Enabling pulses revolution in India

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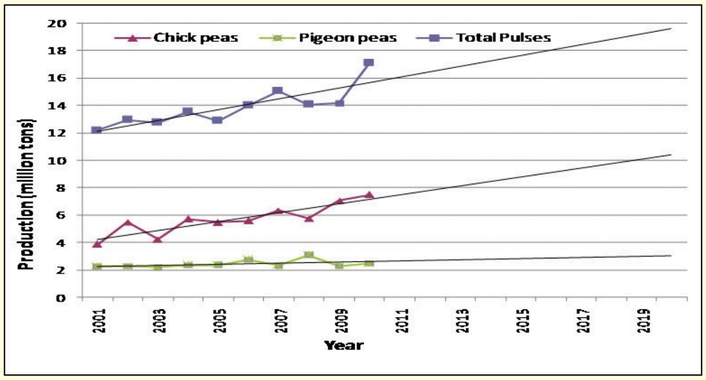
Introduction

Historically India is the largest producer, consumer and importer of pulses. Although it is the world's largest pulses producer, Indiahas been importing 3-4 million tons (MT)of pulses every year to meet its domestic demand. However, during the last decade, growth in pulses production has increased significantly. India achieved a record output in pulses production at 18.1 MT in 2010-11 with an all-time high production achieved in chickpea (8.25 MT), moong (1.82MT) and urad (1.74 MT). Even though pulses production increased significantly during the last decade, continuing the faster growth is a bigger challenge for researchers, extension agencies and policy makers. For some crops such as oilseeds, earlier experience shows most of the success is short lived if we don't align production technology with policy support (Reddy 2009). Still, the productivity of pulses in India (694 kg/ha) is lower than most of the major pulse producing countries and yield potential attained at research stations and on-farm demonstrations.

The brief discusses strategies followed to increase pulses production in the last decade and the way forward to sustain the increased production. It also examines the factors behind the fast growth in production of pulses in recent years with chickpea in Andhra Pradesh as an example. Introduction of chickpea crop into non-traditional areas like south Indian states is an example of technological and institutional breakthrough to be replicated in other crops. Introduction of chickpea into black cotton soils, availability of plenty of rabi fallow lands, adoption of short duration and high yielding varieties like KAK-2 and JG-11, and well developed land lease market to facilitate large scale mechanization to cope with labor shortage in villages are some of the contributing factors for the expansion of chickpea area into south Indian states. It highlighted the importance of (i) successful government programs like National Food Security Mission in increasing pulses production, (ii) development and distribution of improved seed through semi-formal seed systems and farmers participatory varietal selection (FPVS), (iii)emphasis on abiotic and biotic stress management to increase stability in area and yields through integrated approach (iv) increased availability of subsidised improved seed, micronutrients like sulphur, gypsum, popularization of herbicides and farm machinery to cope with labor shortages, and lastly (v) developing market information systems and warehouse infrastructure, enhancing credit availability, establishing markets with state-of-the-art post harvest management and cold storages.

For pulses, there has been no significant technological breakthrough until now due to peculiar problems like indeterminate plant type, low response to fertilizers and management practices. However, after experiencing a steep rise in prices and declining per capita availability of pulses, governments have encouraged pulses production through various programs, including Integrated Scheme of Oilseeds, Pulses, Oil Palm and Maize(ISOPAM) National Food Security Mission (NFSM). The efforts of the governments are supported by various research bodies such as national agricultural research systems (NARS) and ICRISAT. This has resulted in some improvement in the production of major pulses, including chickpea



Graph 1. Trends in pulses production from 2001 to 2011 and projections for 2020.

and pigeonpea (Graph 1). It is only since 2001 that the growth rate of pulses production is significantly high; for example, the growth rate of chickpea is 6.32% per annum and pigeonpea is 2.05%, while that of total pulses is 3.35% per annum, which is much ahead of the population growth but way below the growth in demand.

