Accelerating Agricultural Growth and Poverty Alleviation through Public Expenditure: The Experience of India

Seema Bathla
Jawaharlal Nehru University
Email: seema.bathla@gmail.com

Bingxin Yu
International Food Policy Research Institute
Email: b.yu@cgiar.org

Sukhadeo Thorat
Jawaharlal Nehru University
Email: thoratsukhadeo@yahoo.co.in

Pramod K. Joshi
International Food Policy Research Institute
Email: p.joshi@cgiar.org

Abstract

A slowdown in agricultural growth, persisted during the 1990s and early 2000s has somewhat got reversed from 2004-05. But apprehensions continue on achieving the targeted 4 percent growth amidst decelerating productivity levels and persisting poverty. To what extent has public investment and subsidy impacted agricultural growth, productivity and rural poverty? This study focuses on this issue by quantifying the effectiveness of different types of public investments and subsidies and their relative impact on agricultural growth, and employment and reduction in rural poverty in India. Results obtained from 1981 to 2011 based on a structural econometric model are differentiated with their estimated coefficients to find relative total and marginal effects of investments and subsidies on farm income and rural poverty.

Key words: India, government expenditure, subsidy, poverty, productivity
JEL:H5, H7, N55, Q18

1. Introduction

Public resource allocation is one of the most important instruments for the government to implement its development goals. Concerted efforts were initiated during the early 2000s to reverse the declining trend in public investment and stimulate agricultural growth by better targeting of subsidies, increased investment in the productive assets such as irrigation, power, credit and development of rural infrastructure. Public investment in agriculture averaged 3 percent of agricultural GDP and agriculture income increased at 3.3 percent per annum. Nevertheless, subsidies grew at a far rapid pace and reached 7-12 percent of agricultural GDP by the end of the Eleventh Plan (Planning Commission 2013)1.The government set a goal of reducing agricultural subsidy from 2 percent of GDP to 1.5 percent in the Twelfth Plan. This along with growing inter-regional and farm size disparities in public spending on both agriculture and subsidies hassled to a renewed debate on resource allocation towards investments and/or subsidies.

Literature abounds on the positive impact of public expenditure on agricultural growth, food security and poverty reduction in the developing economies (Fan and Brzeska 2010; Mogues et al. 2012).However only limited studies have examined the impact of input subsidies and controversy remains on their effects on growth and poverty in India (Gulati and Sharma 1997; Gulati and Naryanan 2003; Fan, Gulati and Thorat 2008; Bathla 2014). This paper aims to address the issue of public resource allocation between subsidy and expenditure in agriculture by analyzing the impact of public outlays on different types of investments and input subsidies in raising agricultural productivity, creating employment and reducing poverty in rural areas.

Built on earlier studies, this analysis contributes to the literature on several aspects. First, this analysis collected state-wise expenditures using the Finance Accounts instead of the State

[1]From the 1980s to the late 2000s, public expenditure in agriculture in conjunction with irrigation increased from 230 billion Rupees to nearly 850 billion Rupees (at 2004-05 prices) but the ratio of public investment in agriculture to agriculture gross domestic product (GDP) continued to hover at 3 percent over time. During the same period,

Finances from Reserve Bank of India[2]. Data are extended to 2011-12 to better capture the latest development in the rural India. Secondly, we have re-estimated and added variables to provide a more accurate measurement of socio-economic indicators. More important, structural equation model (SEM) is used to estimate the structural equations along with three-stage least square (3SLS) method. The SEM has an edge over 3SLS as it enables users to capture the unobservable effect of latent variables (such as change in the government/policy) on various types of expenditures across the regions/states.

In addition, the results from this paper suggest inter-relationships between public investment, input subsidies, agricultural growth and rural poverty, which have important implications for government investment policy. Given limited resources, policy makers are in urgent need for information on the tradeoff between public investment on various economic services and subsidies, and this study will contribute to the policy debate by providing insights on the conditions and effectiveness of policies to encourage and sustain agricultural growth and poverty reduction. The results reveal that instead of debating the impact of subsidy in general, it is imperative to first distinguish and examine the magnitude and distribution of different types of farm subsidies through different pathways. The differences in the type and magnitude of subsidy could explain differential productivity and agricultural growth in each period.

The structure of the remainder of the paper is as follows. Section 2 provides a brief review of literature on the impact of different types of expenditures on agriculture and rural development. Section 2 summarizes data definition, followed by a description of the temporal and spatial trends and composition in public expenditure on key social and economic services and input subsidies before and after liberalization. The conceptual framework is presented in section 4 to depict the complex inter-linkages between public expenditure and subsidy on key economic outcomes, and a description of structural equation model for empirical analysis. Section 5 compares the impacts of various investments and subsidies on agricultural production, productivity and rural poverty over different phases of economic transformation. The tradeoff

[2]The Finance Accounts has an advantage of more disaggregated data of social and economic expenditures and also allow us to generate a consistent expenditure series after adjustments in the economic and functional classification of government budget were made from 1987.

between agricultural growth and poverty reduction is discussed and the last section concludes with policy implications.

2. Literature on Inter-linkages between Public Expenditure, Subsidies, Growth and Poverty

The rationale for the allocation of public resources to agriculture lies in its nature of public goods. Social benefits from agricultural expenditure are far greater than the private producer benefits, and private producers cannot extract compensation for the use of agricultural spending from all consumers. Hence the amount spent by the private sector tends to be lower than the socially optimal level and this under-provision creates a rationale for the public provision of such goods. In the agricultural sector, a good example of public goods is agricultural research and development (R&D).

2.1 Impact of agricultural expenditure on growth and poverty

There is a huge body of literature on the positive impact of public expenditure on agricultural output and poverty in developing economies, as reviewed by Fan and Rao (2008), Fan and Brzeska (2010) and Mogues et al. (2012). The consensus from international comparison is that investment in agriculture is important to achieve the dual objective of growth and poverty reduction. Government spending on rural development, especially on rural infrastructure such as transport, power and irrigation also has direct and indirect bearing on agricultural growth and rural poverty reduction by facilitating agricultural production and productivity growth since the impact of infrastructure operates in a cumulative and multiple way (Hazell and Haggblade 1991; Ravallion and Dutt 1995; Fan, Hazell and Thorat 2002).Furthermore, a large number of studies substantiate that public expenditure in agriculture and rural development promotes private investment in agriculture and growth in India (Dhawan 1998; Gulati and Bathla 2002; Bathla 2014).

Economic theory and empirical evidence advocates that increased agricultural productivity is important in development because it frees up resources through resource reallocation and provides raw material for the development of other sectors. It also contributes to higher income and hence higher demand by rural population for inputs, goods and services produced by the spillover effects to non-agricultural sector. Compelling evidence suggests that rapid growth of productivity is the major driver of agricultural growth and the key to regional progress out of poverty, mostly through technology adoption and increased spending on R&D (Fan et al. 2006; Nin-Pratt, Yu and Fan 2009; Fuglie 2010).

Among different types of public spending, agricultural R&D gives the highest rate of returns in productivity, far above any other types of public expenditure. In addition to technical progress, public expenditure contributes to agricultural growth through efficiency gain, achieved by increased investment in infrastructure and subsidy. This is followed by rural infrastructure-mainly roads, education and irrigation. The impact of other types of investments can vary according to individual development goals, which suggests that policymakers should prioritize different agricultural investments judiciously. Unlike expenditures on subsidies, diminishing returns may not apply to agricultural research and education because education enables higher productivity and high returns and hence postpones the diminishing returns for some time (Romer 1989; Fan, Gulati and Thorat 2008).

