish production

India has about 8041 km of coastline, and about 5.70 million ha of fresh water area suitable for fisheries production. Fishing, aquaculture and allied activities are reported to have provided livelihood to over 14 million persons in 2006-07. In 2001 overall fish production was 5666 thousand tonnes it gradually increasing continuously. At present, India's total fish production is about 76.21 thousand tonnes.

This sector has great potential to export fish and fish products. Since 1991, the overall export of fish is raised at considerable rate. According to the data provided by ministry of agriculture and commerce of India, there export of fish and fish product increased from last ten years. In 1991 India has exported 140 thousand tonnes of fish and fish products but till it reached to 541 thousand tonnes its money value is Rs. 7621 crore in 2008.

Meat and meat products

The meat products industry in India is largely in the un-organized sector. With rapid urbanization, higher income levels and changes in lifestyle, market for scientifically produced and hygienically packed meat and meat products are expanding rapidly. Today, the increasing demand for the meat and meat products for in domestic and foreign market, particularly to the Gulf and West Asia and neighboring countries. In 2003 India had a livestock population of 470 million that included 205 million cattle and 90 million buffaloes. Cattle, buffaloes, sheep and goat, pigs and poultry are the types of animals, which are generally used for production of meat.

There is a huge scope for expanding exports, especially in buffalo and poultry meat, eggs and dairy products. Slaughter rate for cattle as a whole is 20%, for buffaloes it is 41%, pigs 99%, sheep 30% and 40% for goats. The country has 3,600 slaughterhouses, 9 modern abattoirs and 171 meat-processing units licensed under the meat products order. The production of meat has increased 1.9 million tonnes to 23 million tonnes from 2001 to 2007.

In the meat and meat processing sector, poultry meat is the fastest growing animal protein in India. The estimated production of meat was 6.5 million tonnes during 2007-08. Per capita consumption increased from 870 grams in 2000 and expected to reach 2 Kg during 2009. According to APEDA, the export of buffalo meat was increased from 343817.08 tonnes (value Rs 1536.77crore) in 2003-04, to 483478 tonnes (Rs.3549.70 crore) in 2007-08. The export of sheep/goat meat is increased from 16820.53 tonnes (Rs 110.39 crore) in 2003-04 to 8908 tonnes (Rs.134.09 crore) in 2007-08. The processed meat export was 986.13 tonnes (Rs 7.63 crore) in 2003-04 and now it is 1245 tonnes (value Rs 12.96 crore). The export of poultry products was 415228.17 tonnes (Rs 202.40 crore) in 2003-04 it is also increased near about 1355246 tonnes (Rs 401.08 crore) in 2007-08.

Livestock species consist of cattle, buffaloes, sheep, goats and pigs (about 450 million) and poultry (450 million). Their asset value is estimated to be Rs. One lakh crore ($20b). Market value of their output – milk, work, dung, and fiber, eggs, meat and slaughter byproducts - is estimated at Rs. 1.2 lakh crore ($24b). Total fund spent for management of the livestock sector is less than Rs. 2,000 crore ($400m) per year.

Strangely, milk, eggs and meat, which are food items, are valued at Rs.1,00,000 crore ($20b). Indirectly, Dairy animals contribute energy for ploughing and carting, valued at Rs. 6,000 crore ($1.2b) per year. Dung is used as manure and fuel, which may be worth Rs.5,000 crore ($1b). And yet, this vital sector still remains neglected.

Meat sector

Cattle and buffaloes are primarily reared for milk production and drought animal power. After their productive

life, they are used for production of meat and hides. Sheep, goats and pigs are largely raised for meat, though sheep are raised for wool, and goats for milk, as well. Meat is an item for human consumption. And yet, meat is the most neglected sector in our country, resulting in enormous wastage, environmental pollution, health hazard to meat eaters and residents around abattoirs and unnecessary suffering to animals.

Annual meat output is about five million tonnes, valued at Rs.15,000 crore ($3b). The meat sector is in a deplorable condition. Only five out of the 3,000 legal Municipal abattoirs have been modernized. Most slaughter takes place in the unorganized sector, in clandestine ways, in backyards and by-lanes. Meat outlets are fly-infested and dirty.

Modernization

Modernization includes health and veterinary care, increased fodder and feed, transport of animals in well designed trucks or wagons, adoption of stunning prior to slaughter, modern abattoir operations and marketing methods, processing of slaughter by products and elimination of all avoidable cruelty to animals.

Modernization of slaughter houses

Most of the 3,000 Slaughter Houses (SHs) were established in the early years of this century, away from city centers. But bus stands, bazaars, worship centers, schools and residential buildings now in central parts of cities, which are crowded and congested, surround them. There is no space for expansion. SHs, which were meant for 100 animals, are now slaughtering 1000 to 5000 per day, which means congestion and suffering to animals. Efforts in the past to relocate

SHs away from city centers were not successful due to objection from butchers and residents in the area identified for location. Also, there are religious groups, which are against slaughter, relocation, stunning etc. Some Municipalities are trying to establish huge SHs near cities. This is not a good idea, since it involves huge investment. Further, animals have to be brought to city SHs, entailing wastage and animal suffering.

Rural abattoirs

The solution lies in shifting SHs away from cities to rural areas, where animals are born, raised and utilized for milk and work. After their productive life, they become available for meat. Sheep, goats and pigs are primarily for meat. Such meat animals become available in animal dense areas or animal tracks. SHs should be located away from villages. Such Rural-based Abattoirs (RAs) will eliminate most of the ill effects of City-based Municipal Abattoirs. Animals can be slaughtered in these small RAs, and only carcasses need be brought to towns in air-cooled or refrigerated vans. Environmental pollution in cities will be eliminated. In RAs, meat can be produced under hygienic conditions. Animals under stress during transport secrete toxic substances, which affect quality of meat. Cattle and buffaloes, weighing about 400 kgs, yield only about 80 kg of meat. Similarly, a 25 kg goat or sheep would only yield about 10 kg of meat. Transportation of carcasses will be much cheaper. In the RA scheme, transport of animals is eliminated, resulting in reduced transport cost and avoidance of needless suffering.

Value added

Meat animals belong to rural people. When RAs are introduced, most middlemen, who now take away bulk of the margin, will be eliminated. In the existing practice, "Value added", goes to urban people. By establishing RAs, the "Value added" will remain with rural people. Employment in RAs and associated industries, which would be processing skin and slaughter by-products, will increase rural income. Meat animals, valued at Rs. 10,000 crore ($2b), ultimately fetch Rs. 20,000 crore ($4b) of meat, skin and slaughter by-products. This means that about Rs.10,000 crore ($2b) can be retained in rural areas if RAs are established.

RAs and rural development

RAs can be integrated into the rural development schemes. Industries for processing of skin, rendering plants, which would use the non-edible parts of animals and several other industries, can be established in rural areas, all of which would create employment and increased earnings. Inspection of animals before slaughter can be done in the shandy itself. Such RAs can be service abattoirs, or operated as commercial or cooperative enterprises.

Benefits of livestock sector development in India

Animal Husbandry sector provides large self-employment opportunities. Presuming that one family member is employed in looking after the livestock, 25 million people are estimated to be employed with the livestock rearing activity. This sector is playing very important role in the rural economy as support sector of the economy. Especially 70 million rural households primarily, small and marginal farmers and landless labourers in the country are getting employment opportunities in dairy. Dairying has become an important secondary source of income for millions of rural families.

Poultry is also another way of getting food and food security in India. Apart from food security it has provides employment to about 1.5 million people. Livestock Sector not only provides essential protein and nutritious human diet through milk, eggs, meat etc but also plays an important role in utilization of non-edible agricultural by-products. Livestock also provides raw material/by products such as hides and skins, blood, bone, fat etc.

This provides subsidiary occupation to a large section of the society particularly to the people living in the drought prone, hilly, tribal and other remote areas where crop production on its own may not be capable of engaging them fully. In the adverse climatic conditions and national calamities like drought, flood etc., animal husbandry practices shall be proved to be boon for sustaining the livelihood of the landless and marginal farmers in the state.

Policy makers in India are finally acknowledging a structural shift in the agriculture sector they have been noticing for a decade. Economic contribution of livestock is today more than that of food grain crops. Traditionally, of the three components of the sector—crops, livestock and fisheries—crops drove the growth, and food grains are a major part of it. As a result, policy and programmes focused on crops

Driving livestock growth are changes in the utility of livestock for farmers and in food consumption pattern. Importance of livestock as the "draught power" has declined due to mechanization of agricultural operations and declining

farm sizes. Use of dung is also being replaced by chemical fertilizers. At the same time, consumption of livestock products like eggs, milk and meat is increasing due to rise in the income of the booming middle class, both in urban and rural areas. Between 1983 and 2004, the share of animal products in the total food expenditure increased from 21.8 per cent to 25 per cent in urban areas and from 16.1 per cent to 21.4 per cent in rural areas. Small and marginal farmers, landless labourers and women are more dependent on livestock for supplementing incomes and generating gainful employment in rural areas. The livestock sector is expected to emerge as an engine of agriculture growth in the 12th Plan and beyond in view of rapid growth in demand for animal food products," says the report of the working group on animal husbandry and dairy. Livestock has assumed the most important role in providing employment and income generating opportunities.

Poverty alleviation

Rise of the livestock sector has implications for poverty. Rural poverty is less in states where livestock contributes more to farm income, as per the Planning Commission report. Punjab, Haryana, Jammu and Kashmir, Himachal Pradesh, Kerala, Gujarat and Rajasthan are a case in point. Mostly, marginal farmers and those who have quit farming are joining the livestock business. About 70 per cent of the livestock market in India is owned by 67 per cent of the small and marginal farmers and by the landless, says Roy. One way, prosperity is now more dependent on per capita livestock ownership than on farms.

But this is not the full potential of the sector. Absence of policy focus has stifled the sector that caters to the poorest. India's livestock productivity is 20-60 per cent lower than the global average. Deficiency of feed and fodder is the biggest factor responsible for 50 per cent of the total unrealised production potential, followed by inadequate breeding and reproduction, and increasing diseases among animals.

Livestock is considered more reliable than rain-fed agriculture. Livestock receives only 12 per cent of the total public expenditure on the agriculture and allied sector and four-five per cent of the total institutional credit flow into the sector. Livestock, poultry, fisheries and horticulture are surging

ahead in production growth in recent years and will have good demand in the future. Despite the structural change, agriculture still remains a key sector, providing both employment and livelihood opportunities to more than 70 percent of the country's population who live in rural areas. The contribution of small farmers to the national and household food security has been steadily increasing.

Food grain supported

Output value of food grains is about Rs. 1.8 lakh crore ($36b), which gets over Rs. 30,000 ($6b) worth of subsidy, a vast management network including the Food Corporation and high priority in research and extension by Agri - Universities and ICAR institutions. One major reason for poverty and lack of purchasing power even to procure food grains for their own use is neglect of livestock. China produces 300 m tonnes of food grains from 100 m hectares of land (3 tonnes per ha), while India is able to get only an average of 1.4 m tonnes per hectare, which shows that China's productivity is double of that of India. Lack of technology and management is the main reason for such poor performance.

Draught animal power

80 million Draught Animals (DAs), mostly bullocks, make available 40 m horse power in as many points of application for ploughing and carting. DAs provide energy for ploughing 100 m hectares, forming 2/3 of the cultivated area. DAs haul 25 billion tonne km of freight in 14 m bullock carts (BCs). DAP saves 6 m tonnes of petroleum, valued at Rs. 12,000 crore ($2.4b) per year. Small and marginal farm lands are further getting fragmented, and dependence on DAP would continue. Mechanization of agricultural operations by tractors and transport by trucks should be encouraged, wherever technically feasible, economically viable and ecologically desirable. Replacement of DAP by petroleum based mechanical power would need an investment of Rs. One lakh crore ($20b), which is beyond the reach of marginal and small farmers.

DAP underutilized

70 million rural based bullocks are used only for 100 days a year for ploughing and carting. Unlike tractors and trucks, DAs have to be fed during the 250 days, when they are idle. There

is a 50 per cent shortage of fodder, price of which is so high that small farmers are unable to purchase commercial fodder. Farmers are then compelled to send their DAs to slaughter ahead of their useful life. They then borrow money for buying DAs for the next season, which increases farmers' indebtedness.

Animals and environment

450 m livestock depend on the meager pastureland of 10 m hectares, which is a heavy burden on land. Overgrazing degrades pasture; Livestock encroach into neighboring forests, depleting forest resources. Solution lies in increasing pasture and raising fodder crops. In the meat sector, SHs pollute the city environment- atmosphere and water. Meat produced in such unhygienic conditions is a health hazard. Illegal slaughter has many ill effects. Animals are not even checked for diseases. Establishment of RAs will reduce: illegal slaughter, pollution, wastage in transport, animal suffering, etc.

Feed and fodder

Due to lack of adequate feed and nutrition, cows and she buffaloes do not calve regularly. Work animals are unable to work efficiently. These animals are sent for slaughter ahead of their useful life. Price of dry fodder is high and availability is less than 50 per cent of the requirement. Solution lies in increasing availability of green fodder and fodder trees as well as concentrates, expanding the area under pasture and reclaiming wasteland, reducing wastages and increasing productivity. Loss of biodiversity is another continuing danger to soil. Watershed management can partly take care of such ill-effects, which consists of conservation of soil, biomass and water resources, development of reclaimable areas, introduction of improved crop production practices, etc.

Status of Land Resources and Role of Resource Inventory for Resource Management

A. Natarajan, Rajendra Hegde and L. G. K. Naidu

The land resources of the nation are under severe strain due to the pressure of the growing population and competing demands of the various land uses. According to the estimates available, about 120 m.ha is affected by land degradation, 55 m.ha area lying as wastelands and about 10 per cent of the irrigated lands are affected by salinity and alkalinity (Figure1 and 2). Apart from this, deficiency of secondary and micronutrients, over exploitation of ground water, increasing fallows, diversion of prime lands to non agricultural uses and declining factor productivity affect the food security of the country seriously. Rising food inflation is the direct consequence of these constraints faced by farming sector.