Importance of pulses in food basket

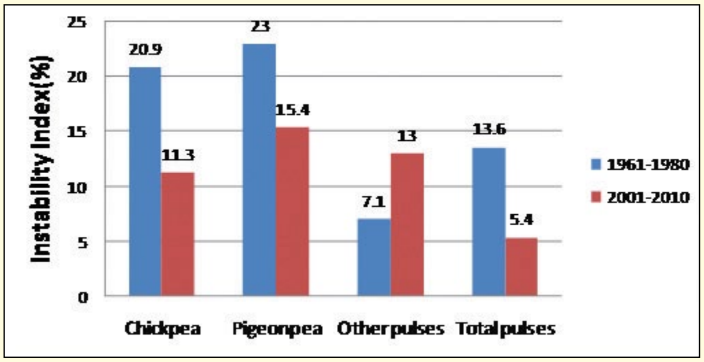
Pulses are a good source of proteins for a majority of the population in India. Protein malnutrition is prevalent among men, women and children in India. Pulses contribute 11% of the total intake of proteins in India (Reddy 2010). In India, frequency of pulses consumption is much higher than any other source of protein, which indicates the importance of pulses in their daily food habits. About 89% consume pulses at least once a week, while only 35.4% of persons consume fish or chicken/meat at least once a week (IIPS, ORCMacro, 2007). It is also to be noted that pulse is consumed by the rich and the poor almost in the same frequency. For example, among the very poor in rural areas, pulses consumption increased from 0.15 kg/month in 1973-74 to 0.41 kg/month in 2009-10. Further, any reduction in prices and increase in incomes will benefit poor consumers significantly more than the rich consumers (Mittal 2006). Keeping the cheapest source of protein, it is important to increase pulses production to increase balanced diet among the socially and economically backward classes. Further, pulses provide healthy proteins, which have nutritional attributes assumed to benefit weight control, including slowly digestible carbohydrates, high fiber and protein content, and moderate energy density when compared to other protein rich sources like meat and meat products. Lastly, pulses meet tastes of different sections of society across India. The major chickpea consuming states are Punjab, Haryana and Rajasthan. The major red gram consuming states are Karnataka, Maharashtra and Andhra Pradesh while the major green gram consuming state is Gujarat. In Assam, Bihar and West Bengal, lentil dal has been predominant. Black gram is a major food item in Tamil Nadu and Uttar Pradesh. This shows diversity in the consumption of pulse crops in terms of quantity and variety among different states within India (Reddy 2004).

Production trends and geographical distribution

Major pulse crops grown in India are chickpea, pigeonpea, mungbean, urad bean, lentil, field peas and beans. They are important crops in terms of the daily diet, contribution to human nutrition (protein) and also in terms of their contribution to farmers' income and employment. Most importantly, all pulse crops improve soil fertility by fixing atmospheric nitrogen into soil and helps in increasing sustainability and soil productivity. Pulses in India have long been considered as the poor man's meat. Pulses are grown on an area of 22-23 million hectares with an annual production of 13-18 million tons (MT). India accounts for 33% of the world area and 22% of the world production of pulses. About 90% of the global pigeonpea, 65% of chickpea and 37% of lentil area falls in India, corresponding to 93%, 68% and 32% of the global production, respectively (FAOSTAT 2011). There is a steep increase in the prices of pulses due to supply constraints to meet the growing demand due to population increase. The net availability of pulses has come down from 70.1gm/day/person in 1951 to 31 gm/day/person (Indian Council of Medical Research recommends 65 gm/day/capita) in 2008. More recently, under the National Food Security Mission (NFSM),high priority has been given for increasing the production of pulses across the country to curtail growing imports, reduce protein malnutrition and make pulses affordable to the common man. Pulses are grown across the country with the highest share coming from Madhya Pradesh (24%), Uttar Pradesh (16%), Maharashtra (14%), Andhra Pradesh (10%),Karnataka (7%) followed by Rajasthan (6%),which together share about 77% of the total pulse production, while the remaining 23% is contributed by Gujarat, Chhattisgarh, Bihar, Orissa and Jharkhand. Among pulses, chickpea (45.1%) occupies the major share, followed by pigeonpea (15.7%), moong (9.9%), urad(9.6%), and lentil (7.3%), which together account for 87% of the total pulses production. Much of the pulses production has been slowly shifted from kharif to rabi and now the rabi share is increased to about 61.0% of the total pulses production. The research and development investments on each crop should be in proportion to the share of the crop in the respective category. More emphasis should be given to rabi pulse crops as their production share is much higher and increasing in recent years.