Promoting agricultural and rural development through public investment can lead to poverty reduction. Fan et al. (2003) indicated that crop research has helped reduce large numbers of rural poor people. It is estimated that every $1 million invested at the International Rice Research Institute (IRRI) in 1999 would lead to more than 800 or 15,000 rural poor people lifted above the poverty line in China and India, respectively. Agricultural research also contributed to a large drop in the urban poverty through lower food prices because poor often spent more than half of their income on food (Fan, Fang, and Zhang 2003). The poverty effects may differ by country but investments in infrastructure and agricultural R&D generally far exceed other types of expenditure if poverty reduction is the paramount policy goal (Mogues et al. 2012). The incidence of poverty is stated to have a negative influence on private farm investment (Chand and Kumar 2004; Bisaliah et al. 2013).

Production-enhancing investments are also key instruments for governments to reduce regional inequality. Studies further argue that investment in agricultural research and rural roads has the largest and most favorable impacts in reducing inequality, because the highest agricultural income growth was found in the lagging region with least favorable biophysical conditions and concentration of the poor (Ravallion 2002; Fan, Kanbur and Zhang 2009; Dastagiri 2010).

2.2 Input subsidy and agricultural growth

While the significance of agricultural investments cannot be undermined, subsidies are widely used to support agricultural production all over the world. Given limited resources, it is important to examine the outcomes of indirect input subsidy and compare with government expenditure in order to put public resources in an efficient use.

Subsidies surged in the 1990s in India to support agricultural production and lower urban food prices. About 12 percent of agricultural income was in the form of input subsidy, the majority went to fertilizer and power subsidy (8 percent of agricultural income). Recognizing the imbalance between subsidies and public agricultural expenditure, several studies posit that this phenomenal increase in subsidies has adversely affected public investment in agriculture (Gulati and Sharma 1997, Gulati and Narayanan 2003). It was further posited that subsidies were raised to compensate farmers for accepting output price much lower than the prevailing free market price. Accordingly, the authors suggested streamlining subsidies to lessen fiscal burden and free up public resources, which also help to address other associated issues including inequity across states, farm size and crops, resource use inefficiency and environmental degradation from overuse of land and water resources.

Empirical evidence on the issue of allocation of public resources for agricultural investments vs. subsidies in the Indian context is somewhat mixed. It suggests that size of government spending, market borrowings and the priority of government economic policies influences the level and types of investment in agriculture (Bathla and Thorat 2006; Roy and Pal 2001; Bathla 2014). A deceleration in the rate of growth in public investment during the eighties and the nineties was largely attributed to the deficit in the revenue account, which would be resulted from public financing of private investment, particularly through transfer in the form of input subsidies and other grants. This led many scholars to suggest that subsidies have “crowded out" public investment in agriculture and irrigation (Gulati and Sharma 1997; Fan, Gulati and Thorat 2008).

These studies also contended that a handful of input subsidies actually reach the farmer without much contribution to agricultural productivity. Declining returns of subsidies is observed over time in India (Fan, Gulati and Thorat 2008).At the initial stage of Green Revolution in the 1960s and 1970s, subsidies of irrigation, power, credit and fertilizer were crucial in adoption of new technologies. But the returns to subsidies diminished quickly and subsidies were criticized for being unproductive, inefficient and aggravating inequality among the rural Indian states. On the other hand, infrastructure investment produced similar returns in the 1970s, and the returns remained strong and kept growing over the next two decades. Similarly, the poverty reduction effects of subsidies exhibited a sharp decrease over time, while the magnitude of the decrease is much slower for investment in rural infrastructure, R&D and education. The authors suggested cutting input subsidies and raising public investments in agricultural research, rural infrastructure and education to sustain long-term growth in farm productivity and reduction in rural poverty.

Other analysis suggested that the deceleration in public investment in agriculture was caused by a decline in expenditure on agriculture and irrigation relative to the aggregate national expenditure (Shetty 1990; Mitra 1996). A decline in irrigation expenditure could also be attributed to external forces such as escalation of irrigation cost, impact of environmentalist movements against large dams, and the way to manage inter-state river disputes (Gulati and Bathla 2002). Mishra and Chand (2005) argued that although the expenditure share of agriculture and irrigation has fallen, it does not necessarily imply a drop in the absolute amount of expenditure on these heads. Instead, the level of expenditures on agriculture and irrigation actually increased.

Controversy remains on the effects of input subsidies including a lack of evaluation on the impact of input subsidy on agricultural productivity, crop profitability and private investment. A few studies support input subsidies in raising private investment and fertilizer subsidy in particular in accelerating productivity of certain crops in certain regions, albeit imbalance in the use of NPK (Sharma 2013, Chand and Kumar 2004). In another study, Chand and Pandey (2008) indicated that a complete removal of fertilizer subsidy would lead to a 9 percent reduction in foodgrain production. Clearly, more research is needed to address the issue of public resource allocation between subsidy and expenditure in agriculture, given rising inequalities in subsidies and inter-state disparities in public expenditure and declining marginal efficiency in investment in recent years. Instead of debating the impact of subsidy in general, it is imperative to first distinguish and examine the magnitude and distribution of different types of farm subsidies. It is also possible that like public expenditure, subsidies affect agricultural productivity through multiple pathways.

3 Public Expenditure and Subsidies in India

3.1 Data description

This study is carried out at the state level from 1981-82 to 2011-12, covering pre-reform period (1981-1990), the first phase of post-reform (1991-1999) and the second phase of post-reform (2000-2011). Compare to the previous study by Fan, Gulati and Thorat (2008), some of the variables have been re-defined or re-estimated due to data availability, and a few more are included to enhance the analysis. Annex I provides details.

Time series on state statistics is extracted from the Statistical Abstract of India, Agricultural Statistics at a Glance, Fertilizer Statistics, Economic and Political Weekly (EPW) Research Foundation, and Annual reports of State Electricity Boards. Poverty estimates, based on NSS Consumption Expenditure Surveys, are taken from the Planning Commission and interpolated. We use data in 17 major Indian states[3]. The expenditures in three newly created states, Chhattisgarh, Jharkhand and Uttaranchal, are available from 2000 onwards, and their respective parent states viz. Madhya Pradesh, Bihar and Uttar Pradesh are merged to create consistent series.The public expenditure series, State Domestic Product and other data set given in nominal prices are converted into real prices at 2004-05 base using income deflators from EPW Research Foundation. Farm and non-farm wages are converted into real prices using WPI and CPI published by the Ministry of Consumer Affairs, respectively. Splicing method is used to convert index at common base of 2004-05. The public expenditure on various heads on capital account is taken as stock after making allowance for depreciation.

[3] Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu &Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

3.2 Trends in public expenditure and subsidies in India

Public expenditure in India is broadly categorized as development and non-development expenditure, which are further bifurcated into revenue (current) and capital expenditures (Table 1). Development expenditure includes expenditures for the promotion of economic development and social welfare, and non-development expenditure refers to expenditure used to maintain the operation of government. Major budgetary heads under the classification is presented below, suggesting that expenditure related to agriculture and rural development is generally development expenditure directly charged from the revenue account. Capital expenditure refers to expenditures usually borrowed for capital formation such as asset creation, machinery and construction.

----------Table 1------

It is important to mention that agriculture expenditure is highly decentralized. Funds are routed through the central government to the respective state governments and the former also spends directly on many economic and social services. The responsibility of incurring expenditure on agriculture as well as irrigation-flood control lies squarely with the states. Within agriculture, expenditure on various flagship programs and also R&D is undertaken by the central government, but is routed through the state budgets. Only the outlays on inter-state rivers and fisheries outside territorial waters, fertilizer and food subsidy are predominantly undertaken by the central government. In this study, the expenditure by the central government and loans and advances are not taken to avoid double counting.

Total public expenditure of all the states has expanded by more than 7 times from 1980 to 2011, growing at a rate of 6.6 percent per year. Development expenditure increased at 5.8 percent annually, much slower than non-development expenditure at 8.3 percent. As a result, the share of development expenditure declined continuously from 75 percent in 1980 to below 60 percent in 2004, then recovered to around 65 percent. It is also promising to see that development expenditure has consistently outgrown population growth, and per capita development expenditure increased from 1,300 in 1981 to 6,000 Rupees in 2011.