Figure 1: Deep gullies in black soils near Kalmali village, Raichur district

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Figure 2: Salt affected paddy fields near Albanur village, Sindhanoor taluk, Bellary District

It is a known fact that the neglect and deterioration of the land resources and consequent decline in the productivity is continuing without significant science based checks for many years in the country. The consequence of this neglect is already expressed in many forms and its impact will be felt severely on the environment and economy of the nation in the future. The existing situation is very much likely to worsen in the years to come and warrants urgent course correction.

Though the outlay for various land resource management schemes in the country was huge under the successive five year plans in the past, the health of the country's resource base, particularly the soil and water resources, has not shown any perceptible change. On the other hand there is a continuing deterioration observed at the field level as reported by various studies undertaken by several government sponsored projects. It is reported that nearly 50-58 percent of land resources in the country are facing various kinds of degradation. It can be presumed without any hesitation that to a great extent, the lack of site-specific data and situation specific recommendations based on the inherent capacity and suitability of the resources present at village or watershed level are the main causes for the failure of most of the schemes initiated in the past by various departments, both at state and central level. It is because there is every likelihood of mismatch between what is actually needed to take care of the health of the natural resources and what is actually executed in the field level.

The root cause for the degradation, neglect and irrational use of land resources exist at the grassroots level in the ountry. To address the emerging issues at this level, the first and foremost thing needed is a detailed site- specific database on land resources at the farm level for all the villages in the country. This can be obtained by carrying out detailed characterization and mapping of all the existing land resources like soils, climate, minerals and rocks, ground water, vegetation, crops, land use pattern, socio-economic conditions, infrastructure, marketing facilities etc. Soil survey provides the required information for farm-level planning. From the data collected at farm level, viable, sustainable land use options suitable for each and every land holding can be identified easily (Figure 3). The importance of land resources survey in the rational management of the land resources has been brought out by many studies carried out in the past in the country.

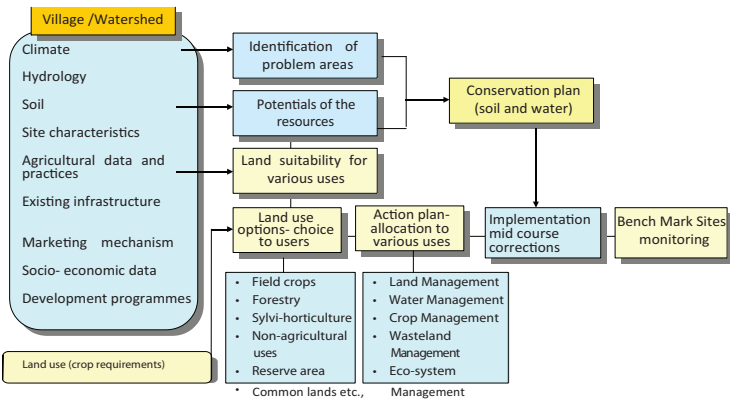


Figure 3: The status of soil survey and mapping in India

For the country as a whole, soil resource information is available at 1:1 M scale, which was generated from the state level mapping done at 1:250, 000 scale under the Soil Resources Mapping(SRM) Project of India during the period from 1986 to 1995 (Figure 4). This information is of general nature and useful for planning on a wide canvas and not particularly useful for farm level planning in the country. For site-specific needs and for developmental works, we need detailed farm level database at 1: 10, 000 scale, which is not

available at present in the country (Figure 5). Once this type of information is generated at village level, this will be useful for

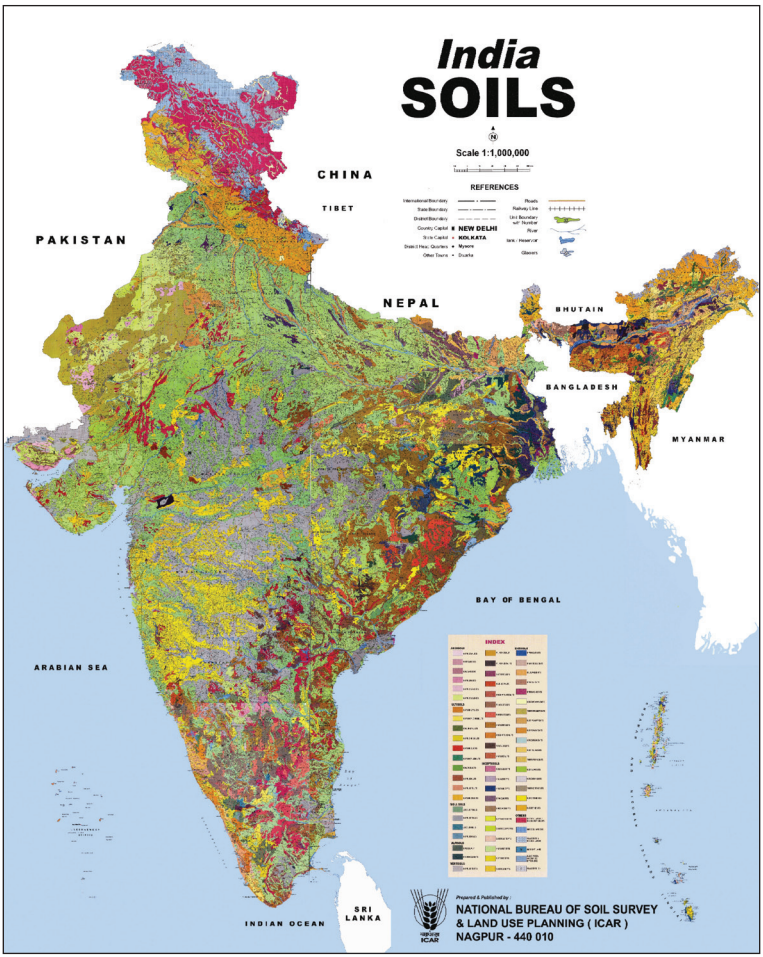


Figure 4: Soil map of India at 1:1 M scale

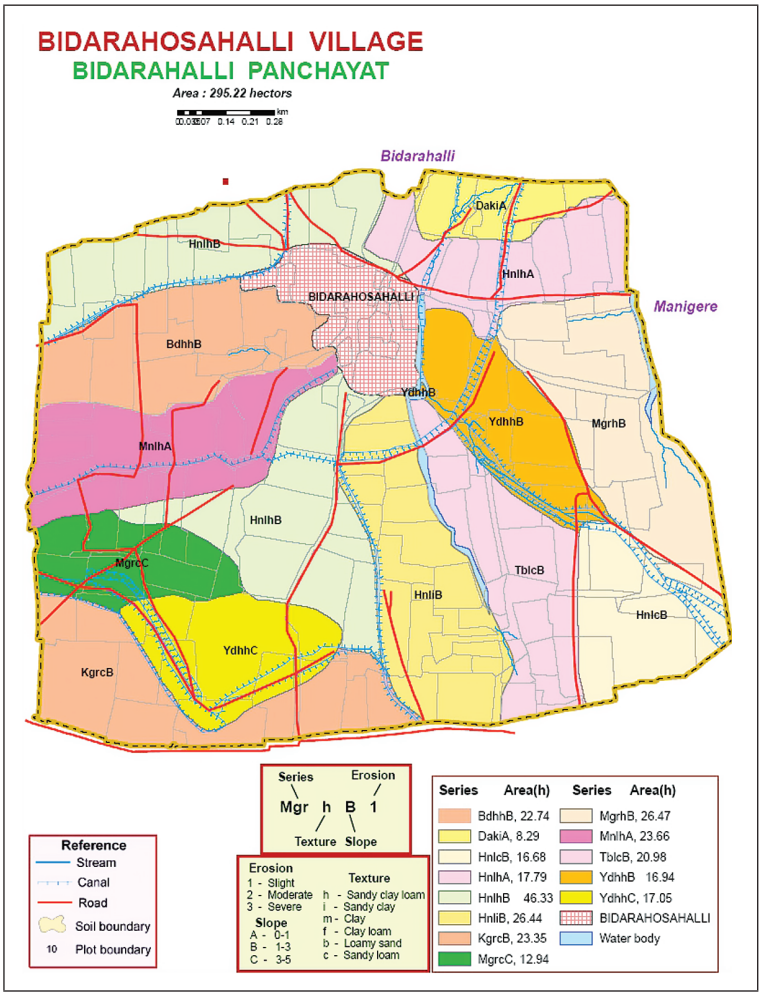


Figure 5: The soil map of Bidara hosahalli village, Mandya district, Karnataka. The map shows the occurrence or distribution of homogenous areas, equivalent to management units, in the village. The parcels of lands included in each map unit are expected to respond similarly to a given level of management

- Identifying site-and area-specific constraints
- For generation of area and site specific agro technologies
- Identifying land-use options based on land-crop suitability assessment
- Wasteland identification
- Identification of prime farm lands and farm clusters for zoning and Strategic planning
- Preparation of Watershed development plans by line departments
- Proactive advice and technology transfer to farmers
- Monitoring Benchmark sites

The cadastral level resource map is generated by studying all the site characteristics like slope, erosion, drainage, salinity, rock fragments etc. and soil characteristics like depth, texture, colour, structure, consistency, gravels, porosity, soil reaction etc.(Figure 6) followed by grouping of similar areas based on soil-site characteristics into homogenous (management) units and showing their extent and distribution on the cadastral map. This job can be accomplished effectively by using digital cadastral base in conjunction with remote sensing data products like Cartosat imagery available in our country. From the database generated for any area, the required thematic outputs can be generated through the use GIS (Figure 7).

Mere generation of database at farm or grassroots level, by itself, will not bring in the desired change in the land use scenario of the country. To be effective, the database generated not only from Soil Survey but also collected from other agencies on various parameters like climate, ground water potential, socio-economic conditions, agricultural practices, etc., needs to be converted into a digital form (Digital Library) and made available to the various line departments and developmental agencies at the village or grassroots level on a real time basis through an appropriate delivery mechanism like Portal or Web services which will help greatly in evolving site-specific, rational and sustainable land use plans appropriate for any given location or situation in the country (Figure 8). Once, this is achieved, not only sustainable

management of land resources at the village or farm level will become a reality but also this will help greatly in carrying out effective monitoring of the implementation of various developmental schemes at the grassroots level.

Figure 6: Profile characteristics of Bydrahalli series.S. No.55,Timmasandra village

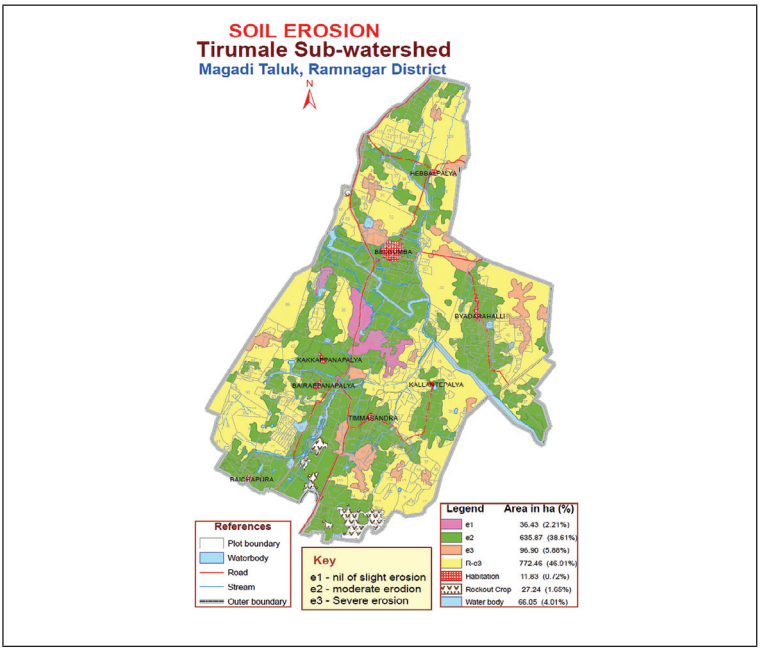


Figure 7: Generation of Thematic layers for identification of constraints, potentials and their suitability for various uses.