Impact of technology-reduction in yield instability

In addition to inelastic supply response to prices, the production of pulses is highly unstable. Instability in yield decreased from 13.6% to 5.5% due to the adoption of pest and disease resistant varieties and adoption of plant protection technologies. Instability in area is higher for chickpea than pigeonpea (Graph 2), while instability in yield is lower in chickpea (11.3%) than pigeonpea (15.4%).



Graph 2. Yield instability of pulses in India.

Methodology

With this background, this policy brief tries to examine the reasons for the success of pulses production in recent years at the all India level with special reference to chickpea and pigeonpea and suggest policy options to increase production. It also examines the reasons behind the successful introduction of a new crop, chickpea, in to South India. The objectives of the policy brief are (i) to understand changes in the trends in area, production and yield of pulse crops in India, (ii) to review the gaps in demand and supply of pulses, (iii) to examine the past success in policy and agricultural techniques for increasing pulses production, and (iv) to evolve policy options for increasing pulses production. The study used secondary data collected from FAO, Directorate of Economics and Statistics, Ministry of Agriculture to depict trends in area, production and yield, and prices of pulse crops over a period. The cost of cultivation scheme data was used to examine the relative cost advantage of pulses in different states. These findings are supplemented by ICRISAT- Village Dynamics in South Asia (VDSA) farm level data collected from 18 SAT villages.

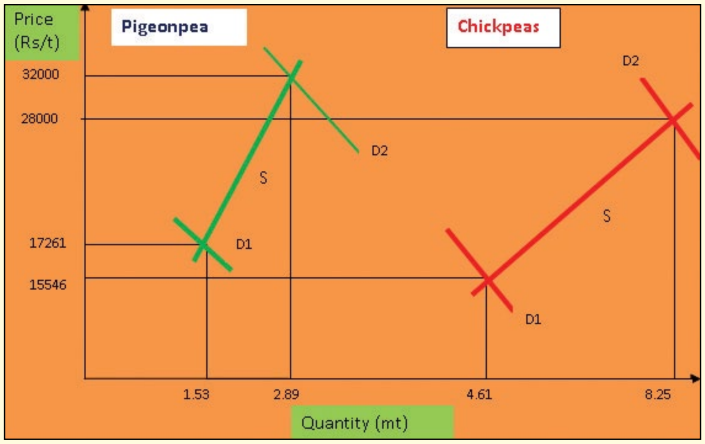
Evidence of growing mismatch between demand and supply

The study by Kumar (1998) used the Food Characteristic Demand System (FCDS) to estimate demand projections. The total demand for pulses is projected to be 30.9 MT in 2020. Mittal (2006) projected pulses demand to be 42.5MT by 2020, which is at the upper end of all the projections.As per these estimates,the deficit of pulses will be to the tune of 24.9 MT by 2020. To bridge this deficit, the required growth rate of pulses production is 6.51%, while the current growth rate is only 3.35%. In its vision 2030, IIPR stated that "in order to ensure self sufficiency, the pulse requirement in the country is projected at 32 MT by the year 2030, which necessitates an annual growth rate of 4.2%" (IIPR 2011). All these estimates indicate that to bridge the gap between demand and supply, pulses production should grow at least 4% per annum.