Nearly 57 percent of development expenditure went to social services in 2011, mostly education and health. Expenditure head within economic services is further subdivided into various subheads. The 2000-11 average share of various expenditure heads reveal that nearly 23 percent was allocated to irrigation and flood control, followed by agriculture and allied activities (17 percent), rural development (13 percent) and rural transport (13 percent) (Figure 1 and Table 2). Within social services, education and sports received more than half of total social service expenditure, followed by medical and public health. Among all, the percentage share of health and nutrition expenditure has drastically decreased from 10.5 percent to 3.7 percent from 1981 to 2011.

----Figure 1-----

----Table 2------

Although the amount spent on every head within economic services has more than doubled, it lagged behind the growth rate of total expenditure on social services. The highest growth rate is found in rural energy over the three decades, leading to an increase of the shares of rural infrastructure like energy and transport in economic service spending (Table 2). It is alarming to notice that the share of agriculture, irrigation and flood control fell substantially because of low growth in investment for irrigation schemes. Expenditure in agriculture and allied activities also grew at a slow pace.

Main subheads related to agricultural and rural development includes crop husbandry, forestry, livestock development within head agricultural and allied services, rural employment within rural development, and medium irrigation within the economic head irrigation and flood control. Expenditure in dairy development and rural employment has decelerated since the 1990s, revealing large resources were diverted to activities like food storage and other rural development programmes.

Expenditure can be further disaggregated into current (revenue) and capital accounts. Both revenue and capital expenditure increased at almost the same rate at 6.6 percent during 1981-2011. However, revenue and capital expenditure on social services increased at a higher annual rate at 6 percent and 8 percent compared to economic services at 5 and 6 percent. High contribution of capital expenditure is reported in irrigation and rural transport in the preceding decade. Rural energy expenditure, largely capital in nature, witnessed an increase in current expenditure since 1990, perhaps due to a rapid rise in subsidy to state electricity boards or distribution losses. In other economic heads, resources seem to have shifted from capital formation to government operation and subsidy because almost all the expenditure increase has been driven by the soaring current expenditure, implying mounting bureaucracy and inefficiency in public expenditures.

Subsidies to agriculture cover many aspects of activities and the major ones are irrigation, electricity, credit, and fertilizer. Expenditure in agriculture and allied services is overshadowed by subsidies as the amount spent on subsidies is usually twice the size of agricultural expenditure (Figure 2) and slightly lesser when irrigation expenditure is also considered. Input subsidies dropped sharply in the mid-2000s due to a hike in power tariff and changes of government priorities, but surged swiftly afterwards partly in response to the food crisis in 2007-2008. Total input subsidies averaged 680 billion Rupees in the late 2000s, more than tripled the amount allocated in the early 1980s. This growth rate surpassed population growth and per capita input subsidy nearly quadrupled from 1981 to 2011.

Fertilizer and power subsidies were the major items of input subsidies, reached 447 and 293 billion Rupees by 2011. The government support for power as well as fertilizer exhibit a brisk increase at almost 7 percent per annum over the three decades. The power subsidy lost its dominance in input subsidy and its share in subsidy dropped from 41 percent in 1981 to 37 percent in 1990, increased again to as high as 62 percent during early 2000 and then fell to 31 percent in 2011. On the other hand, the share of fertilizer subsidy rose from 32 percent in 1981 to 46 percent in 2011. Nearly 80 percent of total input subsidy was used in the provision of power and fertilizer in 2011 whereas irrigation constituted only 12 percent share in total.

----Figure 2------

Figure 3 shows that the input subsidy has expanded far rapidly than capital formation in agriculture on public account[4]. They were about the same size (nearly Rs. 100 billion) in 1981 but the gap quickly enlarged over time, partly due to stagnancy in public investment in the 1990s. It is posited that expenditure on farm subsidy leaves much less resources for financing of public investment in irrigation and for that matter agriculture, which does not appear to be the case during the last decade. Decline in irrigation expenditure was also attributed to a few extraneous forces such as escalation of irrigation cost, impact of environmentalist movement and the federal character of the Indian state involving problem associated with inter-state river disputes (Shetty 1990; Mishra and Chand 1995). Large spatial variations in expenditure and subsidies have been identified across the states. The distribution of subsidy across states has been exceedingly unequal as well, since the average ratio of subsidies to net state domestic product in agriculture ranges from less than 4 percent in Assam to 22 percent in Tamil Nadu in 2000-2011. Generally speaking, high per capita development expenditure is associated with high income, and states with advanced economies in the northwest tend to have higher subsidy per hectare than their eastern counterparts. This underscores that current expenditure and subsidy distribution has exacerbated inequality in the agricultural sector, contributing to the stagnation of productivity and income growth in many states.

---Figure 3---

4 Conceptual framework and model estimation

The impact of government investment and subsidy on agricultural growth and rural poverty is examined by analyzingthe complex inter-linkages among growth, productivity, input use, rural nonfarm economy, farm and non-farm rural wages. Figure 4 portrays the conceptual framework for the structural equation model (SEM). Public expenditure on investment and subsidy is assumed to impact agriculture and poverty through several channels: improvement in technology and availability of inputs, irrigation, relative prices, wages and non-farm employment. The use of

[4]Data on capital formation in agriculture on public account, estimated by the CSO and published in the NAS refers to capital spending mainly on major and medium irrigation works and not agriculture (for details see Gulati and Bathla 2002).

various farm inputs is influenced by the availability of resources and the price at which these are available, and subsidized prices provide incentives to farmers to adopt and use inputs.

---Figure 4---

A system of equations models the relationships between government spending on investment and subsidies and growth through different pathways as illustrated in Figure 4. Equation (1) explains rural poverty as determined by agricultural growth, changes in farm wages, nonfarm employment, and terms of trade (agriculture prices relative to non-agriculture prices). This equation further endogenizes agricultural growth, terms of trade, rural wages and nonfarm employment, as reflected in Equations (2) to (5). Each of these equations are linked to input subsidies and public investment, such as agricultural R & D, rural roads and transport, rural electricity, education, and irrigation in Equations (6) to (10). The role of technology, captured mainly through area under high yielding varieties is not considered due to universal adoption since 2000.

(1)Poverty = f1(AY, TT, AWage, NFEmpl , Pop Density, Rain)

(2) AY = f2 (Agri Research, Land, Labour, IRRI, ELECT, EDU, FERT, ROAD, Rain, NFSM-Dummy)

(3) AWAGE = f3(GDPGNA, AY, ELECT, ROAD, EDU, Health Exp, MNREGA-dummy)

(4) NFEmpl= f4(GDPGNA, NA Wage, ROAD, EDU, ELECT, RurDev Exp, Vill Ind Exp, MNREGA)

(5) TT = f5(AY, World price, ELECT, GDPGNA, ELECT)

(6) FERT = f6(Subsidies-fertilizer, credit, power, irrigation, TOT(-1), IRRI, Agri R&D, ROAD)

(7) IRRI = f7(Irrigation Exp., TT, Power Subsidy, Rain)

(8) ELECT = f8(Energy Exp.)

(9) ROAD = f9(Road-transport Exp.)

(10) EDU= f10(Education Exp.)

Equation (1) is the rural poverty equation. It is determined by agricultural income (*AY*), agricultural wages (*AWAGES*), terms of trade (TT), non-farm employment (*NFEmpl*), population density and rainfall index. Agricultural income can be represented by land productivity (GDPA per cropped area), labour productivity (GDPA per worker) or total factor productivity. Wage from agricultural employment stands equally important as a source of income in rural areas.

Urbanization (captured through growth in GDP non-agricultural sector) promotes jobs out of agriculture, resulting in an increasing share of nonfarm activities in the income portfolio of rural households. The terms of trade measures the impact of the changes in agricultural prices relative to non-agricultural prices to test the underlying hypothesis that the poor who are net buyers of food may be negatively affected by higher agricultural prices. Other variables that may affect poverty include weather conditions (rainfall) and population density.