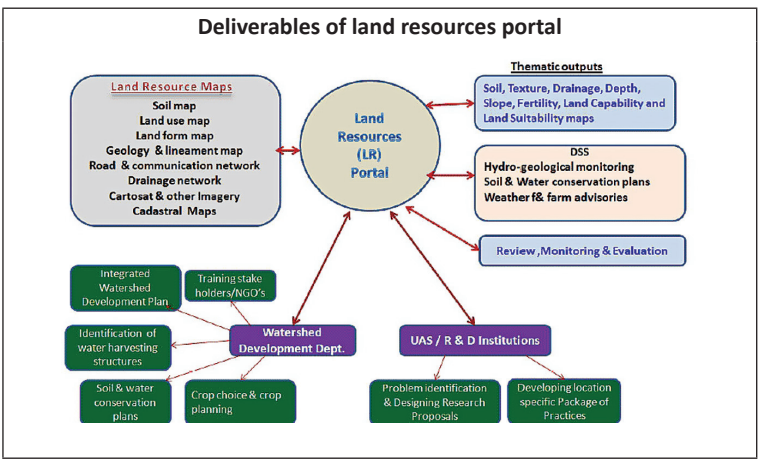


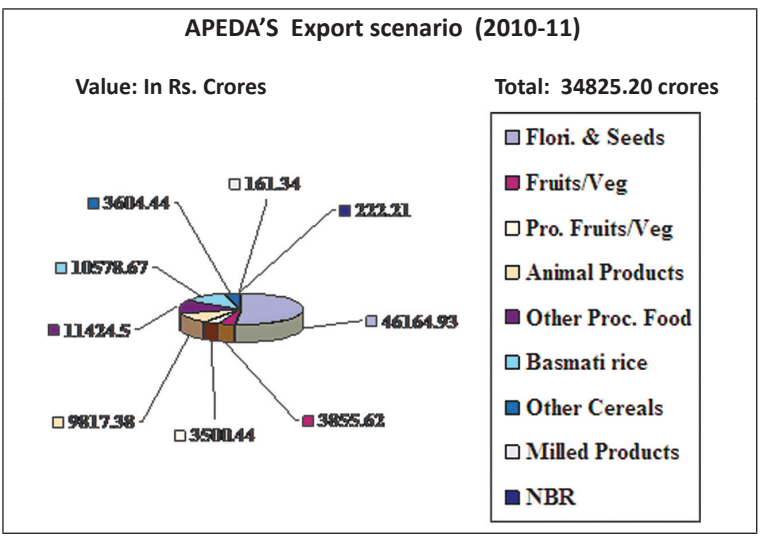
Figure 8: Dissemination of information to the users and developmental agencies through Digital Library and Land Resources Portal

Innovative Policies of APEDA for Exports of Agricultural Products

R. Ravindra

Agricultural and Processed Food Products Export Development Authority, (APEDA), is a statutory body under the Union Ministry of Commerce, found by an Act of the Parliament, with Head Office in New Delhi and having branches at Mumbai, Bangalore, Hyderabad, Kolkata and Guwahati. The functions of APEDA are mentioned below:

- Development of industries relating to scheduled products
- Registration of persons as exporters of scheduled products
- Fixation of standards and specifications
- Carrying out inspection of meat and meat product plants
- Improving packaging of scheduled products
- Marketing of scheduled products outside India
- Promotion of export oriented production



P K Shetty and M V Srinivasa Gowda (eds). *Innovations in Agricultural Policy*, ISBN: 978-81-87663-71-3, © National Institute of Advanced Studies 2013

The major products coming under APEDA's purview for export purpose are:

- Floriculture & Seeds
- Fruits & Vegetables
- Processed Fruits & Vegetables
- Livestock Products
- Other Processed Foods
- Cereals

The following innovative steps have been taken up by APEDA to promote exports of agricultural products

Tracenet

APEDA has taken a major initiative in addressing the traceability of the product through TRACENET, to enhance our countries credibility in the foreign market. This initiative was started with Grapes and has now been extended to Pomegranate and other horticulture crops. India is the first country to introduce this Web Based Traceability in the organic sector.

Agri exchange portal

This is one of the very useful portal in our website, wherein information pertaining to various countries, product profile, trade leads etc., are available. Exporters/Importers can also host their offer in this Interactive Portal.

Participation in international exhibitions

APEDA participates in major international exhibitions related to food, wherein countries strength in export of agro products is highlighted. Opportunity is also provided to registered exporters to participate along with APEDA to showcase their product.

Product specific campaign

APEDA also undertakes product specific campaign like Mango Show, Grape Show etc., in potential countries in order to tap full potential of the product.

Financial assistance schemes of APEDA

Apart from these, APEDA also offers financial assistance to exporters under various schemes which are listed below

- Scheme for Market Development
- Scheme for Infrastructure Development
- Scheme for Quality Development
- Scheme for Research & Development
- Marketing Development Assistance
- Transport Assistance (By Air & Sea)

The details of above schemes are available on APEDA website: **www.apeda.gov.in**

Utilization of Benefits from Government Schemes by Farmers in Karnataka - An Institutional Economic Analysis

D. C. Sowndarya and M. G. Chandrakanth

Good governance is crucial for inclusive growth. Here is a modest attempt to analyze reach of governmental programmes for farmers in Tumkur district, Karnataka. With the hypothesis that benefits from governmental programs depend on size of holding, number of programs, access to irrigation and net returns from farming, field data were obtained from a random sample of 35 farmers each in canal irrigated area (CIA), groundwater irrigated area (GIA) and only rainfed area (RFA) in Kunigal taluka. Among 43 programmes listed as operative by Government departments, farmers identified 22 (51%) in CIA, 12 (28%) in GIA and 16 (37%) in RFA as in vogue. The annual benefit per farm family in CIA was Rs. 5039 from 6, Rs. 8499 in GIA from 5, and Rs. 7682 in RFA from 7 programmes. Regression results indicated that if a farm family does not apply for benefit from programmes, RFA family would lose Rs. 4500; GIA loses Rs. 481 and CIA loses Rs. 5392 worth of benefit per year. Thus, farmers have to be proactive in obtaining programme benefits. Therefore, benefits from programmes formed only two per cent of net return in CIA, one per cent in GIA and four per cent in RFA. For one rupee increase in transaction cost benefit increased by Rs. 3. For every programme, farmer participated, benefit increased by Rs. 938. Elasticity of benefits received with respect to transaction cost was 0.72 % and that with respect to number of programmes participated was 1.25 %.

Successive Governments chalk out programmes devoting planned funds for the welfare of the people. Since independence there have been umpteen numbers of programmes for the welfare. Considering the contemporary economic growth parameters and the perception of the development practitioners, different programmes were shaped at different times of economic development. During green revolution, since food production

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was the major goal, programmes such as "Grow More Food Campaign", "Intensive Agriculture Development Programme" (IADP) was heralded.

At the same time subsidy programmes for fertilizers and other agro chemicals were also launched. In early 1980's at the time of achieving self sufficiency in food (1982), the programme for distribution of food grains such as fair price shops received a fillip. Simultaneously subsidies for agriculture credit, fertilizers, agro chemicals and energy were parallelly provided. Some of the subsidy programmes such as subsidy for drilling irrigation wells became rampened resulting in mushrooming of bore wells resulting in over exploitation of ground water. Such subsidies only consider the supply side ignoring reforms on the demand side of the progress.

As the country began learning lessons from pro-poor policy, programmes such as subsidy for drip irrigation, sprinkler irrigation, precision farming, which help the farmers in achieving self sufficiency in input use were also initiated. After achieving record food production of around 240 million tons in 2011-12, the planners thought of inclusive growth, where distribution of food grains to the lowest strata of population mattered the most. The latest national food security act is a step in this direction.
The Government of Karnataka has been launching different types of programmes for the benefit of farmers and other citizens. The details of all programmes are not available at any particular place. Hence efforts have been made to collect the details of the programmes, in the process it is likely that some of the governmental programmes may not have been listed. Altogether 43 programmes have been identified in the study. While the number of programmes and the diversity are crucial as each programme is theoretically unique, the governance of the programme is the most crucial aspect of the development. Without good governance mere launching of programmes and schemes has limited application in the development economies. Hence this study is an attempt to analyze the reach of governmental programmes for farmers who constitute 70 per cent of the population.

The government programmes can be grouped into four categories. They are: 1. Income enhancement programmes: a. Self

employment programmes and b. wage employment programmes which include MGNREGA; 2. Programmes which focus on providing food and nutritional security *viz*., PDS and ICDS; 3. Programmes which provide basic services-housing, sanitation, health, education and income maintenance programmes *viz*., pension schemes for old aged peoples, widows and physically challenged persons; 4. Agriculture and allied activities schemes-a. Subsidies for seeds, b. Subsidies for machineries and c. Subsidies for feed from co-operatives. Most of the governmental programmes are designed by the centre and implemented by the state by sharing the funds for the programme. The Karnataka state has implemented some programmes like 'Bhagyalakshmi scheme-for girl child protection', 'Yashaswini-health insurance scheme', 'Kaliyuva makkalige free cycle' for students studying in high schools.

1) To estimate utilization of benefits from governmental programmes by farmers with and without irrigation facility, and
2) To estimate the Transaction costs of benefits

Accordingly three villages of Kunigal Taluk, Tumkur district namely (1) Kothagere Hosahalli village representing canal irrigation area (CIA), where farmers have access to irrigation from the Hemavathy dam; (2) Baktharahalli village representing Groundwater Irrigation area (GIA) where farmers have access to groundwater irrigation from bore wells, and (3) Doddamalalavadi village representing rainfed Area (RFA), where farmers are totally dependent on rainfall for their livelihood are chosen for this study.

In each of the categories of the villages, a sample of 35 farmers was randomly selected for field work. Accordingly 35 farmers from Kothagere Hosahalli who have canal irrigation area (CIA) (from Hemavathy dam, Gorur), 35 farmers from Baktarahalli village who have groundwater irrigation area (GIA) from bore wells and 35 farmers from Doddamalalavadi who are totally dependent on rainfall have been randomly sampled.

Averages and percentages were computed to estimate the magnitude of benefit received by different categories of farmers from all the governmental programmes/schemes.

Amortization of benefits is attempted for long term benefits. Transaction cost concept used in this study is the cost involved in getting information regarding the governmental programme including whether the farmer is eligible to receive benefits in any specific programme. The cost of preparing documents and submitting them to the concerned office and the rent paid to receive benefit from the governmental programme. This is related to the Information cost, contractual cost and enforcement cost as enunciated by Ronald Coase (The problem of Social cost, 1960, The Journal of Law and Economics). Transaction cost refer to the costs incurred by farmer in receiving the benefit from governmental programmes/schemes, and it comprises of cost borne by farmer in submitting the application, necessary documents to be produced along with the application for a governmental programme, time spent by farmer in availing the benefit i.e. it is calculated in terms of opportunity cost of labour and amount of rents paid to avail the benefit. In this study transaction cost of farmers is the opportunity cost foregone time by the farmers measured in terms of wage rate per day. Wage rate is taken as Rs. 125 per day prevailing in the study area.

Around 94 per cent of the farmers possess benefit of ration card and derive an annual benefit of Rs. 3984 per family. This itself is a *prima-face* indicator of receiving at least the basic supply of food. Therefore, the provision of food security is adequately taken care by the Government. However, there may still be malnutrition due to inadequate supply of pulses and milk in the village, but the starvation was not reported in the area under study.

Benefits to Farmers from Governmental Programmes

In the case of Canal irrigated area (CIA) farmers derived benefits from 22 Governmental programmes. Around 37 per cent of the farm family children were getting premetric scholarship of Rs. 815 per year; Kaliyuva Makkalige Cycle (23 per cent, Rs. 276); mid day Meal (37 per cent, Rs. 765); old age pension scheme (31 per cent, Rs. 4800); IAY housing scheme (26 per cent, Rs. 5503); subsidies for seeds from cooperatives (80 per cent, Rs. 164). Farmers getting higher benefit of Rs. 5503 from Indira Awass Yojana housing scheme and Rs. 5175 from Subsidy for Drip Irrigation per beneficiary per year. Around cent percent of the farmers derived benefit from Panchayath water supply worth Rs. 163. This is depicted in Table 1.

Table 1: Benefits from governmental programmes for canal irrigated area farmers (CIA) of Tumkur district, 2011 (n=35 farmers)

Type of programme	Name of the programme/scheme	No. of farmers benefited out of 35 farmers (%)	Annual benefit availed per beneficiary family (Rs)	Frequency of benefit flow	Amortized benefit from long-term programme/ beneficiary/year (Rs)
1.Programmes concerning food and nutritional security	Ration Card	33 (94)	3984	Monthly	
2.Wage employment schemes	MGNREGA	1 (3)	5000	Once a year	
	SHG loans & subsidies	6 (17)	1350	Once a year	
3.Education subsidy	Premetric scholarship	13 (37)	815	Once a year	
	Kaliyuva Makkalige Cycle	8 (23)	2400*	One time long term benefit	Amortized benefit =276
4. Integrated Child Development Scheme	Mid-day Meal	13 (37)	765	Daily	
5.Social security	Old age pension	11 (31)	4800	Monthly	
	Widow pension	2 (6)	4800	Monthly	
	Disability pension	1 (3)	4800	Monthly	
	Bhagyalakshmi	2 (6)	19300* ≠	One time long term benefit	Amortized benefit =1305
6.Housing scheme	Ashraya	2 (6)	22500*	One time long term benefit	Amortized benefit =2587
	Indira Awass Yojana	7 (20)	47857*	One time long term benefit	Amortized benefit =5503

Type of programme	Name of the programme/scheme	No. of farmers benefited out of 35 farmers (%)	Annual benefit availed per beneficiary family (Rs)	Frequency of benefit flow	Amortized benefit from long-term programme/ beneficiary/year (Rs)
7.Electicity	Bhagyajyothi	10 (29)	360	monthly	
8.Drinking water and sanitation	Panchayath water supply	35 (100)	163	Daily	
9.Health	Yashaswini	5 (14)	0	Once a year	
10.Animal Husbandry	Dairy Entrepreneurship Dev.Scheme	1 (3)	10000*	One time long term benefit	Amortized benefit =1150
11.Agricultural Department	Comprehensive crop insurance scheme	1 (3)	9000*	One time long term benefit	Amortized benefit =1035
	Subsidies for seeds	28 (80)	164	Twice a year	
	subsidies for drip irrigation	1 (3)	45000*	One time long term benefit	Amortized benefit =5175
12.Horticulture Department	Suvarna Bhoomi Yojana	1 (3)	9000*	One time long term benefit	Amortized benefit =1035
13.Farm Machineries and Implements	Subsidy for Tractor	1 (3)	40000*	One time long term benefit	Amortized benefit =4600
	Subsidy for Country plough	3 (9)	900*	One time long term benefit	Amortized benefit =104

Note: Figures in parentheses indicate percentage to total sample of 35
*indicates benefits from long term benefits.
≠ Under this project, Rs 19, 300 is deposited as fixed deposit in Nationalized Bank in the name of the girl child, which yields Rs 1,0 00,97 after 18 years

Accordingly the most popular governmental programmes in the ground water irrigated area (GIA). The Farmers derived benefits from 12 Governmental programmes. Around 97 per cent of the farmers received benefit of ration card and derived an annual benefit of Rs. 3984. Premetric Scholarship (31 per cent, Rs. 427 per year); Kaliyuva Makkalige Cycle (14 per cent, Rs. 276); Midday Meal (20 per cent, Rs. 765); old age pension (26 per cent, Rs. 4800); subsidies for seeds from cooperatives (49 per cent ,Rs. 332). Farmers are getting higher benefit of Rs. 9806 from Feed Distribution Scheme (from Cooperatives) and Rs. 6900 from Subsidy form Drip Irrigation per beneficiary per year. Around cent percent of the farmers derived benefit from Panchayath water supply worth Rs. 155. This is shown in Table 2.