A long run price trend shows the changes in equilibrium demand and supply of a commodity. If prices of commodity -A goes faster than prices of commodity –B, it indicates that the supply of commodity –A is inelastic to price changes even though demand increases and *vice versa*. To examine the general price trends in pigeonpea and chickpea, Graph-3 presents long run trends of prices of pigeonpea (as exemplar of inelastic supply) and chickpea (as exemplar of elastic supply). The long run price trend of pigeonpea increased faster than that of chickpea, which indicates that the supply of pigeonpeas is not able to meet the increase in demand due to supply side constraints such as biotic, abiotic and other socio-economic constraints.This resulted in faster increase in equilibrium prices to match the increased demand supply. Nominal prices of chickpea are increased less than pigeonpea even though there is huge increase in demand as due to technological progress supply of chickpea increased faster than pigeonpea at lower cost.

Reasons for long run inelastic supply of pulses

Since 1966, pulse crops have been neglected with the agricultural policy environment favoring the spread of green revolution technology in a few crops like paddy and wheat for food security reasons in India. This input-intensive technology further enhanced the already existing yield gap between major cereals and pulses. Due to prolonged neglect for several decades, yield levels of pulse crops are stagnant (increased



Graph 3. Long run supply and demand trends of pigeonpea and chickpeas between 1966 and 2012 (2012 constant prices).

only by 12.2% from 1966 to 2009 as against 162.6% increase in yield of wheat). The real price steeply increased for pulses (by 85.4% for pigeonpea and 80.1% for chickpea) compared to a decline for wheat (-19.6%), maize (-9.6%) and millets (-2.3%), mainly due to the low supply response of pulse crops.

As a result of the widened gap between yields of pulses and major cereals, the relative profitability and competitiveness of pulse crops reduced even though prices increased due to shortage of supply to meet the rising demand. Another important reason for decreased preference of pulses by farmers is continued higher instability in yields of pulse crops than major cereal crops (Chand 2008). The main reasons for inelastic supply of pulses are (i) scattered and thin distribution of various types of pulse crops cultivated mostly in marginal and low productive lands, with each crop contributing a small share in total pulses area – the biggest hurdle for all stakeholders (researchers/extension/development/credit/market support agencies in both public and private sector) to provide input and output services and other institutional support; (ii) indeterminate plant type of many pulse crops with low yield potential; (iii) low response to input management; (iv) shifting of pulses to low-productive and marginal lands; (v) high frequency of crop failure and yield instability due to biotic and abiotic stresses; (vi) low priority by policy makers (Materne and Reddy 2007). The major R&D issues identified for pulses are low genetic yield potential, poor and unstable yield, huge post-harvest losses, inadequate adoption of improved technology and low profitability, which need to be tackled. As a result, the area under paddy and wheat increased in high-productive zones along with high doses of inputs like fertilizer and pesticides, and pulse crops shifted to marginalized lands with no or little inputs and consequent low supply response even though prices are high. The recent increase in pulses production is attributed to the announcement of higher minimum support price (MSP), emphasis on improved seed production and distribution, increase in area in non-traditional areas for crops like chickpea, and higher market prices.

Short-run policy response

In response to shortage and higher prices, the Government of India reduced import duties on all pulses, banned exports (except *kabuli* chickpea), and enabled imposition of stock limit orders by state governments. The Government has also undertaken publicity campaigns to popularize the consumption of yellow peas, and measures have been taken by PSUs to distribute the same through PDS @1 kg per family per month at a subsidy of Rs 10 per kg. All these activities are effective in the short run to reduce prices. However, to reduce supply demand gap in the long run, there is a need for greater R&D efforts to reduce cost of production.