The second equation is a land productivity function, which is taken to be influenced by the conventional inputs viz. land, Labour, Irrigation *(IRRI)*, Rainfall *(RAIN)* and fertilizer use *(FERT)* along with public expenditure on agriculture R&D and other variables. The latter explain agricultural income through education of the rural population (EDU), road density (*ROAD*), and electricity use *(ELECT)*. Land is highly correlated with fertilizer, and is therefore excluded from the equation. A dummy variable is also taken to capture the impact of government's flagship programme viz. national food security mission *(NFSM)* on productivity. The mission initiated from 2006 is expected to raise foodgrain productivity.

Equation (3) captures the impact of various factors on agricultural wages towards poverty alleviation. The rural wage function is determined by land productivity *(AY)*, electrification *(ELECT)*, roads *(ROADS)*, and education *(EDU)*. Some of these variables would capture the impact of government expenditure on poverty via improvement in farm and non-farm activities. Non-agricultural GDP growth (GDPGNA) is included to control for the effects of urban labor demand on rural wages. The expenditure on public health and nutrition *(health exp)* is taken to influence both farm and non-farm wages by improving productivity of workers. The influence of another flagship programme of the government viz. MGNREGA on agricultural wages is tried to capture through a dummy variable from 2005-06. The programme guarantees 180 days of employment in a year, which is expected to have positive influence on both farm and non-farm wages. This employment programme in conjunction with food security mission, which is again highly subsidised are expected to have significant impacts on poverty in rural areas. Its impact is also taken in the non-farm employment function in Equation (4).

Non-farm employment is determined by GDPGNA, land productivity *(AY)*, rural roads *(ROADS)*, electrification *(ELECT)*, and education *(EDU)*. The variables road density and electricity are taken as infrastructure variables to capture their impact in undertaking investments in off farm activities and look for suitable jobs. The government expenditure on rural development and village industry is also taken. Most of the expenditure on rural development is towards creation of infrastructure and roads which may positively determine off farm employment. The impact of MGNREGA in generating off farm employment is tried through a dummy.

Equation (5) models the terms of trade. It is hypothesised that growth in farm output would increase aggregate supply of agricultural products, and hence reduces commodity prices which would help the poor. A world price index of five commodities is included to gauge the impact of international trade on agricultural prices in the domestic markets. ELECT is taken to gauge the impact of infrastructure. The demand side effects on agriculture prices are captured through GDPGNA. Equation (6) is modelled to determine the fertilizer use in agriculture by taking government subsidies in fertilizer (*FERT)*, credit *(CREDIT)*, irrigation *(IRRIGATION)*, and power *(POWER)*. Other variables include irrigation, roads, electricity and agricultural research *(Agri R&D)*. Most of these variables impact agricultural production through fertilizer use. The impact of research on productivity is captured indirectly through fertilizer use. As elicited in Fan, Gulati and Thorat (2007), improved irrigation and new seeds from agricultural research would increase farmers' demand for fertilizer use. The explanatory variable terms of trade is lagged one year as supply response is generally based on last years' price.

Equation (7) indicates the relationship between government spending in major and medium irrigation *(Irrigation Exp)* and the percentage of the cropped area under irrigation *(IRRI)*. It would be useful to consider cropped area as per the canal and tube well irrigation to capture the impact of government investment in canal irrigation on private investment in irrigation tube wells. Due to paucity of data across many states, the variable is considered in totality. Irrigation investment by farmers is influenced by agricultural prices and power subsidy. A favourable price structure is expected to instigate farmers to investment in tube wells and other machinery which in turn is influenced largely by power subsidy. Since expenditure on irrigation subsidy is subsumed in total expenditure on irrigation and flood control head, it was excluded from the equation. Rainfall and TT are highly correlated and hence the latter was dropped.

Like irrigation, equation (8) models agricultural electricity consumption *(ELECT)* as a function of government expenditure on rural energy *(Energy exp.)*. As is the case in Equation (8), the subsidy in agricultural electricity is not taken to avoid double counting. Equations (9) and (10) capture the relationships between improved roads and education as functions of their past investments. Education is represented by years of schooling of workers and also literacy rate. Since the impact of investments on roads, education, irrigation usually last more than one year, we have considered these investments as capital stocks using a 10 percent depreciation rate. It is also possible to determine the optimal lag length in variables in place of stock using adjusted R^2 or Akaike Information Criterion as done in Fan et. al (2007). But one has to deal with loss in the degrees of freedom and also address the problem of high correlations among the lagged independent variables.

The system is estimated using structural equation model (SEM) (Klein 2011).SEM is a methodology increasingly used to describe complex systems in a multivariate setting (Grace 2006). It provides a flexible framework to investigate more than one causal process among the variables. By estimating multiple equations, it has the advantage of permitting the evaluation of networks of direct and indirect effects along with different error structures. It models the relationships among unobservable latent variables by allowing multiple measures to be associated with a single latent variable. In this analysis, the model specification is based on the relevant theory and research literature. Double-log functional forms are used for all the equations in the system. State dummies are added to each equation to capture the state level unobservable specific effects. We added a trend in the trade equation to highlight the impact of supply side variables other than agriculture income and world prices.

The total poverty effects (both direct and indirect) of public expenditure and subsidy are obtained by taking into account two components: (1) the estimated elasticities of the variable in the poverty equation and (2) the elasticities of other variables in the poverty equation that are affected by the variable in other equations. For example, the effect of agricultural R&D on poverty may work through various channels through improved productivity, and productivity increase can reduce poverty through fertilizer use, terms of trade and wages. The total effects of agricultural R&D on poverty is summarized in Equation (11).

$$\begin{aligned}\frac{\partial Poverty}{\partial AgRD} &= \frac{\partial Poverty}{\partial AY}\left(\frac{\partial AY}{\partial AgRD}+\frac{\partial AY}{\partial FERT}\frac{\partial FERT}{\partial AgRD}\right)\\ &+\frac{\partial Poverty}{\partial TT}\frac{\partial TT}{\partial AY}\left(\frac{\partial AY}{\partial AgRD}+\frac{\partial AY}{\partial FERT}\frac{\partial FERT}{\partial AgRD}\right)\\ &+\frac{\partial Poverty}{\partial AWAGE}\frac{\partial AWAGE}{\partial AY}\left(\frac{\partial AY}{\partial AgRD}+\frac{\partial AY}{\partial FERT}\frac{\partial FERT}{\partial AgRD}\right)\end{aligned} \qquad (11)$$

The marginal effect of poverty and different types of government subsidies and expenditures are obtained based on the estimated coefficients. Marginal effects are expressed as (a) increase in agricultural GDP (Rupees per unit of spending during 1981 to 2011) and (b) reduction in poverty headcount (number of rural poor brought out of poverty per unit of spending). It enables to compare the relative benefits of additional units of expenditure across different types of subsidy and investment items. These can be taken as useful indicators in setting priorities for government expenditures for accelerating production and lessening poverty.

5. Results and Discussions

5.1 Robustness and model specification

In structural equation modeling, assessing the goodness-of-fit of the model is critical as inferences drawn on poorly fitting models may be misleading. A good-fitting model is one that reasonably represents the data, reflects underlying theory and explains a high proportion of the variability in the data, and can be used for prediction without distortion. Multiple goodness-of-fit tests are performed to examine whether the model is acceptable and fits the observations.

The model chi-square values are reported in Table 3. Two likelihood test compare the model with a saturated model (model fits the covariance perfectly) and both statistics reject the null hypotheses that the model fits as well as the saturated model. Root mean squared error of approximation (RMSEA) measures error of approximation based on residuals matrix for looks at discrepancies between observed and predicted covariance. The model is found to be a close approximate fit because the lower bound of the 90 percent confidence interval is below 0.05.

