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I would like to extend my whole-hearted thanks to the Editorial team, the Publisher, and all who have helped in the publication process, and especially the office bearers of Bangiya Arthaniti Parishad for their kind endeavours to make this issue of **Artha Beekshan** viable and **Kolkata Mudran** for bringing out the present issue.

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INCLUSIVE GROWTH, ECONOMIC REFORMS AND THE POST-CRISIS MACROECONOMIC SLOWDOWN IN INDIA¹

ASIS KUMAR BANERJEE*

Abstract

In this address, I will try to relate the persistent nature of the growth deceleration in India to issues closely related to inequality in general and to the share of labour in GDP in particular during the post-reform period. I will argue that it is possible to restructure our economic reforms in ways that can enable us to fight our way out of the current phase of deceleration.

Keywords : Inequality, Inclusive growth, Economic Reforms, Macroeconomic slowdown in India.

JEL Classification Codes : E32, F43, O11, P 46.

I. Introduction

I consider it to be a matter of great privilege to be invited to be the Conference President of the 37-th Annual Conference of Bangiya Arthaniti Parishad. While accepting the invitation, I was aware of the fact that together with the privilege went the responsibility of having to prepare a presidential address. Over the past few years I have been working on inclusive economic growth. On the other hand, the announced theme of the Conference is related to economic reforms. I, therefore, thought that I might try to put these two things together and to say a few things on the relation between economic inequality and economic reforms in the light of one of the major economic issues before the country today.

The economic problem that I have in mind here is the persistence of the decelerating phase of the rate of growth of our GDP. As is well-known, the Indian economy recorded an impressive growth performance (posting a GDP growth rate of 8.9 per cent per annum on the average) in the five-year period from 2003-04 to 2007-08. Then it was hit by the global financial crisis. In 2008-09 the growth rate fell sharply to 4.15 per cent. However, in the following two years 2009-10 and 2010-11 there was a remarkable recovery, with GDP growing at rates that were unprecedentedly high. Since then, however, the growth rate has remained rather subdued. At the moment the growth rate (6.8 per cent for 2016-17) remains not only by far lower than the high point of 10.3 per cent (achieved in 2010-11) but also significantly lower than the *average* growth rate of 8.4 per cent of the period 2003-04 to 2010-11. In what follows I will try to relate the persistent nature of the growth deceleration in India to issues closely related to inequality in general and to the share of labour in GDP in particular.

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1. Presidential Address delivered in the 37th Annual Conference of Bangiya Arthaniti Parishad, at Prabhu Jagatbandhu College, Andul, Howrah, September 15, 2017.

I will, however, start with the inequality angle by discussing the economic reasons of our interest in inequality and the difficulties of estimating inequality in India. I will argue that because of these difficulties a fall in labour share in GDP is a more manageable indicator of an increase in inequality than the ones given by the conventional inequality indices (such as a rise in the value of the Gini coefficient). I will then go into the observed global trends in labour share, the factors that explain the trends and the macroeconomic effects of the observed trends. It is in this last context that the matter of growth deceleration in India will enter our discussion. I will try to argue that it is possible to restructure our economic reforms in ways that can enable us to fight our way out of the current phase of deceleration.

II. Inequality and economic variables

II.1 Why study inequality?

Why, at all, are we interested in inequality? Is it primarily a moral issue? It is certainly a matter of value judgment. I can sympathise with the judgment that inequality is a bad thing per se and that, therefore, economists should spend time estimating the degree of inequality prevailing in the economy. I want to make it clear at the outset that this is not the only perspective on inequality, at least for an economist. In fact, my own interest in the matter does not derive from the moral position, at least not wholly. I am concerned with the question whether there are significant relationships between inequality and the variables that are traditionally considered to be more economic in nature.

The genesis of the debate over the question of existence of such relationships can be traced to the famous “Kuznets curve”. (See Kuznets (1955).) An “inverted U” relation between per capita income and the degree of inequality of the distribution of income in an economy was uncovered empirically: as per capita income increases, inequality increases upto a point but declines thereafter. The Kuznets curve was at one time interpreted to imply that even if inequality was considered to be a bad thing per se, there was no need for economists to be overly worried about it: if the economy keeps growing, inequality would come down sooner or later. Growth was the solution to the problem of inequality.

Uneasiness with the Kuznets hypothesis began to manifest itself when data revealed a *rising* trend in inequality in some of the developed economies (especially the UK) in the 1980's *after* a declining phase while per capita income was rising all along. This led to a re-examination of the Kuznets hypothesis with the help of the richer set of data that was now available. The exercise led to a definitive rejection of the Kuznets hypothesis. (See Deininger and Squire (1996, 1998).) It was also noted that the finding is not substantially altered if instead of the *level* of per capita income we consider its rate of *growth*.

Subsequently, attention shifted to the question whether there was causation in the *other* direction i.e. whether inequality affected growth. There was a good deal of theoretical work. A pioneering contribution was that of Galor and Zeira (1993). But there were other important contributions.

(For a review see Aghion, Caroli and Garcia-Penalosa (1999).) There was also an enormous amount of empirical research “the so-called “growth regression” literature of the 1990’s. While, quite expectedly, inequality did not come out to be the *sole* determinant of the growth rate, most of these exercises pointed towards a *significant* negative impact of inequality on the growth rate of per capita income.