Long-run policy response

The low priority for pulses restrained productivity increases and investments in enabling institutions, R4D and other drivers of progress (Planning Commission 2008). If such policy support and investments were in place, they would have increased pulses productivity more rapidly, making them more affordable for the poor and expanding their environmental benefits. Pulses were brought under the umbrella of The Technology Mission on Oilseeds, Maize, Oil palm in 1990–91, but it has been ineffective in increasing production. On the price front, the price of pulses in most years has been more than the MSP for all crops, which indicates that real action is needed in the technology front with focus on reducing cost of production. As a first step, efforts will have to be made to fill up productivity gaps of the existing technologies and their scaling up through proper extension mechanisms through supply of inputs, institutions and proper governance. In some regions, pulses are replacing coarse cereals, which needs to be promoted by providing improved seeds of pulses, availability of specific nutrients like sulphur and phosphorous and better market linkages (Planning Commission 2008).

To give a boost to pulses production, the government has been implementing National Food Security Mission-Pulses in 16 major pulses producing states covering about 97.5% pulses area in the country. India has also launched Accelerated Pulses Production Program (A3P) in 2010 as a part of NFSM-Pulses for demonstration of production and protection technologies in village level compact blocks. Assistance is also being provided to the farmers under other crop development programs such as integrated development of 60,000 villages of Pulses, Rashtriya Krishi Vikas Yojana (RKVY), Macro Management of Agriculture (MMA), Bringing Green Revolution to Eastern India (BGEI) in rain fed areas across the country for increasing crop productivity and strengthening market linkages. The substantial increase in the MSPs of pulses incentivised farmers to increase their area and input use. All these efforts resulted in record production.

Technological options

Through integration of conventional breeding approaches with cutting edge technologies such as genomics, molecular marker-assisted breeding, transgenics, it is possible to develop suitable varieties which tolerate biotic and abiotic stress, high input use efficiency, desired quality traits. Exploitation of heterosis and yield genes from wild relatives have also been identified as promising avenues for breaking yield plateaus (IIPR 2011).

Wide yield gaps and farmers' level of technology adoption

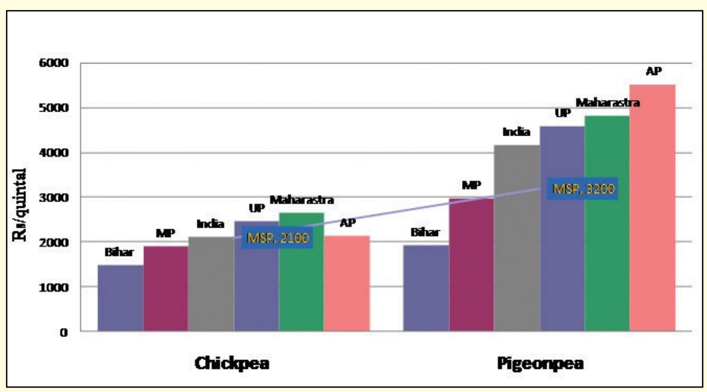
Yield gap analysis for chickpea shows that significant yield differences exist both in *desi* and *kabuli* cultivars. Yield gap I, which is the gap between research station and on-farm trial yields, is highest in the South Zone (30%) and lowest (17%) in the Northwest Zone. Yield gap II, which is the gap between on-farm trials and zone average yields, is very large in all zones, ranging from 64% in the Northeast Zone to 148% in the Central Zone. Wider yield gap II is an indication that there is a large gap between on-farm demonstration yield and zone average yield, which can be bridged by wider adoption of existing technology by farmers. The existing technology has the potential of doubling production at national level without increasing area under chickpea if farmers adopt the recommended package of practices (Reddy et al. 2007).A similar yield gaps exist in pigeonpea also.

Huge crop loss due to insect pest and diseases

Pulse crops are also affected by different pests and diseases during the crop growing stage and also after harvest of the crop. Most of the studies estimated the losses in the range from 15% to 20% (IIPR 2011). It means, India can increase pulses availability by 15 to 20% with investments in appropriate crop protection research and development. This is an important way to reduce the gap between demand and supply. As a strategy to cope with this situation, cultivars having combined resistance to most frequent and major biotic and abiotic stress factors need to be developed. The scope for development of multiple resistant varieties increased after recent advances in genomics and needs to be exploited further.