The benefits derived by farmers from governmental programmes in the rainfed area (RFA). Farmers derived benefits from 16 governmental programmes. Around 97 per cent of the farmers possess benefit of ration card and derived the annual benefit of Rs. 4008. Premetric scholarship (66 per cent, Rs. 320); Kaliyuva Makkalige Cycle (46 per cent, Rs. 276); Midday Meal (66 per cent, Rs. 765); old age pension scheme (37 per cent, Rs. 4800); IAY housing scheme (54 per cent, Rs. 6052); subsidies for seeds from cooperatives (26 per cent worth Rs. 120). Farmers were getting higher benefit of Rs. 8400 from disability pension and Rs. 6052 from Indira Awass Yojana housing scheme. Around 100 per cent of the farmers derived benefit from Panchayath water supply worth Rs. 155. Around 86 per cent of the farmers are getting free electricity from Government through Bhagyajyothi scheme with worth of Rs. 360 per year. This was indicated in Table 3. The benefits derived from different governmental programmes are also depicted in Figure 1 to Figure 3.

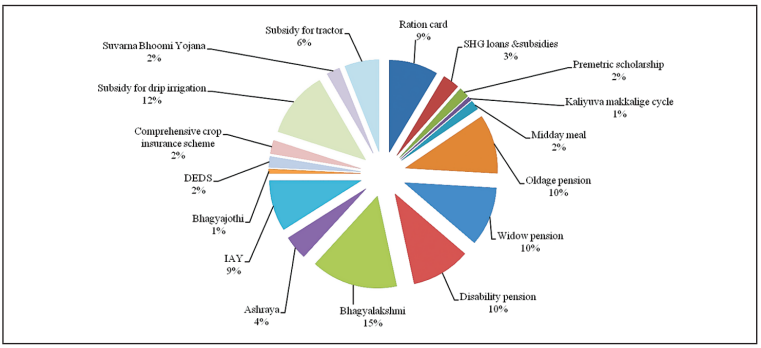

Figure 1: Benefit to farmers from governmental programmes in canal irrigation area (CIA) in Tumkur district

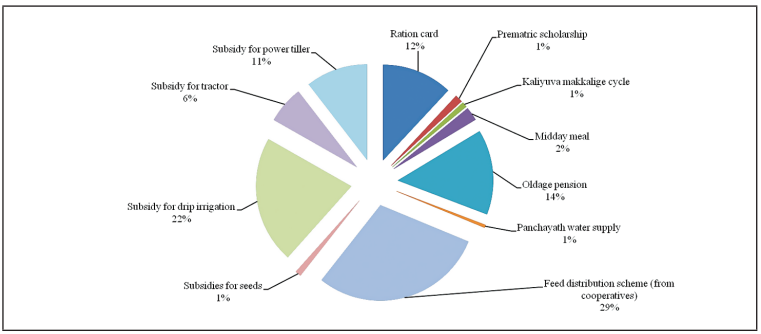

Figure 2: Benefit to farmers from governmental programmes in ground water irrigation area (GIA) in Tumkur district

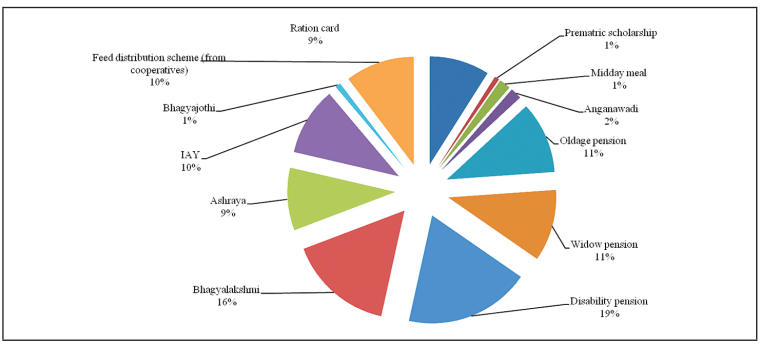

Figure3: Benefit to farmers from governmental programmes in rainfed area (RFA) in Tumkur district

Table 2: Benefits to farmers from governmental programmes in ground water irrigation area (GIA) of Tumkur district, 2011 (n=35 farmers)

Type of programme	Name of the programme/ scheme	No. of farmers benefited out of 35 farmers (%)	Annual benefit availed per beneficiary family (Rs)	Frequency of benefit flow	Amortized benefit from long-term programme/ beneficiary/year (Rs)
1.Programmes concerning food and nutritional security	Ration Card	34 (97)	3984	Monthly	
2.Education Subsidy	Premetric Scholarship	11 (31)	427	Once a year	
	Kaliyuva Makkalige Cycle	5 (14)	2400*	One time long term benefit	Amortized benefit =276
3.Integrated Child Development Scheme	Midday Meal	7 (20)	765	Daily	
4.Social Security	Old age pension	9 (26)	4800	Monthly	
5.Drinking Water And Sanitation	Panchayath Water Supply	35 (100)	155	Daily	
6.Health	Yashaswini	18 (51)	0	Once a year	
7.Animal Husbandry	Feed distribution scheme (from cooperatives)	21 (60)	9806	Monthly	
8.Agricultural Department	Subsidies for seeds	17 (49)	332	Twice a year	
	Subsidy for drip irrigation	1 (3)	60000*	One time long term benefit	Amortized benefit =6900
9.Farm Machineries and Implements	Subsidy for Tractor	1 (3)	30000*	One time long term benefit	Amortized benefit =3450
	Subsidy for Power tiller	3 (9)	50000*	One time long term benefit	Amortized benefit =5750

Note: Figures in parentheses indicate percentage to sample of 35 *indicates benefits from long term benefits

Table 3: Benefits to farmers from governmental programmes in rainfed area (RFA) of Tumkur district, 2011 (n=35 farmers)

Type of programme	Name of the programme/ scheme	No. of farmers benefited out of 35 farmers (%)	Annual benefit availed per beneficiary family (Rs)	Frequency of benefit flow	Amortized benefit from long-term programme/ beneficiary/year (Rs)
1. Programmes concerning food and nutritional security	Ration Card	34 (97)	4008	Monthly	
2.Education Subsidy	Premetric Scholarship	23 (66)	320	Once a Year	
	Kaliyuva Makkalige Cycle	16 (46)	2400*	One time long term benefit	Amortized benefit =276
3. Integrated Child Development Scheme	Mid-day Meal	23 (66)	765	Daily	
	Anganawadi	4 (11)	765	Daily	
4.Social Security	Old age pension	13 (37)	4800	Monthly	
	Widow pension	1 (3)	4800	Monthly	
	Disability pension	2 (6)	8400	Monthly	
	Bhagyalakshmi	3 (9)	19300**	One time long term benefit	Amortized benefit=1305
5.Housing Scheme	Ashraya	3 (9)	48333*	One time long term benefit	Amortized benefit=5558
	Indira Awass Yojana	19 (54)	52632*	One time long term benefit	Amortized benefit=6052

Type of programme	Name of the programme/ scheme	No. of farmers benefited out of 35 farmers (%)	Annual benefit availed per beneficiary family (Rs)	Frequency of benefit flow	Amortized benefit from long-term programme/ beneficiary/year (Rs)
6.Electicity	Bhagyajyothi	30 (86)	360	monthly	
7.Drinking Water and Sanitation	Panchayath Water Supply	35 (100)	155	Daily	
8.Health	Yashaswini	10 (29)	0	Once a Year	
9.Animal Husbandry	feed distribution scheme (from cooperatives)	6 (17)	4620	Monthly	
10.Agricultural Department	Subsidies for seeds	9 (26)	120	Twice a Year	

Note: Figures in parentheses indicate percentage to sample of 35

* indicates benefits from long term

≠ Under this project, Rs 19, 300 is deposited as Fixed Deposit in Nationalized Bank in the name of the girl child, which yields Rs 1,0 00,97 after 18 years

Table 4: Types of benefits accruing to farmers from governmental programmes in CIA, GIA and RFA of Tumkur district, 2011

Particulars	CIA (n=35)	GIA (n=35)	RFA (n=35)
Total number of programs listed by line departments of the government at state level	43	43	43
Number of programmes listed by line departments in Kunigal taluk	22	12	16
Average number of programs benefiting per family considering state level	**6** (14%)	**5** (12%)	**7** (16%)
Average number of programs benefiting per family considering Taluk level	**6** (28%)	**5** (42%)	**7** (44%)
Average benefit received per family per year	**5039**	**8499**	**7682**

Note: figures in parentheses indicate percentage of programmes participated to total programmes listed by line departments.

There were 43 governmental programmes listed by line Departments of Government of Karnataka and Government of India in CIA, GIA and RFA. The average number of governmental programmes benefiting per family was 6 in CIA, 5 in GIA and 7 in RFA. The average benefit received per family per year was Rs. 5039 in CIA, Rs. 8499 in GIA and Rs. 7682 in RFA. In CIA farmers participated in 14 per cent of the programmes and received average benefit of Rs. 5039 per year per family, where as in the case of GIA farmers participated in 12 per cent of the programmes and received higher average benefit of Rs. 8499 per year per family but in the case of RFA farmers participated in 16% of the programmes and received lower benefit of Rs 7682 than GIA.

Transaction cost incurred by the farmers in availing benefits

Transaction costs are the costs involved in deriving benefit from governmental programmes. Transaction costs included the (1) value of the time spent in preparing documents and applying

for the programme, (2) expenditure involved in documents to be produced, (3) rents paid towards sanction of the benefit.

The transaction costs incurred by farmers in availing benefit from government programmes in CIA are represented in table 5. On an average the TC of around Rs. 651. Transaction cost incurred to avail benefit per farm ranged between Rs. 145 and Rs. 2312. However, the benefits ranged from Rs. 104 to Rs. 5503. Considering TCs as percentage of total benefit, this ranged from 2 per cent in the case of Indira Awass Yojana programme to 122 per cent in the case of subsidized seeds. The farmers were found to pay higher transaction cost of Rs. 2312 for subsidies for Tractor followed by Rs. 1288 to get benefit from Comprehensive Crop Insurance Scheme and Rs. 1250 to get benefits from Subsidy for Drip Irrigation and so on. There was zero transaction cost for the programmes like Midday Meal and Panchayath Water Supply. The average transaction cost incurred by the CIA farmers was Rs. 651 of which 36% was for information cost, 13% was for documentation cost and 51% was rent paid per programme per family (Table 8).

Table 6 represents the transaction costs incurred by farmers in availing benefit from governmental programmes in GIA. On an average a TC of Rs. 305 was paid in GIA and the benefits ranged from Rs. 155 to Rs. 9806. Transaction cost incurred to avail benefit per farm ranged between Rs. 135 and Rs. 875. Considering TCs as percentage of total benefit, this ranged from 1 per cent in Subsidy for Drip Irrigation and Subsidy for power tiller program to 47 per cent in subsidized seeds. The farmers incurred higher transaction cost of Rs. 875 to get subsidies for tractor followed by Rs. 716 to get subsidies for power tiller and Rs. 669 to get benefits from Yashaswini health insurance card. There was zero transaction cost for the programmes like Midday Meal and Panchayath Water Supply. The average transaction cost incurred by the GIA farmers was Rs. 305 of which 47% was information cost, 25% was documentation cost and 27% was rent paid per programme per family (Table 9).

The transaction costs incurred by farmers in availing benefits from government programmes in RFA are represented in Table 7. On an average the TC was around Rs. 396 in RFA. Transaction cost incurred to avail benefit per farm ranged

between Rs. 146 and Rs. 1475. However, the benefits ranged from Rs. 120 to Rs. 8400 per family in RFA. The TCs as a percentage of total benefit ranged from 3 per cent in the case of Ashraya and feed distribution schemes (from cooperatives) to 129 per cent in the case of subsidized seeds programme. The farmers incurred higher transaction cost of Rs. 1475 towards Ashraya housing scheme followed by Rs. 792 to get benefit from Bhagyalakshmi scheme and Rs. 775 to get benefits from Widow Pension scheme. The transaction cost for the programmes like Midday Meal, Anganawadi and Panchayath Water Supply was zero. The average transaction cost incurred by the RFA farmers was is Rs. 396 of which 64% was information cost, 12% was documentation cost and 24% was rent paid per programme per family (Table 10).