---Table 3---

The root mean square residual is a measure of the mean absolute correlation residual, or the overall difference between the observed and predicted correlations. The model is considered a favorable fit because the standardized root mean square residual (SRMR) is less than recommended threshold of 0.08. The coefficient of determination is viewed R-square for the model, suggesting the model is adequately fit. Both comparative fix index and Tuker-Lewis index compare the model performance to a baseline model (unconstrained estimates of variance). But it was pointed out that this baseline model could be improper in many cases and should be treated carefully (Widaman and Thompson 2003). It is recommended to check any non-recursive models for stability because the calculation of the indirect effect might fail to converge to finite results. In summary, the test results indicates that the SEM is stable and has goodness of fit based on the combined rule of low RMSEA, low SRMR, high CD and high stability values.

Besides fitness test, we also experimented with different model specification to check for possible misspecification. Sargan test was performed for over-identification of the equations and test results show equations to be identified. The Hausman test indicated a few expenditure and subsidies variables were endogenous. Variables lagged for one year were used as they can be considered predetermined and weakly exogenous. In case of multicollinearity among the explanatory variables such as fertilizer and credit subsidies, alternate equations are reported. Following Fan et al. (2008), we also performed 3SLS estimation and the results are largely consistent with SEM results.

The discussion focuses on three policy questions:(a) effectiveness of different types of expenditures in influencing agricultural growth, and employment and reducing rural poverty, (b) relative impact of various subsidies and investments on agricultural production and also competition between the two for resource allocation, particularly from 2000 when public investments in agriculture and irrigation upsurge, (c) tradeoff, if any between agricultural growth and poverty reduction based on estimation of marginal returns, firstly from investment in different types of public spending on social and economic services and then from key input subsidies.

5.2 Estimation results

Table 4 reports estimation results. Rural poverty is significantly influenced by agricultural income, non-farm employment and terms of trade. Higher land productivity and favourable relative prices of agricultural commodities have always benefitted the poor farm households starting from 1980s.The coefficient of terms of trade is significant at 95 percent level and the elasticity is 0.49 for the period of 1981-2011. The terms of trade turned favourable from 2004-05. Non-farm employment has become important in addressing poverty but has not undercut the contribution of agriculture income and prices. These variables explain nearly 90 percent of the variations in the incidence of rural poverty as indicated in the R square.

Estimated results from agricultural income (land productivity) equation suggest it to be positively determined by agricultural R&D, fertilizer, labour, irrigation and education. Road & electricity infrastructure have a decreasing impact on land productivity. Among all the variables, elasticity is found to be high for education represented by the number of years of schooling of rural population in each decade. The elasticity of education variable is high at 0.32, suggesting a 10 percent increase in literacy level would raise agriculture income by 3.2 percent. Agriculture R & D has an increasing impact on agricultural productivity showing elasticity at 0.07. Rural roads and electricity consumption in agriculture appear to have lost their significance compared to other factors at the aggregate level.

---Table 4---

Broadly results for equations 1 to 10 suggest the following. (a) Rural wages are affected by land productivity, education of workers, public spending on health and decreasingly by infrastructure i.e. road density and rural energy consumption. Interestingly, expenditure on health which was low during the 1980s jumped during the 2000. The coefficient turned out to be positive and highly significant; (b) variations in non-farm employment are explained by non-farm wages, urban growth and education. Public expenditure on rural development and for that matter MGNREGA has somewhat helped compared to that on village industry in contributing to non-farm employment. A disaggregate district or farm level analysis may show some sharp difference; (c) agricultural terms of trade are affected negatively by land productivity as an increase in the supply depresses prices. The impact of world prices on agricultural prices is expected to be positive and significant mainly during the post-reform period when India embarked up economic reforms. Comparative advantage in many agricultural commodities coupled with a relatively greater openness to international trade and favourable price regime enabled price integration; (d) compared to power and credit subsidy, irrigation and fertilizer subsidies have impact on agricultural production. Irrigation intensity and public spending on agricultural research hold importance in raising farm output and fertilizer use. The importance of terms of trade is visible i.e. the long run effect of favourable price structure is favourable on agricultural output; (e) farmers tend to put more area under irrigation in response to government spending on major and medium irrigation systems and power subsidy rather than to terms of trade; (f) education, road density and power consumption in agriculture are positively determined by the stock of public spending.

5.3 Marginal returns and total effects in agricultural growth and poverty reduction

Table 5 reports the estimated total marginal effects on agricultural growth and poverty reduction. The results suggest the government to prioritise expenditures on various heads as follows. (a) Health and education continue to be the most effective public spending item followed by agriculture research and education. Returns to these stood high at more than 300 percent; (b) high returns to investments from rural road and transport found during the eighties in the literature have subsided. However, the estimated total effects do not undermine the importance of road infrastructure. It may suggest that additional expenditure on roads may not be vital for raising land productivity but certainly stands important for augmenting non-farm employment and hence poverty alleviation. Government should continue to allocate appropriate outlays for maintenance of such infrastructures; (c) returns are relatively higher from irrigation and fertilizer subsidies compare to credit and power subsidies; (d) marginal impacts of investment in irrigation and subsidy in rural energy on agricultural productivity and poverty have substantially declined over the period. The percentage of area irrigated is slightly influenced by power subsidy, implying a growing dependence of farmers on diesel- run machinery; (e) returns to productivity and poverty reduction from irrigation subsidy were ranked high. Scaling up credit flow to farmers would go a long way in creation of productive assets; (f) fertilizer subsidy has large growth effects, implying that it is not actually unproductive. If macro fiscal policy allows funds towards subsidies then there is no harm in spending more on irrigation and credit subsidies given their high impact on productivity. But care has to be taken in their efficient use and equitable distribution. Additional expenditure in power subsidy would possibly act as a drain on the government resources; (g) there is absence of any tradeoff between productivity and poverty reduction from public spending on various social and economic services and also subsidies on account of irrigation, power, credit and fertilizer.

---Table 5---

6 Main findings and lessons drawn

Broad findings obtained reveal a relative decline in the allocation of public expenditure on various economic heads and increases on social services. Agriculture, irrigation and rural development sectors appear to have borne the maximum brunt of decreasing share of resources for investment towards economic services. In absolute terms, expenditures on both social and economic heads have increased over time but the increase in the former is higher (5 times) compared to the latter (3 times). Within agriculture, the share of expenditure on food storage-warehousing and research has gone up.

The results make evident that the long standing argument that agricultural subsidies '*crowd out*' public investment in agriculture may not hold during the 2000s as both have accelerated phenomenally. The share of input subsidies and also expenditure on agriculture plus irrigation in agriculture income hovers at nearly 13 percent. Also, the persistent claims that input subsidies tend to be unproductive needs to be revisited in the light of higher marginal returns from irrigation and fertilizer subsidies. Undoubtedly, investments in health, education, agricultural research, and rural energy have turned out to be most preferred expenditure items followed by subsidies. If macro fiscal policy allows funds towards subsidies then there is no harm in spending more on subsidies given their high impact on productivity. But care has to be taken in their efficient use and equitable distribution. The richer states have taken a lead in allocating more outlays for developmental purposes as well as providing input subsidies. The latter has implications for equity in terms of subsidy reaching a particular region, farm size and crops and sustainability in view of unbalanced use of irrigation and fertilizer that could adversely impact soil and water resources.

A growing literature suggests an increased public expenditure towards subsidies may provide incentives to private investment, under certain conditions and trigger agricultural growth (Lopez 2005; Chirwa and Dorward 2013), which might be the case in India during the 2000s. It is further argued that the low supply of public goods due to cut in expenditure may reduce the marginal returns to private investment in the long run. This aspect however needs to be researched by first, identifying the well defined subsidies that overcome market failures, second, quantifying their benefits, full costs, as well as detrimental impacts, and lastly, working on the best and efficient instruments of delivery. Recent studies have deliberated upon some of the ways by which farm subsidies can be made "market smart" through better targeting and rationing (Morris et al. 2007;Jayne and Rashid, 2013).

Evidence for the African countries where the input subsidy programs have got initiated since the mid 2000s indicates that the costs of the programs have generally outweighed their benefits (Chirwa and Dorwad 2013). The authors have suggested a partial reallocation of expenditures from fertilizer subsidies to R&D and infrastructure for higher returns to agricultural growth and poverty reduction. Given that subsidies would stay due to economic and/or political compulsions, the ways in which benefits can be enhanced through changes in implementation modalities, complementary investments to improve soil fertility and more efficient usage of fertilizer are identified.