MSP and cost of production

For rabi pulse crops, MSP is far less than for kharif pulse crops (Rs 2100/q for chickpea and Rs 2250/q for lentil vs. Rs 3200/q for pigeonpea, Rs 3500 for moong and urad). This indicates the competitiveness of rabi pulse crops for further expanding area, keeping their low cost of production (Graph 4). It is also to be noted that the cost of production is less in Bihar and Madhya Pradesh for both chickpea and pigeonpea than the MSP, which indicates the cost competitiveness of Bihar and Madhya Pradesh in pulses production. In addition, in case of chickpea, cost of production is also less in Andhra Pradesh. This indicates the scope for expanding area under pulses in Bihar, Madhya Pradesh and Andhra Pradesh based on higher profitability. It is important to increase yield to reduce cost of production; for example, the cost could be reduced by 6% in pigeonpea if its yield levels increase by 10% (CACP 2012).



Graph 4. Projected cost of production of chickpea and pigeonpea for the year 2011-12.

Profitability and resource conservation of pulse based cropping systems

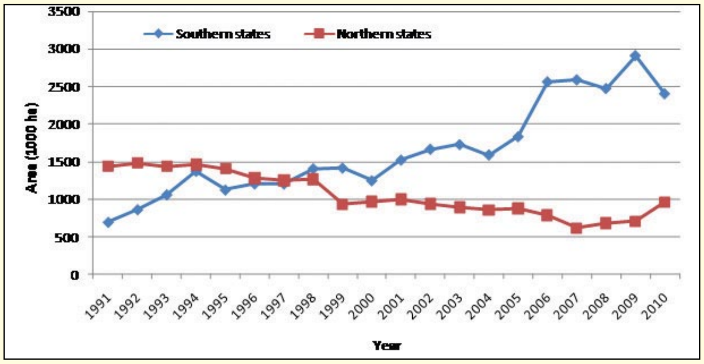
Pulses are usually cultivated as mixed crops along with cotton, mustard, etc, or as catch crop between two cereal crops. If a pulse crop is one of the crops in crop rotations or in a mixed cropping system, then we categorize that cropping system as a pulse-based cropping system. A comparison of economics of pulse-based cropping systems with non-pulse-based cropping systems has been done by Materne and Reddy (2007). The input utilization (fertilizers, pesticides, labor and water) was less for the pulse-based cropping systems. The benefit-cost ratio was almost same (1.8) for both the cropping systems. However, gross returns and net returns per unit area were higher for non-pulse-based cropping systems (as they are mostly irrigated and high input-intensive) but water use efficiency is higher for pulse-based cropping systems. Overall, pulse-based cropping systems are more suitable for resource-poor farmers and water scarce regions. The pulse-based cropping systems are environmentally sustainable also, as they require lower use of fertilizers, pesticides and irrigation in addition to enhancing the productivity of cropping systems by increasing yield of subsequent crops (Reddy 2004, Reddy 2009a).

Windows opened for technological breakthrough in pigeonpea

Hybrid Pigeonpea Technology: To break the yield barrier in pigeonpea, ICRISAT and partners have developed a cytoplasmic male-sterility (CMS) based hybrid breeding technology in pigeonpea. CMS-based medium maturity hybrids, ICPH 2671 and ICPH 2740 produced 30-40% greater grain yields than the popular varieties across farmers' fields in India.

The mapping of the pigeonpea genome: It is a breakthrough that helps in speeding up the development of improved varieties that can provide stable and also higher yields. The genome sequencing will enable the identification of the structure and function of more than 48,000 genes of pigeonpea. There are some unique genes that impart drought tolerance to pigeonpea. This trait can be transferred to identify high yielding varieties. This would also help cut down on the time taken to breed new varieties, from 6-10 years to just about 3 years.