Table 5: Transaction cost incurred by farmers in availing benefit in canal Irrigation area (CIA) of Tumkur district, 2011 (n=35 farmers)

Sl. No.	Name of the programme/ scheme	No. of farmers benefited out of 35 farmers	Transaction cost incurred to avail benefit per programme (Rs)	Percentage of transaction cost to total benefit	No. of families eligible to receive the benefit in the sample	Gap between actual number of beneficiaries and eligible families
1	Ration Card	33 (94)	323	8	35	2 (6)
2	MGNREGA	1 (10)	750	15	10	9 (90)
3	SHG loans & subsidies	6 (20)	156	12	29	23 (80)
4	Premetric Scholarship	13 (100)	145	18	13	0
5	Kaliyuva Makkalige Cycle	8 (100)	155	6	8	0
6	Midday Meal	13 (100)	0	0	13	0
7	Old age Pension	11 (52)	299	6	21	10 (48)
8	Widow Pension	2 (100)	438	9	2	0
9	Disability Pension	1 (100)	475	10	1	0
10	Bhagyalakshmi	2 (100)	675	3	2	0
11	Ashraya	2 (20)	619	3	10	8 (80)
12	Indira Awass Yojana	7 (58)	739	2	12	5 (42)
13	Bhagyajyothi	10 (84)	350	97	12	2 (16)
14	Panchayath Water Supply	35 (100)	0	0	35	0
15	Yashaswini	5 (18)	838	0	28	23 (82)
16	Dairy Entrepreneurship Development Scheme	1 (20)	1125	11	5	4 (80)

Sl. No.	Name of the programme/ scheme	No. of farmers benefited out of 35 farmers	Transaction cost incurred to avail benefit per programme (Rs)	Percentage of transaction cost to total benefit	No. of families eligible to receive the benefit in the sample	Gap between actual number of beneficiaries and eligible families
17	Comprehensive crop insurance scheme	1 (16)	1288	14	6	5 (84)
18	Subsidies for seeds	28 (80)	200	122	35	7 (20)
19	Subsidy for drip irrigation	1 (20)	1250	3	5	4 (80)
20	Suvarna Bhoomi Yojana	1 (12)	875	10	8	7 (88)
21	Subsidy for Tractor	1 (25)	2312	6	4	3 (75)
22	Country plough	3 (30)	197	22	10	7 (70)

Note: *1. Figures in parentheses indicate percentage to eligible farmers*

2. Gap = $\frac{\text{column (6) - column (3)}}{\text{column (6)}}$ X 100

Table 6: Transaction cost incurred by farmers in availing benefit in ground water irrigation area (GIA) of Tumkur district, 2011 (n=35)

Sl. No.	Name of the programme/scheme	No. of farmers benefited out of 35 farmers	Transaction cost incurred to avail benefit per programme (Rs)	Percentage of transaction cost to total benefit	No. of families eligible to receive the benefit in the sample	Gap between actual number of beneficiaries and eligible families
1	Ration Card	34 (97)	211	5	35	1 (3)
2	Premetric Scholarship	11 (100)	135	32	11	0
3	Kaliyuva Makkalige Cycle	5 (100)	155	6	5	0
4	Midday Meal	7 (100)	0	0	7	0
5	Old age Pension	9 (45)	212	4	20	11 (55)
6	Panchayath Water Supply	35 (100)	0	0	35	0
7	Yashaswini	18 (87)	669	Na	16	2 (13)
8	Feed distribution scheme (from cooperatives)	21 (60)	155	2	35	14 (40)
9	Subsidies for seeds	17 (49)	155	47	35	18 (51)
10	Subsidy for drip irrigation	1 (100)	625	1	1	0
11	Subsidy for Tractor	1 (100)	875	3	1	0
12	Power tiller	3 (100)	716	1	3	0

Note: *1. Figures in parentheses indicate percentage to eligible farmers*

2. $\text{Gap} = \frac{\text{column (6) - column (3)}}{\text{column (6)}} \times 100$

Table 7: Transaction cost incurred by farmers in availing benefit in rainfed area (RFA) of Tumkur district, 2011 (n=35)

Sl. No.	Name of the programme/scheme	No. of farmers benefited out of 35 farmers	Transaction cost incurred to avail benefit per programme (Rs)	Percentage of transaction cost to total benefit	No. of families eligible to receive the benefit in the sample	Gap between actual number of beneficiaries and eligible families
1	Ration Card	34 (97)	229	6	35	1 (3)
2	Premetric Scholarship	23 (100)	146	46	23	0
3	Kaliyuva Makkalige Cycle	16 (100)	155	6	16	0
4	Midday Meal	23 (100)	0	0	23	0
5	Anganawadi	4 (100)	0	0	4	0
6	Old age Pension	13 (70)	271	6	17	5 (30)
7	Widow Pension	1 (100)	775	16	1	0
8	Disability Pension	2 (40)	425	5	5	3 (60)
9	Bhagyalakshmi	3 (75)	792	4	4	1 (25)
10	Ashraya	3 (100)	1475	3	3	0
11	Indira Awass Yojana	19 (82)	925	2	23	4 (18)
12	Bhagyajyothi	30 (86)	200	55	32	2 (6)
13	Panchayath Water Supply	35 (100)	0	0	35	0
14	Yashaswini	10 (77)	425	NA	13	3 (23)
15	Feed distribution scheme (from cooperatives)	6 (46)	155	3	13	7 (54)
16	Subsidies for seeds	9 (26)	155	129	35	26 (74)

Note: *1. Figures in parentheses indicate percentage to eligible farmers*

2. $\text{Gap} = \frac{\text{column (6) - column (3)}}{\text{column (6)}} \times 100$

Table 8: Transaction costs incurred by farmers in availing benefit of governmental programmes in CIA of Tumkur district, 2011 (n=35)

Sl.No	Name of the programme /scheme	Time spent in availing the benefits (Man days)	Transaction Cost			Total transaction cost per programme (Rs)
			Opportunity cost of labour in availing benefit (Rs)	Expenditure involved in obtaining documents (Rs)	Rent paid exclusively for receiving programme benefit (Rs)	
1	Ration Card	2	250 (73)	141 (41)	0	342
2	MGNREGA	2	250 (33)	500 (67)	0	750
3	SHG Loans & Subsidies	1	125 (80)	31 (20)	0	156
5	Premetric Scholarship	1	125 (86)	20 (14)	0	145
6	Kaliyuva Makkalige Cycle	1	125 (81)	30 (19)	0	155
7	Midday Meal	0	0	0	0	0
8	Old age Pension	1	125 (42)	61 (20)	96 (32)	299
9	Widow Pension	3	375 (86)	50 (11)	75 (17)	438
10	Disability Pension	3	375 (79)	25 (5)	75 (16)	475
11	Bhagyalakshmi	4	500 (74)	75 (11)	100 (15)	675
12	Ashraya	2	250 (40)	75 (12)	325 (53)	619
13	Indira Awass Yojana	2	250 (34)	76 (10)	396 (54)	739
14	Bhagyajyothi	3	375 (87)	45 (10)	73 (17)	431
15	Panchayath Water Supply	0	0	0	0	0
16	Yashaswini	2	250 (30)	188 (22)	450 (54)	838

Sl.No	Name of the programme /scheme	Time spent in availing the benefits (Man days)	Transaction Cost			Total transaction cost per programme (Rs)
			Opportunity cost of labour in availing benefit (Rs)	Expenditure involved in obtaining documents (Rs)	Rent paid exclusively for receiving programme benefit (Rs)	
17	DEDS	5	625 (56)	50 (4)	450 (40)	1125
18	Crop Insurance Scheme	2	250 (19)	100 (8)	1000 (78)	1288
19	Subsidies for Seeds	1	125 (63)	39 (20)	0	200
20	Subsidy for Drip Irrigation	2	250 (20)	50 (4)	950 (76)	1250
21	Suvarna Bhoomi Yojana	3	375 (43)	150 (17)	350 (40)	875
22	Subsidy for Tractor	2	250 (7)	200 (6)	3000 (89)	3388
23	Subsidy for Country Plough	1	125 (93)	17 (13)	55 (41)	134
Average		**2**	**244 (36%)**	**87 (13%)**	**336 (51%)**	**651**

Note: Figures in the parentheses indicate percentage to the total transaction cost

The human labour time spent in availing the benefit is valued @ Rs 125 per man day in rural area.

Table 9: Transaction costs incurred by farmers in availing benefit of governmental programmes in ground water irrigation area of Tumkur district, 2011 (n=35)

Sl.No	Name of the programme / scheme	Time spent in availing the benefits (Man days)	Transaction Cost			Total transaction cost per programme (Rs)
			Opportunity cost of labour in availing benefit (Rs)	Expenditure involved in obtaining documents (Rs)	Rent paid exclusively for receiving programme benefit (Rs)	
1	Ration Card	1	125 (59)	86 (41)	0	211
2	Premetric Scholarship	1	125 (93)	10 (7)	0	135
3	Kaliyuva Makkalige Cycle	1	125 (81)	30 (19)	0	155
4	Midday Meal	0	0	0	0	0
5	Old age Pension	1	125 (59)	47 (22)	40 (19)	212
6	Panchayath Water Supply	0	0	0	0	0
7	Yashaswini	1	125 (19)	292 (44)	253 (38)	669
8	Feed Distribution Scheme (from Cooperatives)	1	125 (81)	30 (19)	0	155
9	Subsidies for Seeds	1	125 (81)	30 (19)	0	155
10	Subsidy for Drip Irrigation	3	375 (60)	250 (40)	0	625
11	Subsidy for Tractor	2	250 (33)	100 (13)	400 (53)	750
12	Subsidy for Power Tiller	2	250 (42)	60 (10)	323 (55)	592
Average		**1**	**146 (47%)**	**78 (25%)**	**85 (27%)**	**305**

Note: Figures in parentheses indicate percentage to the total transaction cost.

The human labour time spent in availing the benefit is valued @ Rs 125 per man day in rural area.

Table 10: Transaction costs incurred by farmers in availing benefit of governmental programmes in rainfed area of Tumkur district, 2011 (n=35)

Sl.No	Name of the programme /scheme	Time spent in availing benefits (Man days)	Transaction Cost			Total transaction cost per programme (Rs)
			Opportunity cost of labour in availing benefit (Rs)	Expenditure involved in obtaining documents (Rs)	Rent paid exclusively for receiving programme benefit (Rs)	
1	Ration Card	1	125 (55)	104 (45)	0	229
2	Premetric Scholarship	1	125 (86)	21 (14)	0	146
3	Kaliyuva Makkalige Cycle	1	125 (81)	30 (19)	0	155
4	Midday Meal	0	0	0	0	0
5	Anganawadi	0	0	0	0	0
6	Old age Pension	1	125 (46)	37 (14)	110 (41)	271
7	Widow Pension	5	625 (81)	50 (6)	100 (13)	775
8	Disability Pension	3	375 (88)	50 (12)	0	425
9	Bhagyalakshmi	5	625 (79)	67 (8)	100 (13)	792
10	Ashraya	7	875 (59)	83 (6)	517 (35)	1475
11	Indira Awass Yojana	3	375 (41)	68 (7)	521 (56)	925
12	Bhagyajyothi	3	375 (91)	34 (8)	61 (15)	412
13	Panchayath Water Supply	0	0	0	0	0
14	Yashaswini	1	125 (29)	160 (38)	140 (33)	425

Sl.No	Name of the programme /scheme	Time spent in availing benefits (Man days)	Transaction Cost			Total transaction cost per programme (Rs)
			Opportunity cost of labour in availing benefit (Rs)	Expenditure involved in obtaining documents (Rs)	Rent paid exclusively for receiving programme benefit (Rs)	
15	Feed Distribution Scheme (from Cooperatives)	1	125 (81)	30 (19)	0	155
16	Subsidies for Seeds	1	125 (81)	30 (19)	0	155
Average		**2**	**258 (64%)**	**48 (12%)**	**97 (24%)**	**396**

Note: Figures in parentheses indicate percentage to the total transaction cost.

The human labour time spent in availing the benefit is valued @ Rs 125 per man day in rural area.

Factors influencing differential distribution of benefits among different groups of farmers

To ascertain the relationship between total benefit derived by farmers from government programmes and the explanatory variables in the sample area, linear and multiplicative models were used.

Linear model: $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 D_1 + \beta_5 D_2$

Multiplicative model: $Y = \gamma X_1^{\delta 1} X_2^{\delta 2} X_3^{\delta 3} e^{\delta 4 D_1} e^{\delta 5 D_2}$

The lessons from both linear and multiplicative models explaining the relationship between the benefits derived from government programmes by farmers and the explanatory variables considered are as under:

1. Rainfed farmer would lose a total benefit of Rs. 4518 per year, if he/she does not participate in governmental programmes and if he/she does not incur transaction cost (which includes cost of obtaining information, cost of providing documents and rents)
2. For every rupee of transaction cost incurred, the total benefit from governmental programmes increases by Rs. Three.
3. Bore well farmer would lose a total benefit of Rs. 481 per farm if the farmer does not participate in governmental programmes and if he/she does not incur transaction cost (which includes cost of obtaining information, cost of providing documents and rents)
4. Access to canal irrigation does not significantly influence the benefit received per farmer
5. Elasticity of benefits received with respect to transaction cost is 0.72. Thus for one percent increase in transaction cost, the benefits increase by 0.72 per cent.
6. Elasticity of benefits received with respect to the number of programmes participated is 1.25 per cent. Thus for one per cent increase in number of programmes, the benefits from governmental programmes increase by 1.25 per cent.

Results presented in Table 11 reveal that in the use of linear model the estimated benefits from government programmes were almost same as the actual benefits obtained from the government programmes. Negative intercept implied that if RFA farmer had participated in the government programmes of

the government s/he would have received a benefit of Rs. 4500; GIA farmer would have realized Rs. 481 while CIA farmer would have realized Rs. 5392. The last column in the table indicates the error or gap in estimation of the proportion of under-estimation and over-estimation of benefits is within 10 per cent. Hence linear model is more appropriate in estimating the relationship between benefit and explanatory variables.

Table 11 : Estimated benefits received from governmental programmes of the government in Kunigal Taluk, Tumkur district of Karnataka, 2011

Type of farmer	Minimum benefit obtained (intercept value of benefit function) (Rs)	Mean transaction cost (Rs)	Mean no. of programmes participated	Mean net return from the farm (Rs)	Estimated total benefit from governmental programmes (Rs)	Actual benefits received (Rs)
RFA: Linear model	-4518	1774	7	7263	7817	7682
Multiplicative model	1.16	1596	7	7063	1905	
GIA Linear model	-481	859	5	28535	8365	8499
Multiplicative model	2.91	724	5	27366	3417	
CIA Linear model	-5392	1356	6	20656	5468	5039
Multiplicative model	1.97	1151	5	17445	2677	

Note: 1. RFA: rainfed area farmer; GIA: Groundwater irrigated area farmer; CIA: canal irrigated area farmer

Policy implications:

It is necessary for the development departments to bring out a guide book in Kannada highlighting all the governmental programmes, details of documents to be submitted, last date, to whom to submit the application and follow-up actions to be

taken by the farmer. The guide book should be revised as and when changes occur.

In addition to the guide book, awareness and capacity building programmes regarding the procedures to be followed, along with follow-up action need to be provided to the citizens. The websites should be created in Kannada and the above information should be updated.