The study also brings forth the fact that the policy objective of encouraging adoption of new technology was achieved around 1990s as high yield variety has been universally applied, fertilizer consumption tripled, villages electrified, and irrigation spread to cover almost half of the crop area. The technology adoption has now slowed down or plateaued, resulting in diminishing returns. Keeping in view the importance of agricultural productivity in reduction in poverty and sectoral income gaps, one of the key strategies of the government should be to augment spending on education and agricultural research. We also find that an improvement in agricultural growth, visible since mid-2000s has coincided with favourable terms of trade. Better price structure, which can possibly be explained by a continuous increase in the minimum support price of cereals has indeed helped the poor, but has not been effectual in improving the crop productivity. Instead public spending on R&D should be given priority as marginal returns on productivity are estimated to be relatively high but far below the average rate of return at 43 percent from research and extension services in the developing countries (World Bank 2008).

Going by the experience of other countries, spending on this head should be scaled up from less than 1 percent of agricultural income at present to atleast 2 percent. Even if agricultural R&D is redefined by taking expenditure on soil conservation, animal husbandry and R&D, the share reaches to maximum 2 percent, which is way below the expenditure being incurred in many other countries. It is also important that investment intensity of agricultural R&D (i.e. creation of capital assets) has remained much lower at 0.4 percent of agricultural GDP. It should rise to 1 percent as is targeted in the 12th Plan period (Balasubramanian 2014). Fewer resources to R&D are contested to be one of the factors behind a decline in total factor productivity growth in the recent years. A significant scope exists for improving the farm productivity with available technology which can increase incomes over 3 times (World Bank 2014).

The findings also indicate the importance of health and education in enhancing farm income, wages, and non-farm employment which have far reaching impact on labour productivity and poverty. Across all the states, agricultural sector has the maximum number of 'not literates' workers having low levels of productivity. The share of educated workers (from primary grade onwards) in agriculture and allied sector stands as low as 40 percent compared to more than 80 percent in manufacturing and tertiary sectors. Currently, the estimated number of years of schooling of rural labour force is 4.5, which is 3 times higher than that in 1981-82 but far below than 7.3 years in the high literacy rate states viz. Kerala and Himachal Pradesh. An increase in public expenditure on education and skill development at primary level stands crucial at this juncture.

The role of non-farm employment in poverty reduction has emerged significant during the 2000s. Off-farm employment is found to be relatively more effective compared to agricultural productivity in poverty alleviation, which could be due to trimming of the size of land holdings in the country and also rising wage rates. Literature confirms that land productivity may be high in the small farms but they may not be efficient in terms of labour productivity, which has greater impact on farmers' incomes. The non-farm share of rural employment has increased considerably from 16 percent in the early 1980s to 36 percent in 2011-12. Results show that changes in non-farm employment at the state level are explained more by non-farm wages, infrastructure and education. Nevertheless, public expenditure on rural development has also been important in raising non-farm employment.

The recent NSS employment-unemployment (2011-12) reveals a movement of labour from agriculture to construction and services sectors. A rising share of rural income from these sectors again testifies increasing prospects of non-farm employment. The opportunities are likely to increase as a few agriculturally dominant low income states have attracted private investment in food processing industry, which has boosted employment and productivity (Bathla and Gautam 2013). Promoting private investments in agro industry can not only generate off farm jobs but also improve agricultural productivity for which a favourable investment climate, reforms in the power sector and development of infrastructure stand crucial.

Annex I: Specification of Variables

(a) Public expenditure on various social and economic services under revenue (current) and capital accounts were collected from the Finance Accounts, Government of India. It is important to note that the economic and functional classification in the budget and finance accounts have changed since 1987 and extra efforts have been taken to adjust the expenditure data in the period of 1981 -1986 under various heads to match with the new budgetary classification.

(b) Irrigation subsidy is calculated as the difference between the total operation and maintenance costs and the total revenue in the irrigation sector based on the detailed state-wise data taken from the Finance Accounts. Interest payments are included in revenue (receipts). Irrigation subsidy is estimated based on the definition above, plus 1 percent of the cumulative capital expenditure on major and medium irrigation and command area development programmes because it better captures the total public cost to deliver irrigation (Gulati and Narayanan 2003).

(c) Fertilizer subsidy is measured as fertilizer subsidy from the Central government apportioned to states according to actual consumption. In other words, it equals to the unit price (national subsidy estimates divided by total national fertilizer consumption) multiplied by fertilizer consumption in each state. It is reported in Fertilizer Statistics of India.

(d) Credit subsidy consists of interest subsidy and default subsidy. Interest subsidy is the difference between commercial interest rates and the interest rate farmers receive multiplied by the amount of outstanding loan. Interest is collected from National Bank for Agriculture and Rural Development, annual report of State Bank of India, and National Federation of State Co-Operative Banks. Default subsidy refers to the defaulted loans to agriculture based on the non-performing assets and age distribution of loans. Since data on non-performing assets as per age is not available for commercial banks which provide nearly 60 percent of total credit to agriculture, only interest subsidy is considered in this study.

(e) The electricity (power) subsidy is estimated as total power supplied to agriculture multiplied by the difference between unit cost of power supply and unit revenue from agriculture based on information given in the annual report of the state electricity board.

(f) Government policies targeted agricultural and rural sector are introduced. The National Food Security Mission (NFSM), introduced in 2006, is funded by the Central Government to boost production and productivity of wheat, rice and pulses through dissemination of improved technologies and farm management practices. The 2005 Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) guarantees at least 100 days of waged employment per year to a rural household whose adult member volunteer to do unskilled manual work. The policy objective of MGNREGA is to ensure livelihood security of rural residents, which may lead to changes in labor market by raising wage and shifting labor supply. Non-farm employment is included as an endogenous variable to see the impact of MGNREGA and non-farm wages.

(g) Other changes include - the variable literacy is replaced with number of years of schooling; number of villages electrified is replaced with consumption of electricity in agriculture; expenditure on health, rural energy and rural development are included.

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Table 1. The structure of Indian public expenditure

Type	Accounts	Main Heads
Non-development	Revenue	• general services (interest payments, defense, law and order, fiscal and administrative services, pension) • grants-in-aid domestic and abroad
	Capital	• loans and advances domestic and abroad
Development	Revenue	• economic services (agriculture and allied services, rural development, irrigation and flood control, energy, industry and minerals, transport, communication, science and technology, environment and general economic service) • social services (public works, education, sports, culture, health, family welfare, water supply, sanitation, housing, urban development, information and broadcasting, social welfare, labor, and nutrition) • grants-in-aid to states and union territories
	Capital	• loans and advances for economic and social development

Source: Reserve Bank of India (2014).