Production of pigeonpea can be increased through (i) Popularization of extra early and stable dwarf type suitable for multiple cropping and improved crop management in sequence with wheat under irrigated conditions in the states of Uttar Pradesh (UP), Haryana, Punjab and northern parts of Madhya Pradesh(MP), (ii) Replacement of other dryland crops like cotton in states with less water availability like Gujarat, Karnataka, Andhra Pradesh, Maharashtra and Tamil Nadu, (iii) Popularization of rabi pigeonpea in the states of Orissa, Gujarat, West Bengal, Bihar and eastern UP, and (iv) Increasing area through inter-cropping of pigeonpea with soya bean in MP,



Graph 5. Shift in area from northern states to southern states (1991 to 2010).

Maharashtra and Rajasthan; and with cotton, sorghum, pearl millet and groundnut in the states of Andhra Pradesh, Maharashtra, Karnataka, Gujarat, MP and UP,which is expected to get additional coverage under pigeonpea by at least 1 million hectares by the turn of the century, (v) Pest management of pod borer, fusarium wilt and sterility mosaic.

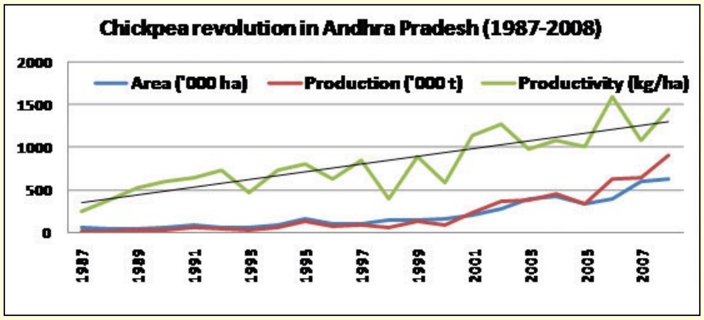
Chickpea revolution in South India

Introduction of chickpea crop into non-traditional areas like south Indian states is an example of technological and institutional breakthrough,which has the potential to be replicated in other crops.The area under chickpea is shifting from northern states to southern states. During the period 1991-93 to 2006-08, highest increase in productivity of chickpea has been recorded in Andhra Pradesh (124%), followed by Karnataka (63%), Maharashtra (52%) and Gujarat (40%). Still, there is scope for productivity enhancement in the states to increase production to meet growing demand at the national level (AICRP on chickpea,2012).

Many institutional and technological factors contributed tothe expansion of area in to South India.These include introduction of chickpea into black cotton soils, availability of plenty of rabi fallow lands, adoption of short duration and high yielding varieties (KAK-2, which was a Kabuli type with higher market demand; and short duration and wilt resistant varieties like JG-11), stable yield and prices, and well developed land lease market,which facilitated large scale mechanization.This large scale mechanization facilitated consolidation of operational holdings, contracting out of major labor demanding works like harvesting and threshing, to address the labor shortage, helped in scale economies in procurement of inputs as well as in production and marketing of output. Overall, even though investments increased in chickpea cultivation due to adoption of technology, it helped in reducing cost of production due to steeper increase in yieldsand profitability. The wider availability of highly subsidized cold storage warehouses helped farmers to store chickpea during the peak harvest season to overcome lower market price and to reap profits from higher prices during later periods. Importance of successful government programs like NFSM, subsidized seed distribution and mechanization, encouragement for cold storage structures and higher MSP helped in chickpea revolution in South India.

Chickpea revolution in Andhra Pradesh

In Andhra Pradesh yield of chickpea increased from 393 kg/ha to 1375 kg/ha from 1987 to 2008 while area increased from 52.2 thousand ha to 542 thousand ha, which resulted in production increase from 19.9 thousand tons to 730.7 thousand tons during the same period. The annual compound growth rate of area is 12.41% and yield is 5.80% and resulted in a whopping 18.21% per annum growth in production from 1987 to 2008.



Graph 6. Trends in chickpea revolution in Andhra Pradesh. Future thrust areas.