There are no gross root workers similar to gross sevak prior to green revolution period, to promote governmental programmes. Since agriculture is the main source of income for more than 60 % of the farmers. It is crucial to have a gross root developmental worker similar to gram sevak for smooth functioning of village panchayath.

It is crucial for the farmers to be in touch with members of the village panchayath, so that they get to know about the different government programmes, periodic updates of budget allocation and procedures. This will empower the farmers to effectively participate in the government programmes.

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Utilization of Benefits from Governmental Schemes by Farmers in Andhra Pradesh – An Institutional Economic Analysis.

Sravanthi Kolla and M. G. Chandrakanth

Andhra Pradesh has been a role model in designing and implementing several types of innovative Government programmes for alleviation of poverty in rural areas. This study focuses on estimating annual benefit received by farmers from Government programmes. A sample of 35 farmers each having access to canal irrigation (CIA), ground water irrigation (GIA) and rainfed (RFA) from Krishna district in Andhra Pradesh was chosen for analysis.

The results of data analysis indicated that 39 programmes were listed as being operative at the village level. The farmers, however, listed only 17 (44%) programmes in CIA, 17 (44%) in GIA and 15 (38%) in RFA. The annual benefit received per farm family is Rs. 8732 in CIA from 6, Rs. 7518 in GIA from 5 and Rs. 11202 in RFA from 6 programmes. The benefits from governmental programmes formed three percent of net return from all sources in CIA, GIA (4%) and RFA (16%). Transaction cost incurred per family in CIA was Rs. 1439, Rs. 1383 in GIA and Rs. 1351 in RFA.

A RFA farmer gets at least Rs. 1260 but a CIA and GIA farmer losses an amount of Rs. 3604 and Rs. 2484 respectively if s/he does not participate in any government programmes. For every increase or percentage change in the government programme in which the farmer participates, the benefit received increases by Rs. 1558 or 1.18 percent. To enhance the reach of benefit it is necessary for development departments to bring out a guide book in Telugu highlighting all the governmental programmes.

Andhra Pradesh has been a front runner in implementing several types of innovative developmental programmes from

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Participatory Irrigation Management (PIM) in surface irrigation to 'Abhayahastham' (for self-help groups) and 'Rajiv Arogya Shree' (free health insurance programme for all BPL families). While the state has been actively and dynamically implementing many such programmes, it is crucial to note how many programmes are launched and formulated, planned and how many programmes are actually in vogue. This study focuses on the benefits from developmental programmes received by farmers in Krishna district of Andhra Pradesh.

Most of the Government programmes are designed by the Centre and implemented by the State on fund sharing basis for financing the programmes. Andhra Pradesh has its own programmes such as "Rajiv Arogya Shree" Community Health Insurance Scheme with an objective to improve access of BPL families to quality medical care, "Pavala Vaddi Padhakam" with an objective of providing interest subsidy on the loans taken by the self-help groups. "Pasukranthi Padhakam" for farmers who are members of self-help groups at village level to take up dairying activity successfully as one of the income generation activities.

The per capita income of an Indian is estimated at Rs. 53331 during the year 2011-12. However the per-capita income of an average farmer was Rs. 17,600 which is hardly $1/3^{rd}$ of the national average. The study is mainly focused to find the share of the benefits from developmental programmes in the per capita income of farmers.

Efforts were made to list the different development programmes of Andhra Pradesh aimed at benefiting people at micro level (i.e., individual rather than group or macro benefit), using the printed and electronic media including internet. Altogether 39 developmental programmes were listed including the ration card for BPL families, Indiramma Housing Scheme, 'Abhayahastha' (interest subsidy for SHGs) etc. Out of 39 programmes which were found from different government sources in Andhra Pradesh, only 19 (50%) were found to be actually in operation. This shows the first inefficiency in the governance.

Policy makers have been launching different types of programmes for the benefit of farmers and other citizens. As the details of programmes at any particular place was not available efforts were made to collect the information regarding Governmental programmes in the process it is likely that all the Governmental programmes may not have been listed. In all 39 developmental programmes have been identified in the study. While the number of programmes and the diversity are vital, as each programme is theoretically unique, the governance of the programme is the most crucial aspect of the development. Without good governance, sheer launching of programmes and schemes has limited application in the developing economies.

The transaction costs arise because the resources for each programme are scarce and all the beneficiaries in a given area cannot be covered in any reasonable time frame. According to a study by Channaveer (2011), the elasticity of benefits received with regard to the transaction cost incurred to obtain the benefit is 0.63. This shows that unless farmers cough up quite a bit of money, it is not possible to derive the potential benefits from the development programmes. This study focused on the transaction costs incurred by the farmers to avail the benefit and their perception regarding the reach of the benefits.

The basic objective of this study was to compare the distribution of benefits from Governmental programmes among canal irrigated area (CIA), groundwater irrigated area (GIA) and rainfed area (RFA) farmers of Krishna district. The specific objectives are,

- To estimate utilization of benefits from governmental programmes by farmers with and without irrigation facility
- To estimate the Transaction costs of benefits.

In Krishna district, 35 farmers possessing canal irrigation (CIA) (from Nagarjuna sagar Left Bank Canal), 35 farmers possessing groundwater irrigation (bore well) (GIA) and 35 farmers totally dependent on rainfall (RFA) have been randomly selected from Gopinenipalem village of Vatsavai mandal, Anigandlapadu village of Penuganchiprolu mandal and Ramachandrunipeta village of Jaggaihpeta mandal respectively.

The Gopinenipalem village is situated at the latitude of 16^0 52′ degrees North and longitude of 80^0 10′ degrees east. Agriculture is main provider of livelihood in village. The village has relatively good access to canal irrigation from Nagarjuna sagar left bank canal enabling farmers to cultivate Maize, Chilli, Cotton and Paddy. Anigandlapadu village is situated at the latitude of 16^0 53′ degrees North and longitude of 80^0 17′ degrees east. Major source of irrigation is groundwater extracted from bore wells. Ramachandrunipeta village situated at the latitude of 16^0 56′ degrees North and longitude of 80^0 05′ degrees east. Livelihood in this village is mainly from off farm employment. Major crops grown are Red gram, Cotton, Chilli.

Measures of central tendency were employed to quantify the magnitude of benefit from Governmental programmes or schemes. Percentages were used to find the share of each programme or benefit to the total. Some of the Government programmes like Indiramma Housing Scheme, Pasukranthi Padhakam, Crop Loss Relief Fund, Subsidy for Farm Machinery extended benefits over time. Thus such benefits were amortized. In order to condense the information contained in the number of original variables which influenced the receipt of benefits from different Government programmes into a smaller set of composite dimensions with minimum loss of information, principle component analysis (PCA) was attempted.

Transaction costs

Transaction cost concept used in this study is the cost involved in gathering information regarding the Government programme including whether the farmer is eligible to receive benefits under a specific programme, the cost of preparing documents and submitting them to the concerned office, and the rent seeking (bribe if any) to be paid to the officials in order to receive the benefit from the Government programme. This is similar to the information cost, contractual cost and enforcement cost as enunciated by Ronald Coase (1960). It involves cost of obtaining information, establishing one's bargaining position, bargaining and arriving at a group decision and enforcing the decision made (Allan Randall, 1982).

Transaction costs are the costs in addition to the price of the resource involved during exchange. In the context of

Government programmes benefiting farmers, transaction costs refer to the costs incurred by the farmer in receiving the benefit and they include the cost borne by farmer in submitting the application, necessary documents to be produced along with the application for the Government programme, opportunity cost of the time spent by farmer in availing the benefit, calculated in terms of sacrificed labor time and the amount of rents paid to different officials, middlemen and local leaders to avail the benefit. In this study transaction cost of farmers was defined as the opportunity foregone by the farmers measured in terms of wage rate per day including the managerial cost as followed by the CACP (commission for agriculture costs and prices) while estimating the cost of the farmers involved infarm management. Wage rate is taken as Rs.125/day prevailing in the study area and 10 per cent towards the managerial cost and other transaction costs paid out by farmer are rents (bribes) to the officials, middlemen, local leaders and other costs involved in applying for Government programme like, documents to be given along with application form. Information costs include time spent by the farmers in availing information regarding Government programmes/subsidy scheme, visits to line Department to get information.

Farmers' participation in developmental programmes in the study area

All the sample farmers in the CIA category received white ration cards and obtained Rs.3621 worth of food security ration per year; 80 per cent of these farmers received subsidized interest loan of Rs.1418 under SHG; all received Panchayath Water Supply at Rs.180; 97% received Crop Loss Relief Fund at Rs. 7657. Between high value and low participation ranges lies Indiramma housing scheme from which 11 per cent of the farmers received an amortized benefit of Rs.3340 per family, followed by Pasukranthi scheme benefiting 9 per cent of the farm families deriving an amortized benefit of Rs.1759 per year. The popularity of the Government programmes can be examined by considering the proportion of farmer beneficiary in column 3 of the Table 1.

Benefit to Farmers in GIA category from Government programmes is indicated in Table 2. About 97 per cent of the sample farmers in GIA received white ration cards and obtained

Rs. 2962 worth of food security ration per year; 63 per cent of the farmers received subsidized interest loan of Rs.1031 under SHG; all of them received Panchayath Water Supply at Rs.360; Crop Loss Relief Fund at Rs.11,916. Between high value and low participation ranges lies Indiramma housing scheme from which 9 per cent of the farmers received an amortized benefit of Rs.3340 per family, followed by Pasukranthi scheme benefiting 3 per cent of the farm families deriving an amortized benefit of Rs.1759 per year. The popularity of the Governmental programmes can be examined by considering the proportion of farmer beneficiary in column 3 of the Table 2.

Benefit to Farmers from Governmental programmes in the category RFA is indicated in Table 3. About 97 per cent of the sample farmers in RFA received white ration cards and obtained Rs. 3969 worth of food security ration per year; 89 per cent of the farmers received benefit of Rs. 4500 from MGNAREGA; 86 per cent received subsidized interest loan of Rs. 1194 under SHG; all of them received Panchayath Water Supply at Rs. 360; 83% recurred Crop Loss Relief Fund at Rs. 4072. Between high value and low participation range lies in subsidized seeds from which 11 per cent of the farmers received benefit of Rs. 750 per family, followed by NTR colony houses benefiting 11 per cent of the farm families who derived an amortized benefit of Rs.1336 per year. The popularity of the Government programmes can be examined by considering the proportion of farmer beneficiary in column 3 of the Table 3.

It was hypothesized that rainfed farmers were benefiting more than irrigated farmers from Government. Around 97 per cent of the sample farmers had ration card and this itself is a *prima-face* evidence to show that they got at least the basic supply of food. Thus food security is taken care of by the Government. The village panchayath is supplying water to all the farmers, indicating the initiative taken by the village panchayath in obtaining macro level benefit from Government. Panchayath is supplying piped water to people in GIA and RFA for the past eight years.

Around 85 per cent of the farmers were having Rajiv Arogya Shree cards in all the three regions. In Andhra Pradesh,

all the BPL card holders are automatically health insured. The BPL Card holders just need to enroll their names and also the names of the family members in the Village Panchayath office to be eligible to receive the benefits. For this health insurance, the Government of Andhra Pradesh pays the premium amount.

Subsidies for seeds are the most popular programme of the Department of Agriculture in the case of GIA farmers, where 91 per cent of the farmers are getting benefit. In CIA 40 per cent of the farmers and in RFA, 11 per cent of the farmers are receiving seed subsidy. This difference is because; the Farmers' cooperatives are functioning well in GIA. In RFA 90 per cent of the people are benefiting from MGNAREGA while in GIA and CIA less than 15 per cent are benefitting from MGNAREGA due to disinterest towards the programme. A larger number of RFA farmers are participating in MGNREGA compared with CIA and GIA farmers due to low net returns from different sources. Around 85 per cent of the farmers in all the three sample areas received compensation towards crop loss by floods, protecting the farmer from the risk due to natural calamities.

Around 97 per cent of the farmers in the three sample areas have BPL cards and are connected with drinking water supply. About 85 to 95 per cent of the BPL families have been health insured and this demonstrates the Government of Andhra Pradesh's commitment, and concern in creating awareness about the health insurance programme. The government of Andhra Pradesh, the health department and the Food and Civil supplies Department deserve full appreciation for Comprehensive health insurance among farmers and people living in the rural areas.

The total benefit received by sample farmers from Governmental benefit across three regions is indicated in table 4. On an average CIA farmer receives benefit of Rs. 8732 from six Governmental programmes out of 39 listed Governmental programmes. A GIA farmer receives an average benefit of Rs. 7518 from five Governmental programmes. A RFA farmer receives an average benefit of Rs. 11202 from six developmental programmes. CIA and RFA participated in 15 per cent of the total programmes listed by line departments and GIA farmers participated in 12 per cent of total programmes.