Figure 1.Structure of social and economic expenditure, 2000-11 average

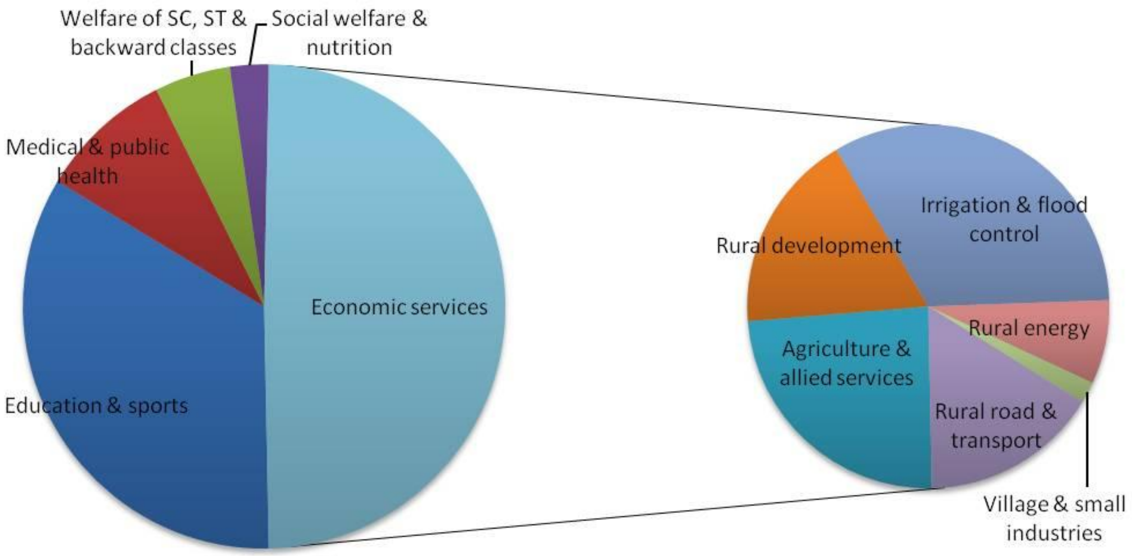


Table 2. Share of subheads within each expenditure head

Average share within head (%)	1981-1989	1990-1999	2000-2011	Growth rate (%)	Share of capital exp. (%)
Total exp. (billion rupees)	1412	2427	5245	6.6	12.3
Development exp. (billion rupees)	1035	1590	3283	5.8	17.9
Social exp. (billion rupees)	517	827	1763	6.3	5.6
Economic service exp. (billion rupees)	518	763	1520	5.4	31.0
Economic services	100	100	100	5.4	
Agriculture & allied services	21.8	22	17.3	4.2	9.1
Rural development	15	14.9	12.9	4.6	6.7
Irrigation and flood control	33.1	26.8	23.7	3.9	55.7
Rural energy	1.3	4.3	5.4	12.2	28.9
Rural road and transport	9.9	8.6	11.4	1.8	9.3
Village and small industry	2.84	2.35	1.37	1.76	45.6
Agriculture & allied services	100	100	100	4.2	
Crop husbandry	23.1	27.9	27.8	5.8	2.5
Soil and water conservation	5.9	6.9	5.7	3.9	20.9
Animal husbandry	11.6	11.4	10.9	3.9	2.3
Dairy development	13.6	8.5	4.6	-1.9	2.1
Fisheries	2.3	2.5	2.5	4.7	17.7
Forestry and wildlife	22.3	19.7	19.1	3.8	10.6
Plantations	0.4	0.1	0.9	-	71.2
Food, storage warehousing	2.5	5.4	10.2	-	-
Agri. research and education	6.3	6.2	7.3	4.8	1.8
Agri. financial institutions	0.8	0.7	0.02	--	--
Cooperation	11.1	10.4	11.1	4	21.7
Other agri. Programs	0.8	0.9	0.7	3.7	17.1
Rural Development	100	100	100	4.6	
Special programs	22.3	13.6	9.1	0.6	0.0
Rural employment	43.5	42.7	16.7	-0.4	0.0
Land reforms	3.5	0.9	0.6	-3.1	0.0
Other programs	30.3	40.7	58.5	8.1	0.0
Others	0.07	2.05	15.07	-	0.0
Irrigation& Flood Control	100	100	100	3.9	
Major irrigation	-	-	15.2	-	69.7

Medium irrigation	72.5	74.5	63.6	2.6	60.1
Minor irrigation	18.7	17.6	14.6	2.9	41.1
Command area development	3.8	3.2	1.8	-0.16	23.9
Flood control and drainage	5	4.6	4.8	3.8	58.8
Social Services	100	100	100	6.3	
Education & sports	49.8	54.1	49.6	6.1	1.4
Medical & public health	17.5	15.8	13.1	4.7	5.8
Welfare of SC, ST & backward classes	6.9	6.8	7.4	6.7	9.9
Social welfare & nutrition	10.5	8.4	3.7	1.5	2.3
Other	15.2	14.9	26.1	-	-

Note: Growth rate and average share of capital expenditure refer to average annual growth rate from 1981 to 2011.