The future thrust areas are:

- Development of varieties tolerant to drought, moisture stress, high temperature
- Diversification of cereal based cropping systems
- Management of pod borer, Fusarium wilt, Ascochyta blight
- Emphasis on large seeded kabuli chickpea

Overcoming socio-economic constraints

Semi-formal seed systems: Even though there are good HYVs released for all major chickpea and pigeonpea locations in India, and there is enough Breeder seed and Foundation seed produced, at farmers level there is a shortage of Certified/Truthful seed. Both public and private agencies have failed in the supply of enough quality seed andthe seed replacement ratio is very low. There has beensome success in establishing semi-formal seed systems to produce Truthfully Labelled seed, in which linkages were established between the formal and informal seed sectors through supply of basic quality seed by the NARS, and quality of seed production is monitored by university/non-governmental organisationss/farmers' associations. In this way, there will be enough quantity of seed production at the local level. It should also be coupled with farmer participatory varietal selection (FPVS), which gives farmers an opportunity to select from a range of improved varieties (Abate 2012).

Awareness about new technology: Farmers' awareness on improved varieties and seed availability of improved varieties are the key factors in the spread of improved varieties. The television would be the most popular media for increasing awareness and also FPVS will also be helpful.

Cash and Credit: Cash is a key element for enabling smallholder farmers to shift from low input-low-output to high-input-high-output agriculture. But access to credit by these farmers is low because of their low asset base, low risk bearing ability and high risk environments. This can be effectively tackled by the insurance-linked credit to pulse crops without any collateral security. The scale of finance should be sufficient enough to cover all the costs of the recommended practices.

Marketing: Markets for legumes are thin and fragmented due to scattered production and consumption across states. Farmers/village traders sell their marketed surplus immediately after harvest, while some large traders/wholesalers trade between major markets and hoard pulses to take advantage of speculative gains in the off-season. Due to this, farmers do not benefit from the higher market prices of pulses. Investments in market infrastructure, cold storage, warehouses, market information systems both in public and private sector through PPP models and viability gap funding models need to be encouraged in SAT India.

Farm mechanization and land lease market: One of the reasons for success of expansion of area under chickpea in Andhra Pradesh is the development of suitable varieties for farm mechanization. Hence, farm mechanization in peak season activities like harvesting and threshing needs to be encouraged through the distribution of subsidized farm machinery to cope with labor shortage and higher wage rates.

Supplemental irrigation: With the expansion of irrigation facilities through ground water and also through canal irrigation systems, there is a scope for expansion of irrigated area under pulse crops, especially summer, rabi and spring season crops, as yield response is higher.

In short, to increase area and production of pulse cropswe need crop specific and region specific approaches. Already ICAR and ICRISAT, with the support of state and central governments, are involved in the development of short duration, photo-thermo insensitive varieties for different agro-ecology, development of hybrids in pigeonpea, development of efficient plant architecture in major pulses crops, development of bio-intensive Integrated Pest Management modules, design of improved machines to cope with labor shortage,production of Breeder seed of latest released varieties and in organizing frontline demonstrations in farmers' fields. The efforts under NFSM-Pulses and R&D under NARS needs to be strengthened with the major thrust on

- Replacing cereal crops in the prevailing rice-wheat cropping systems with high yield varieties of pulses
- Encouraging R&D on extra early maturity pigeonpea suited to multiple cropping and improved crop management
- Developing pigeonpea genotype suitable for rabi/ spring and summer seasons
- Including short duration varieties of pulses as catch crop; introducingurad/mung (spring) will utilize unutilized land and water in the spring/summer season with high returns
- Usinggenomics and biotechnology tools for development of multiple disease and pest resistant varieties to reduce yield loss of standing crop and to increase yields
- Reducing storage losses and improving market information and infrastructure.
- Technology dissemination and input delivery mechanisms were too weak for pulses. Coordinatingresearch, extension and farmers to encourage farmer-participatory research.
- Linking MSP to market prices can bridge the gap between demand and supply.

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