Table 1: Benefit to farmers from governmental programmes in CIA area of Krishna District, 2011

Type of the programme or scheme	Name of the programme/scheme	No. of farmers benefited in sample (n=35)	Total annual benefit availed per beneficiary family (Rs.)	Frequency of benefit flow	Amortized benefit availed from long term programme per beneficiary per year (Rs.)
1.Programmes focusing on providing food and nutritional security	White ration card (BPL card)	35 (100)	3621	monthly	--------
2.Wage Employment	MGNREGA	5 (14)	no work allocated	once a year	--------
3.Social security	Old Age Pension	13 (37)	2400	monthly	--------
	Disability pension	1 (3)	6000	monthly	--------
4.Housing	Indiramma housing	4 (11)	Total benefit 30000 *	one time long term benefit	Amortized benefit Rs. 3340
	NTR colony houses	3 (9)	Total benefit 12000*	one time	Amortized benefit Rs. 1336
5. SHG	SHG loan subsidy	28 (80)	1418	yearly	----------
	Deepam (free one time LPG cylinder and gas connection)	8 (23)	Total benefit 1400*	one time	Amortized benefit Rs. 109
6. Drinking water and sanitation	Panchayath Water Supply	35 (100)	180	daily	----------
7. Health insurance	Rajiv Arogya Shree	5 (14)	Total benefit 11429*	one time	Amortized benefit Rs. 1272

Type of the programme or scheme	Name of the programme/scheme	No. of farmers benefited in sample (n=35)	Total annual benefit availed per beneficiary family (Rs.)	Frequency of benefit flow	Amortized benefit availed from long term programme per beneficiary per year (Rs.)
8. Animal husbandry	Pashukranthi Padhakam.(one milch buffalo per family)	3 (9)	Total benefit 15800*	one time	Amortized benefit Rs. 1759
	Cattle Feed Distribution (From Cooperatives)	2 (6)	1800	monthly	----------
9. ICDS	Mid Day Meal	1 (3)	1530	daily	----------
10. Agriculture	Crop Loss Relief Fund. (Rs. 2400 per farm as a relief due to drought or flood)	34 (97)	7657	effected season	Amortized benefit Rs. 852
	Subsidized seeds (from Agriculture Department)	14 (40)	1664	twice a year	----------
11. Farm machinary, impliments and buildings	Taiwan sprayer subsidy from Agriculture Department	19 (54)	Total benefit 6500*	one time	Amortized benefit Rs. 723
	Oil engine (50 per cent subsidy up to Rs. 20000 from Agriculture Department)	13 (37)	Total benefit 20000*	one time	Amortized benefit 1360

Note: Figures in parentheses indicate percentage to total. * Total benefit from long term programmes

Table 2: Benefit to farmers from governmental programmes in GIA of Krishna District, 2011

Type of the programme or scheme	Name of the programme/scheme	Number of farmers benefited in the sample (n=35)	Total annual benefit availed per beneficiary family (Rs.)	Frequency of benefit flow	Amortized benefit availed from long term programme per beneficiary per year (Rs.)
1.Programmes focusing on providing food and nutritional security	White ration card (BPL card)	34 (97)	2962	monthly	----------
2.Wage employment	MGNREGA	1 (3)	2500	once a year	----------
3.Social security	Old Age Pension	5 (14)	2400	monthly	----------
	Widow Pension	2 (6)	2400	monthly	----------
4.Housing	Indiramma Housing	3 (9)	30000 *	one time	Amortized benefit Rs. 3340
	NTR colony houses	1 (3)	12000*	one time	Amortized benefit Rs. 1336
5. SHG	SHG loan subsidy	22 (63)	1031	yearly	----------
	Deepam (free one time LPG cylinder and gas connection)	1 (3)	1400* (20 years)	one time	Amortized benefit Rs. 109
6. Drinking water and sanitation	Panchayath Water Supply	35 (100)	360	daily	----------
7. Health	Rajiv Arogya shree (health insurance)	5 (14)	67250*	one time	Amortized benefit Rs. 7487

Type of the programme or scheme	Name of the programme/scheme	Number of farmers benefited in the sample (n=35)	Total annual benefit availed per beneficiary family (Rs.)	Frequency of benefit flow	Amortized benefit availed from long term programme per beneficiary per year (Rs.)
8. Animal husbandry	Pashukranthi Padhakam. (one milch buffalo per family)	1 (3)	15800*	one time	Amortized benefit Rs. 1759
	Cattle Feed Distribution (from cooperatives)	5 (14)	2640	monthly	----------
9. Agriculture	Crop Loss Relief Fund. (Rs. 2400 per farm as a relief due to drought or flood)	28 (80)	11916*	effected season	Amortized benefit Rs. 1327
	Subsidized seeds (from Agriculture Department)	32 (91)	662	twice a year	----------
	Subsidies for Micro Irrigation	2 (6)	115665*		Amortized benefit Rs. 12877
10. Farm machinary, impliments and buildings	Taiwan sprayer subsidy from Agriculture Department	6 (17)	6500*	one time	Amortized benefit Rs. 723

Note: Figures in parentheses indicate percentage to the total.

* Total benefit from long term programmes

Table 3: Benefit to farmers from governmental programmes in RFA of Krishna District, 2011.

Type of the programme or scheme	Name of the programme/ scheme	Number of farmers benefited in the sample (n=35)	Total annual benefit availed per beneficiary family (Rs.)	Frequency of benefit flow	Amortized benefit availed from long term programme per beneficiary per year (Rs.)
1.Programmes focusing on providing food and nutritional security	White Ration Card (BPL card)	34 (97)	3969	monthly	----------
2.Wage Employment	MGNREGA	31 (89)	4500	once a year	----------
3.Social security	Old Age Pension	5 (14)	2400	monthly	----------
4.Housing	Indiramma Housing	10 (29)	30000 *	one time	Amortized benefit Rs. 3340
	NTR Colony Houses	4 (11)	12000*	one time	Amortized benefit Rs. 1336
5. SHG	SHG loan subsidy	31 (86)	1194	yearly	----------
	Deepam (free one time LPG cylinder and gas connection)	18 (51)	1400*	one time	Amortized benefit Rs. 109
6. Drinking water and sanitation	Panchayath Water Supply	35 (100)	360	daily	----------

Type of the programme or scheme	Name of the programme/ scheme	Number of farmers benefited in the sample (n=35)	Total annual benefit availed per beneficiary family (Rs.)	Frequency of benefit flow	Amortized benefit availed from long term programme per beneficiary per year (Rs.)
7. Health	Rajiv Arogya Shree (health insurance)	3 (9)	50000	one time	Amortized benefit Rs. 5566
8. ICDS	Mid Day Meal	6 (17)	1530	daily	----------
9. Agriculture	Crop Loss Relief Fund. (Rs. 2400 per farm as a relief due to drought or flood)	29 (83)	4072*	effected season	Amortized benefit Rs. 453
	Subsidized seeds (from Agriculture Department)	4 (11)	750	twice a year	----------
10. Farm machinary, impliments and buildings	Taiwan sprayer subsidy from Agriculture Department	9 (26)	6500*	one time	Amortized benefit Rs. 723

Note: Figures in parentheses indicate percentage to total.

* Total benefit from long term programmes.

Table 4: Benefits accrued to farmers from governmental programmes in CIA, GIA and RFA, 2011.

Location (Area)	CIA (n=35)	GIA (n=35)	RFA (n=35)
Total number of programmes listed in Line Departments of the Government	39	39	39
Number of programmes listed by line departments in study area	17	17	15
Average number of programmes benefiting per family	6 (15%)	5 (12%)	6 (15%)
Average number of programmes benefiting per family considering at state level	6 (35%)	5 (29%)	6 (40%)
Average benefit received per family per year (Rs)	8732	7518	11202

Note: figures in parentheses indicate percentage of programmes participated to total programmes listed by line departments.

Transaction cost incurred by farmers in availing benefit in CIA is presented in Table 5. Column 4 presents the Percentage of transaction cost to total benefit. The percentage extends to 24 per cent in the case of subsidized seeds followed by 17 per cent in the case of SHG loan subsidy. The least Percentage of transaction cost to total benefit is in the case of mid day meal scheme with one per cent followed by pension scheme with two per cent.

Transaction cost incurred by farmers in availing benefit in RFA is presented in Table 6. Column 4 represents the Percentage of transaction cost to total benefit. The percentage extends to 60 per cent in the case of subsidized seeds followed by 41 per cent in the case of SHG loan subsidy. No transaction cost to total benefit in the case of mid day meal scheme. In case of white ration card it is one per cent followed by MGNAREGA with three per cent.

Transaction cost incurred by farmers in availing benefit in GIA is presented in Table 7. Column 4 presents the Percentage of transaction cost to total benefit. The percentage extends to 53 per cent in case of subsidized seeds followed by 46 per cent in case of SHG loan subsidy. The Least percentage of transaction cost is in subsidies for subsidies for micro irrigation with one per cent followed by MGNAREGA with 1.4 per cent in case of white ration card it is two per cent.

Table 5: Transaction cost incurred by farmers in availing benefit in CIA area of Krishna District, 2011

Sl. no.	Name of the programme/ scheme	Number of farmers benefited in sample farmers (n=35)	Transaction cost incurred to avail benefit (Rs)	Percentage of transaction cost to total benefit	Number of families eligible to receive the benefit in sample (n= 35)	Gap between actual number of beneficiaries and eligible farmers
1	White ration card (BPL card)	35 (100)	38	1	35	0 (0)
2	MGNREGA	5(14)	145	--	35	30 (86)
3	Old Age Pension	13 (68)	58	2	19	6 (31)
4	Disability pension	1 (3)	135	2	1	0 (0)
5	Indiramma housing	4(57)	1775	6	7	3 (42)
7	NTR colony houses	3 (75)	1030	9	4	1 (25)
8	SHG loan subsidy	28 (80)	237	17	35	7 (20)
9	Deepam (free one time LPG cylinder and gas connection)	8 (67)	65	5	12	4 (33)
10	Panchayath Water Supply	35 (100)	10	6	35	0 (0)
11	Rajiv Arogya shree (health insurance)	29 (83)	80		35	6 (17)
12	Pashukranthi padhakam.(one milch buffalo per family)	3 (11)	200	1.3	28	25 (89)
13	Cattle feed distribution (from cooperatives)	2 (33)	135	7.5	6	4 (67)
14	Post metric scholarship	2 (50)	51	1.7	4	2 (50)
15	Mid day meal	1 (100)	0	0	1	0 (0)

Sl. no.	Name of the programme/ scheme	Number of farmers benefited in sample farmers (n=35)	Transaction cost incurred to avail benefit (Rs)	Percentage of transaction cost to total benefit	Number of families eligible to receive the benefit in sample (n= 35)	Gap between actual number of beneficiaries and eligible farmers
16	Crop loss relief fund. (Rs. 2400 per farm as a relief due to drought or flood)	34 (97)	307	4	35 (100)	1 (3)
17	Subsidized seeds (from Agriculture Department)	14 (40)	403	24	35	21 (60)
18	Taiwan sprayer subsidy from Agriculture Department	19 (54)	264	4	35	16 (45)
19	Oil engine 50% subsidy up to Rs. 20000	13 (77)	658	3.29	17	4 (23)

Note: Figures in parentheses indicate percentage to eligible farmers

Table 6: Transaction cost incurred by farmers in availing benefit in RFA of Krishna District, 2011.

Sl No	Name of the programme/ scheme	Number of farmers benefited in sample farmers (n=35)	Transaction cost incurred to avail benefit (Rs)	Percentage of transaction cost to total benefit	Number of families eligible to receive the benefit in sample (n= 35)	Gap between actual number of beneficiaries and eligible farmers
1	White ration card (BPL card)	34 (97)	41	1	35	1 (3)
2	MGNREGA	31 (89)	141	3	34	3 (11)
3	Old age pension	5 (33)	103	4	15	10 (67)
6	Indiramma housing	10 (46)	2215	7	22	12 (54)
7	NTR colony houses	4 (67)	1456	12	6	2 (33)
8	SHG loan subsidy	31 (89)	494	41	35	4 (11)
9	Deepam (free one time LPG cylinder and gas connection)	18 (69)	145	10	26	8 (31)
10	Panchayath Water Supply	35 (100)	30	8	35	0
11	Rajiv Arogya shree (health insurance)	33 (94)	51		35	2 (6)
12	Pashukranthi padhakam.(one milch buffalo per family)	0 (0)	0	0	31	31 (100)
13	Cattle feed distribution (from cooperatives)	2 (6)	135	7.5	35	33 (94)
14	Mid day meal	6 (17)	0	0(0)	6	0 (0)

Sl No	Name of the programme/ scheme	Number of farmers benefited in sample farmers (n=35)	Transaction cost incurred to avail benefit (Rs)	Percentage of transaction cost to total benefit	Number of families eligible to receive the benefit in sample (n= 35)	Gap between actual number of beneficiaries and eligible farmers
15	Crop loss relief fund. (Rs. 2400 per farm as a relief due to drought or flood)	29 (93)	328	8	31	2 (7)
16	Subsidized seeds (from Agriculture Department)	4 (11)	450	60	35	31 (89)
17	Taiwan sprayer subsidy from Agriculture Department	9 (42)	475	7	21	12 (68)

Note: Figures in parentheses indicate percentage to eligible farmers

Table 7: Transaction cost incurred by farmers in availing benefit in GIA of Krishna District, 2011.

Sl No	Name of the programme/ scheme	Number of farmers benefited in sample farmers (n=35)	Transaction cost incurred to avail benefit (Rs)	Percentage of transaction cost to total benefit	Number of families eligible to receive the benefit in sample (n= 35)	Gap between actual number of beneficiaries and eligible farmers
1	White ration card (BPL card)	34 (97)	56	2	34	0 (0)
2	MGNREGA	1 (3)	35	1.4	35	34 (97)
3	Old Age Pension	5 (26)	85	4	19	14 (74)
4	Widow pension	2 (100)	73	3	2	0 (0)
5	Indiramma housing	3 (60)	4675	16	5	2 (40)
6	NTR colony houses	1 (50)	1550	13	2	1 (50)
7	SHG loan subsidy	22 (63)	477	46	35	13 (37)
8	Deepam (free one time LPG cylinder and gas connection)	1 (17)	145	10	6	5 (83)
9	Panchayath Water Supply	35 (100)	30	8	35	0 (0)
10	Rajiv Arogya shree (health insurance)	32 (94)	35	--	34	2 (6)
11	Pashukranthi padhakam. (one milch buffalo per family)	1 (4)	1675	11	23	22 (96)

Sl No	Name of the programme/ scheme	Number of farmers benefited in sample farmers (n=35)	Transaction cost incurred to avail benefit (Rs)	Percentage of transaction cost to total benefit	Number of families eligible to receive the benefit in sample (n= 35)	Gap between actual number of beneficiaries and eligible farmers
12	Cattle feed distribution (from cooperatives)	5 (23)	135	5	22	17 (77)
13	Crop loss relief fund. (Rs. 2400 per farm as a relief due to drought or flood)	28 (83)	664	6	34	6 (17)
14	Subsidized seeds (from Agri Dept)	32 (91)	350	53	35	3 (9)
15	Subsidies for micro irrigation	2 (40)	1275	1	5	3 (60)
16	NHM	1 (25)	1300	4	4	3 (75)
17	Taiwan sprayer subsidy from Agriculture Department	6 (100)	350	5	6	0 (0)

Note: Figures in parentheses indicate percentage to eligible farmers

Transaction cost incurred by farmers in availing benefit from Governmental programmes in CIA is indicated in Table 8. In CIA the highest transaction cost of Rs.1775 per family was incurred while applying for Indiramma housing scheme (rural housing scheme) of which 21 per cent is the opportunity cost of labor, 63 per cent is the rent paid and 15 per cent is the documentation cost. Similarly, Rs. 1030 per family was incurred while applying for NTR colony houses (housing scheme) of which 73 per cent is the rent paid, 24 per cent is the opportunity cost of labor and three per cent is documentation cost. To get subsidy for oil engine, farmers incurred transaction cost of Rs. 658 of which 56 per cent is opportunity cost of labor and 44 per cent is documentation cost. The average transaction cost per programme per family is Rs. 368 out of which 43% is due to opportunity cost of time spent by farmer in availing benefit.