Figure 2. Agricultural expenditure and input subsidies, in billion Rupees

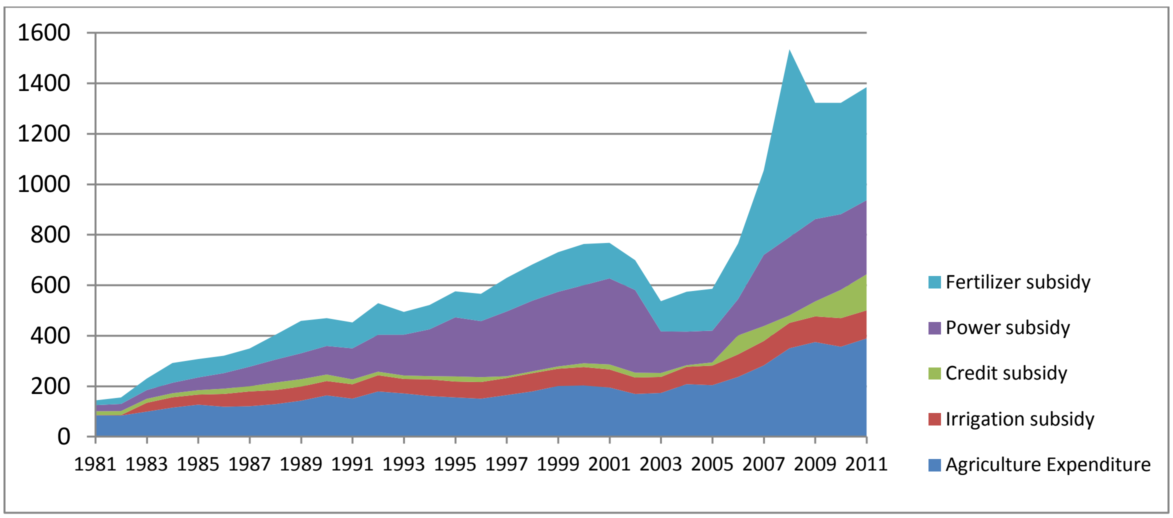


Figure 3. Public investment and input subsidy in agriculture, in billion Rupees

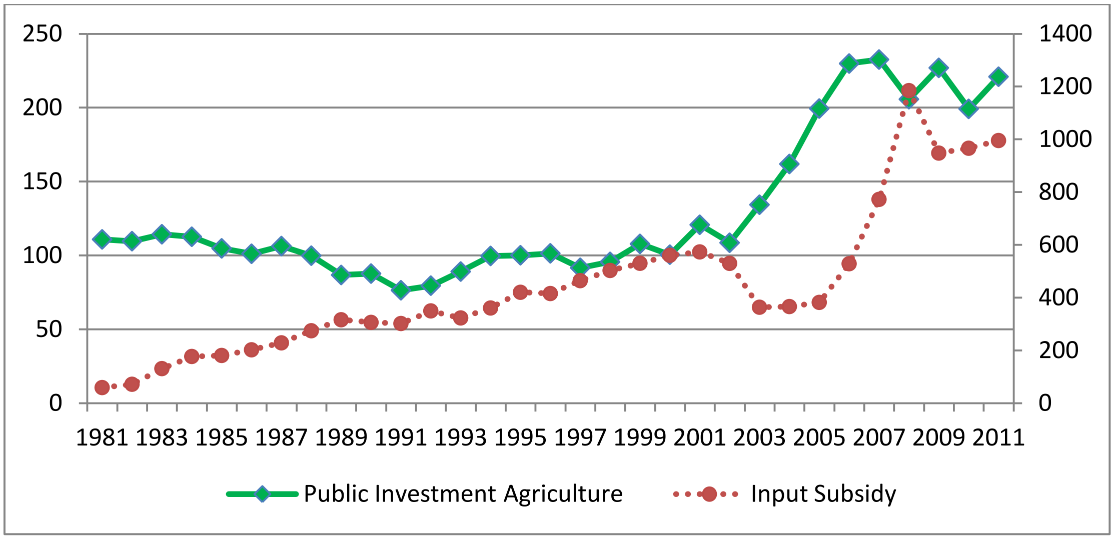
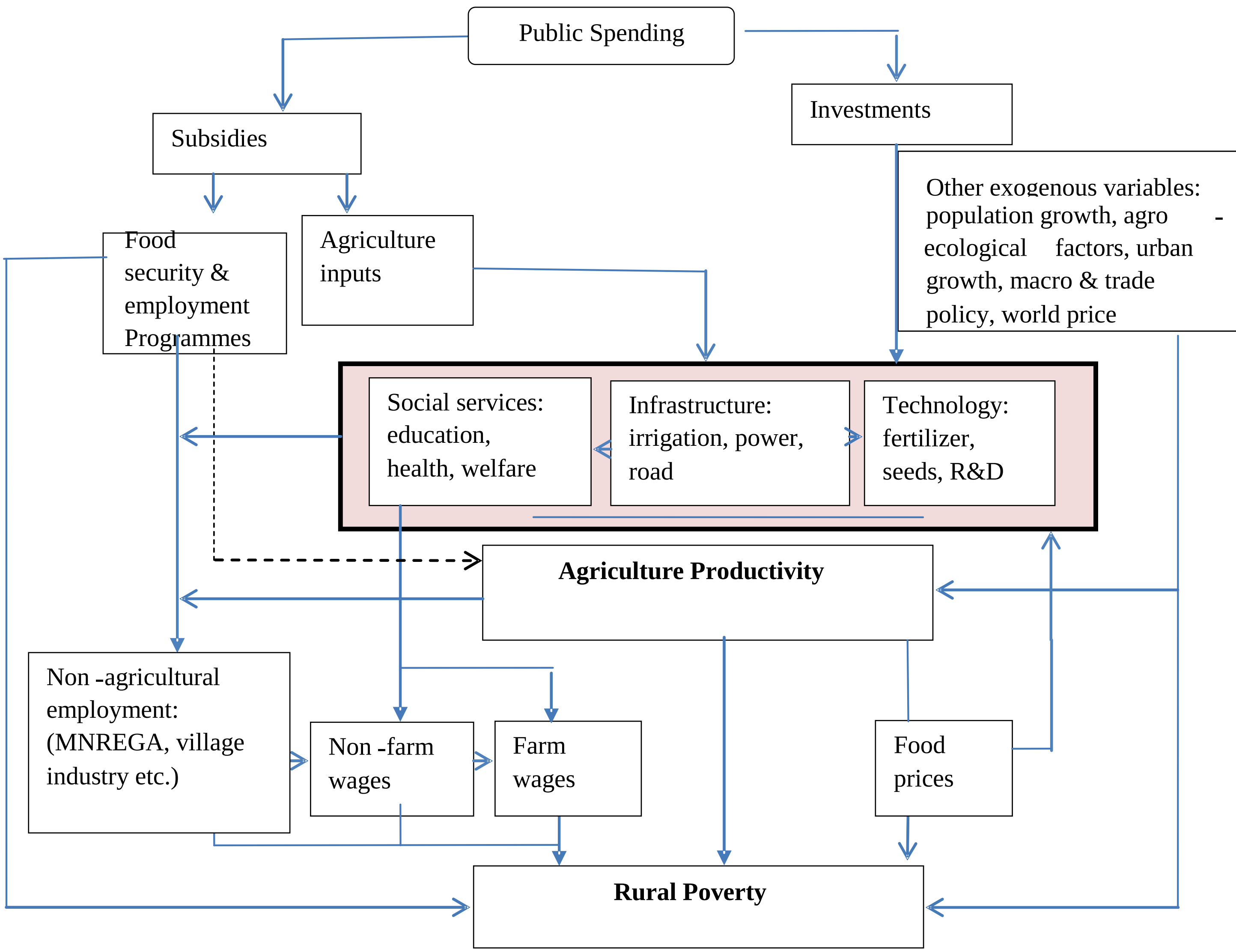


Figure 4.Analytical framework of the impact of public expenditure and subsidy on growth and poverty



Note: Dotted line indicates indirect effects.

Table 3. Goodness of fitness tests

Description	Fit statistic	1980-2011
Chi-square	Chi-square	4781.6
Null: Model fits as well as the saturated model	LR p-value	0.000
Null: Baseline model fits as well as the saturated model	LR p-value	0.000
Good fit if <= 0.05	90% CI of RMSEA, lower bound	0.000
Good fit if close to 1	Comparative fit index	0.707
Good fit if close to 1	Tucker-Lewis index	0.420
Good fit if <0.08	SRMR	0.032
Good fit if close to 1	CD	1.000
Eigenvalue stability	stability index	0.000

Table 4: determinants of Poverty and Agriculture Income: 1981-2011 (N=527)

(1) Poverty =14.29* -0.32AY* –1.0TT* -0.94AWage* -0.03NFEmpl -0.03 Rain (R^2 0.83)

(2) AY = 7.04*+0.065Agri R&D**+0.10 Labour*+0.13 IRRI*+0.11 ELECT*+0.32 EDU* +0.104FERT*-0.038 ROAD+0.04 Rain*+0.076 NFSM** ($R^2$0.95)

(3) AWAGE =0.12*+0.14GDPGNA+0.10AY*-0.06ELECT*+0.057 ROAD*+1.02EDU*+0.22Health Exp*-0.01 MNREGA (R^2 0.94)

(4) NFEmpl=1.34*+0.36GDPGNA*+ 0.30 NAWage*+0.02ROAD+0.07ELECT*+0.06RurDev Exp*-0.086Vill Ind. Exp*+0.09MNREGA* (R^2 0.82)

(5) TT = -16.8*-0.12AY*+0.25 World price*-0.52GDPGNA+0.06 ELECT*+0.01*Trend (R^2 0.64)

(6a) FERT = -3.09*+ 0.36fertilizer sub*-0.014power sub+0.04irrigation sub*+0.45TOT(-1)*+0.11 IRRI*+0.06Agri R&D**+0.35 ROAD* (R^2 0.94)

(6b) FERT = -5.17* +0.01credit sub+0.012power sub+0.11irrigation sub*+0.92TOT(-1)*+0.11 IRRI*+0.20Agri R&D*+0.64 ROAD* (R^2 0.92)

(7) IRRI = 2.91*+0.23Irrigation Exp.*-0.30 TT*+0.05 Power Subsidy* (R^2 0.87)

(8) ELECT = 5.40* +0.24Energy Exp.* (R^2 0.89)

(9) ROAD Density= 4.93 +0.29Road-transport Exp.* (R^2 0.92)

(10) LITE= -3.05* +0.65Education Exp.* (R^2 0.92)

Notes:*,**,*** indicate significance at 1, 5,10% level. State effects are significant. TOT is 3 yrs moving average. Variables are specified on per hectare basis; public expenditure is per capita; In eq. 2, land (GCA/worker) is dropped due to problem of multicollinearity; Edu is highly significant but dropped due to high correlation with other explanatory variables; Expenditure on R&D is extended to include soil conservation, animal husbandry and R&D. In eq. 6 separate equations are estimated due to multicollinearity between fertilizer and credit subsidies.

Table 5: Agricultural Growth and Poverty Reduction: Returns to Investments and Input Subsidies: 1981 to 2011

	Returns in Agricultural GDP (Rs per Rs spent)	Returns in Rural Poverty Reduction (decrease in number of poor per million Rs. spent)	Ranking
Agriculture R&D	3.17	487	3
Education Investment	4.92	756	2
Health Investment	5.22	801	1
Rural Road & Transport Investment	2.25	346	7
Irrigation Investment	1.00	150	10
Rural Energy Investment	2.98	458	4
Rural Development	1.63	251	8
Irrigation Subsidy	2.67	410	5
Fertiliser Subsidy	2.53	389	6
Power Subsidy	0.50	75	11
Credit Subsidy	1.50	230	9