Transaction cost incurred by farmers in availing benefit from Governmental programmes in GIA is indicated in Table 9. In the GIA, the highest transaction cost of Rs.4675 was incurred on Indiramma housing scheme of which 8 per cent is the opportunity cost of labor, 86 per cent is the rent paid and 6 per cent is the documentation cost, followed by, Rs. 1675 was incurred in pashukranthi padhakam programme of which 22 per cent is opportunity cost of labor, 60 per cent is the rent paid and 18 per cent is expenditure on documentation. For subsidies on micro irrigation, the transaction cost was Rs. 1275 of which 49 per cent was opportunity cost of labor and 51 per cent was the expenditure on documentation cost. The average transaction cost per programme per family was Rs. 759 out of which 51% was due to Rent paid exclusively for the programme by farmer in availing benefit.

Transaction cost incurred by farmers in availing benefit of Governmental programmes in RFA is indicated in Table 10. In RFA the highest transaction cost of Rs. 2215 per family was incurred while applying for Indiramma housing scheme (rural housing scheme) of which 17 per cent was the opportunity cost of labor, 72 per cent was the rent paid and 11 per cent was the documentation cost. Similarly, Rs. 1456.25 per family was incurred while applying for NTR colony houses (housing scheme) of which 52 per cent was the rent paid, 28 per cent was the opportunity cost of labor and 21 per cent was documentation cost. To get subsidy for seeds, farmers incurred transaction cost of Rs. 450 of which

56 per cent was opportunity cost of labor, and 44 per cent was documentation cost. The average transaction cost per programme per family was Rs. 494 out of which 43% was due to Rent paid exclusively for the programme by farmer in availing benefit.

A comparison of transaction costs incurred for different programmes under CIA, GIA and RFA categories indicate that on an averaged transaction cost of around Rs. 310 was spent in CIA areas and Rs.760 was paid in GIA and in RFA it was around Rs. 456. However, the benefits ranged from Rs. 109 to Rs. 5566 in CIA areas, from RS. 109 to Rs. 11566 in GIA and Rs. 109 to Rs. 4500 per family in RFA.

Factors influencing differential distribution of benefits among different categories of sample of farmers

To find out the relationship between total benefit by farmers from government programmes and the explanatory variables in the sample area, both linear and multiplicative models were used.

1. Linear model is: $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 D_1 + \beta_5 D_2$
2. Multiplicative model is $\text{Ln } Y = \text{Ln } \gamma + \delta_1 \text{Ln } X_1 + \delta_2 \text{Ln } X_2 + \delta_3 \text{Ln } X_3 + \delta_4 D_1 + \delta_5 D_2$

The lessons from both linear and multiplicative models explaining the relationship between the benefits derived from governmental programmes by farmers and the explanatory variables considered are as under:

1. Rainfed farmer would get at least a total benefit of Rs. 1260 per year, if the farmer does not participate in developmental programs and if he/she does not incur transaction cost (which includes cost of obtaining information, cost of providing documents and rents)
2. Bore well farmer would lose a total benefit of Rs. 2484 per farm if the farmer does not participate in developmental programmes and if he/she does not incur transaction cost (which includes cost of obtaining information, cost of providing documents and rents).
3. Access to canal irrigation does not significantly influence the benefit received per farmer
4. Elasticity of benefits received with respect to the number of programmes participated is 1.18 per cent. Thus for one

percent increase in number of programmes, the benefits from governmental programmes increase by 1.18 per cent.

The results of the statistical analysis presented in Table 11 regrding the estimated benefits received from governmental programmes that in the linear model the estimated benefits were almost same as the actual benefits obtained from the government programmes. Negative intercept implied that if CIA and GIA farmer had participated in the government programmes s/ he would not have lost the benefit of Rs. 2484 and Rs. 3604 respectively.

Policy implications

1. It is necessary for the developmental departments to bring out a guide book in Telugu highlighting all the governmental programmes, details of documents to be submitted, last date, eligibility to avail benefit, the number of days of waiting period, to whom to submit and follow-up actions by the farmer. The guide book should be revised as and when changes occur.
2. In addition to the guide book, awareness programmes and capacity building programmes regarding procedure need to be followed, along with follow-up action.
3. The gap in net returns from all sources between irrigated and rainfed farmers is substantial, hence it is crucial to involve, explore and improve governance of different programmes for rainfed farmers.
4. Farmers should get in touch with the members of village panchayath for benefit utilization. This will empower the farmers to participate in the governmental programmes.
5. Panchayath Raj system should be governed in such a way that errors of inclusion and exclusion should be minimum. This would help reduce the gap between actual beneficiaries and eligible farmers.
6. The websites should be produced in Telugu and the above information should be updated.
7. There are no grass root workers similar to Gram Sevak who was in service prior to green revolution period, to promote governmental programmes. Since agriculture is the main source of income for more than 60 % of the farmers, it is crucial to have a grass-root developmental worker similar to gram sevak for smooth functioning of village panchayath.

Table 8: Transaction cost incurred by farmers in availing benefit from governmental programmes in CIA of Krishna District, 2011

Sl No	Name of the Programme/ Scheme	Time spent in availing the benefit (man-day)	Transaction costs			Total Transaction cost (Rs)
			Opportunity cost of labour in availing the benefit (Rs)	Expenditure involved in obtaining documents plus associated rent (Rs)	Rent paid exclusively for the programme (Rs)	
1	White ration card (BPL card)	0.14	17.8 (47)	20 (53)	0 (0)	38
2	MGNREGA	1.00	125 (86)	20 (14)	0 (0)	145
3	Old age pension	0.38	48 (36)	10 (17)	0 (0)	58
4	Disability pension	1.00	125 (93)	10 (7)	0 (0)	135
5	Indiramma housing	3.00	375 (21)	275 (15)	1125 (63)	1775
6	NTR colony houses	2.00	250 (24)	30 (3)	750 (73)	1030
7	SHG loan subsidy	0.70	87 (37)	50 (21)	100 (42)	237
8	Deepam (free one time LPG cylinder and gas connection)	0.44	55 (85)	10 (15)	0 (0)	65
9	Panchayath Water Supply	0.00	0.00	10 (100)	0 (0)	10
10	Rajiv Arogya shree (health insurance)	0.48	60 (75)	20 (25)	0 (0)	80
11	Pashukranthi padhakam.(one milch buffalo per family)	3.00	375 (67.3)	20 (10)	162 (81)	557
12	Feed distribution (from cooperatives)	1.00	125 (93)	10 (7)	0 (0)	135

Sl No	Name of the Programme/ Scheme	Time spent in availing the benefit (man-day)	Transaction costs			Total Transaction cost (Rs)
			Opportunity cost of labour in availing the benefit (Rs)	Expenditure involved in obtaining documents plus associated rent (Rs)	Rent paid exclusively for the programme (Rs)	
13	Post metric scholarship	0.25	31 (39)	20 (39)	0 (0)	
14	Mid day meal	0.00	0.00	0.00	0 (0)	
15	Crop loss relief fund. (Rs. 2400 per farm as a relief due to drought or flood)	1.16	145 (47)	20 (7)	162 (53)	307
16	Subsidized seeds	1.93	241 (60)	162 (40)	0 (0)	403
17	Taiwan sprayer from Agriculture department	1.32	164 (62)	100 (38)	0 (0)	264
18	Diesel engine 50 per cent subsidy up to Rs. 20000 (from Agriculture department)	2.92	365 (56)	292 (44)	0 (0)	658
Average transaction cost per programme per family		1.2	150 (43%)	62 (18%)	135 (39%)	368

Note: Figures in parentheses indicate percentage to the total transaction cost.

Table 9: Transaction cost incurred by farmers in availing benefit from governmental programmes in GIA of Krishna District, 2011

Sl No	Name of the Programme/Scheme	Time spent in availing the benefit (man-day)	Transaction costs			Total Transaction cost (Rs)
			Opportunity cost of labour in availing the benefit (Rs)	Expenditure involved in obtaining documents plus associated rent (Rs)	Rent paid exclusively for the programme (Rs)	
1	White ration card (BPL card)	0.29	37 (66)	20 (36)	0	56
2	MGNREGA	0.16	20 (57)	15 (43)	0	35
3	Old Age Pension Scheme	0.6	75 (88)	10 (12)	0	85
4	Widow pension	0.42	53 (73)	20 (27)	0	73
5	Indiramma housing scheme	3	375 (8)	300 (6)	4000 (86)	4675
6	NTR colony houses	4	500 (32)	300 (19)	750 (48)	1550
7	SHG loan subsidy	1.45	182 (38)	195 (41)	100 (21)	477
8	Deepam (free one time LPG cylinder and gas connection)	1	125 (86)	20 (14)	0	145
9	Panchayath Water Supply	0	0 (0)	30 (100)	0	30
10	Rajiv Arogya shree (health insurance)	0.2	25 (71)	10 (29)	0	35
11	Pashukranthi padhakam.(one milch buffalo per family)	3	375 (22)	300 (18)	1000 (60)	1675

Sl No	Name of the Programme/Scheme	Time spent in availing the benefit (man-day)	Transaction costs			Total Transaction cost (Rs)
			Opportunity cost of labour in availing the benefit (Rs)	Expenditure involved in obtaining documents plus associated rent (Rs)	Rent paid exclusively for the programme (Rs)	
12	Feed distribution scheme (from cooperatives)	1	125 (93)	10 (7)	0 (0)	135
13	Crop loss relief fund. (Rs. 2400 per farm as a relief due to drought or flood)	0.5	62.5 (9)	26 (4)	575 (87)	663
14	Subsidized seeds	2	250 (71)	100 (29)	0	350
15	Subsidies for micro irrigation	5	625 (49)	650 (51)	0	1275
16	NHM	4	500 (38)	800 (62)	0	1300
17	Taiwan sprayer from Agriculture Department	2	250 (71)	100 (29)	0	350
Average transaction cost per programme per family		1.7	211 (27)	171 (22)	402 (51)	759

Note: Figures in parentheses indicate percentage to the total transaction cost.

Table 10: Transaction costs incurred by farmers in availing benefit of governmental programmes in RFA of Krishna District, 2011

Sl No	Name of the Programme/ Scheme	Time spent in availing the benefit (man-day)	Transaction costs			Total Transaction cost (Rs)
			Opportunity cost of labour in availing the benefit (Rs)	Expenditure involved in obtaining documents plus associated rent (Rs)	Rent paid exclusively for the programme (Rs)	
1	White ration card (BPL card)	0.168	21(51)	20(49)	0	41
2	MGNREGA	0.96	121(86)	20(14)	0	141
3	Old Age Pension Scheme	0.75	94(90)	10(10)	0	103.75
4	Indiramma housing scheme	3	375(17)	240(11)	1600(72)	2215
5	NTR colony houses	3.25	406(28)	300(21)	750(52)	1456
6	SHG loan subsidy	2.2	274(56)	219(44)	0	494
7	Deepam (free one time LPG cylinder and gas connection)	1	125(86)	20(14)	0	145
8	Panchayath Water Supply	0	0(0)	30(100)	0	30
9	Rajiv Arogya shree (health insurance)	0.25	31(61)	20(39)	0	51
10	Crop loss relief fund. (Rs. 2400 per farm as a relief due to drought or flood)	1	125(38)	20(6)	183(56)	328
11	Subsidized seeds	2	250(56)	200(44)	0	450

Sl No	Name of the Programme/ Scheme	Time spent in availing the benefit (man-day)	Transaction costs			Total Transaction cost (Rs)
			Opportunity cost of labour in availing the benefit (Rs)	Expenditure involved in obtaining documents plus associated rent (Rs)	Rent paid exclusively for the programme (Rs)	
12	Taiwan sprayer from Agriculture Department	3	375(79)	100(21)	0	475
Average transaction cost per programme per family		1.5	183 (37%)	100 (20%)	211 (43%)	494

Note: Figures in parentheses indicate percentage to the total transaction cost.

Table 11: Estimated benefits received by farmers using linear model.

Type of farmer	Minimum benefit obtained (Intercept value of benefit function) (Rs.)	Mean transaction cost (Rs.)	Mean No. of programmes participated	Mean Net returns from farm (Rs.)	Estimated Total benefit from developmental programmes (Rs.)	Actual benefit received (Rs.)	Error or gap in estimation (%)
RFA	1260	1261	6	1683	10889	11202	2.8
GIA	-2484	1450	5	114358	7197	7518	4.3
CIA	-3604	1438	6	149509	8125	8732	7.0

Note: RFA = Rainfed area farmer GIA = Groundwater irrigated farmer CIA = Canal irrigated area farmer.
Negative benefit indicates that if he/she does not participate in Governmental programmes CIA farmer loses Rs. 3604 and ground water farmer loses Rs. 2484.

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