II.2 Problems of studying the time pattern of inequality in India

So far as country-specific empirical studies are concerned, absence of long time series on inequality has been a major problem. In this context the recent project undertaken by Piketty and others on the construction of country-specific time series on the share of national income going to the *top income earners* deserves mention. In most cases income tax data constituted the main data source. (See Banerjee and Piketty (2005) for the Indian case.) However, while the time pattern of inequality has been thoroughly analysed on the basis of this measure of inequality, the relationship between inequality and growth does not seem to have been studied so far for the case of India. It can also be argued that the top income shares do not reveal the entire distribution scenario. An investigation of how inclusive economic growth has been must pay attention to the entire spectrum of income distribution. Moreover, in the case of India the top income shares series stops at the year 2000 because it was from that year that the Government of India stopped publishing data on income tax returns. Hence, not much is known about the trend of top income shares in India in the very recent years.

If we intend to make a frontal attack on the problem of unraveling the relation between inequality and economic growth in India (instead of reformulating the question in other ways), there seems to be no alternative to using measures of overall inequality. There does exist some information on the time pattern of the Gini coefficient in India in recent decades. However, the extremely short span of the time series prevents it from being of much use for the purpose at hand. The following are the major gaps in our knowledge in this regard.

First, as is well-known, we do not have measures of *income* inequality in India. The NSSO reports of the quinquennial large-sample surveys give values of the monthly per capita consumption expenditure (MPCE) for each household in samples drawn for the rural and the urban areas separately. On the basis of this information researchers provide estimates of the rural and the urban inequality indices of the distribution of MPCE. The Gini coefficient is the most widely used index of inequality in this context. It is these estimates that serve as the measure of inequality in India. (The NSSO, however, is reported to be in the planning stage for conducting *annual* surveys of *income*.)

Secondly, what we need in our context is the value of the inequality index for the country as a whole while the official reports of the NSSO give the rural and the urban distributions separately and, therefore, researchers usually calculate the rural and the urban Gini separately. The problem is that the overall (countrywide) Gini is *not* an average, either weighted or unweighted, of the

rural and the urban Ginis. For calculating all-India Ginis, we have to go to the original (unit-level) data base.

Thirdly, all researchers do not report on the estimates of the Gini coefficients for all the survey years. The over-all picture can only be obtained by collating the works of different researchers. The Planning Commission (2012), apart from reporting only the sectoral Ginis, does not give estimates for the year 1987-88. Bhalla (2011) does estimate the all-India Gini but does not give estimates for the years 1987-88 and 1999-2000 years. Motiram and Vakulabharanam (2012) report both sectoral and all-India Ginis but skip the years 1987-88 and 1999-2000. Moreover, for some of the years, there are wide divergences between the estimates given by different authors due to methodological differences on various matters of detail.

Fourthly, the (rural and urban) Ginis that are usually available in the literature are those of the *nominal* consumption expenditure of the households. As is well-known, such nominal comparisons are likely to exaggerate the degree of inequality among the households in any given year. What is needed is the inequality of *real* consumption (in much the same way as we need to carry out inter-country comparisons in terms of incomes expressed in PPP dollars). The nominal consumption expenditure comparisons between households should be adjusted to correct for differences in the prices faced by households at different locations. In a large and diverse country such as ours, these price differences are observed to be quite significant.

Fifthly, it should be noted that while the Gini coefficient happens to be the most widely used index of inequality, it is by no means the only such index that is available in the literature. (For a discussion of various inequality indices and their properties see, for instance, Sen (1997).) To add to an already-long list of problems, there is no logical reason why *different* inequality indices should move in the same direction over time for any given country or region.

Scanning the literature I have been able to find only one contribution, Krishna and Sethupathy (2011), that tries to address all of the issues raised above. For four years (1987-88, 1993-94, 1999-00 and 2004-05, they report all-India values, calculated in *real* terms, for three different inequality indices (viz. the Gini, Theil's first index and variance of the logarithm) for MPCE.

The basic problem of a very short time series, however, remains. Note that if we only wish to study the time pattern of inequality, the data size can be stretched a little. *State-wise* Gini coefficients for both the rural and the rural sectors are available. We can pool this cross section data with their time series. This would give us a data size that would be fairly respectable. However, our focus is on the inequality-growth nexus. We can, of course, relate the inequality data to, say, the growth rate of per capita state domestic product (SDP). However, the rural-urban breakdown of SDP is not available. More importantly, as has been rightly emphasized in the literature, for an analysis of the time pattern of growth rate and its relation to inequality, it is country-level data that should be used. While inter-state variations are not necessarily insignificant, the economic growth rate is affected by far more significantly by various types of policies (monetary, fiscal, trade and so on) formulated at the national level and by various national-level economic parameters.

Meanwhile, for countries (mostly, the advanced economies) for which inequality data *are* available, evidence continues to pour in to the effect that even in the recent past inequality may have been a drag on economic growth. See, for instance, Berg and Ostry (2011), Lavoie and Stockhammer (2013) and Ostry et. al. (2014) who, again, found that inequality can harm economic growth.

II.3 Labour Share in Total Income

It, therefore, seems worthwhile to formulate the distribution question a little differently. In my opinion we can profitably take a cue here from the classical economists who emphasized what we today call the *functional distribution of income* i.e. the distribution of income between the two major factors of production viz. labour and capital. Recall David Ricardo's now-famous sentences in his letter to Thomas Malthus about two centuries ago:

“Political economy you think is an enquiry into the nature and causes of wealth – I think it should rather be called an enquiry into the laws which determine the division of the produce of industry amongst the classes which concur in its formation. No law can be laid down respecting quantity but a tolerably correct one can be laid down respecting proportions. Every day I am more satisfied that the former enquiry is vain and delusive and the latter only the true object of the science”. (See Sraffa (1952, Vol. 8, pp. 278 – 279).)

We do not, however, propose to undertake here the ambitious programme of *determining* the laws of functional distribution. We are merely asking what the trends in functional shares are and how, if at all, these are related to the economic problems of a country such as ours. In doing so we are motivated by Piketty's (2014) now-famous work. Piketty, however, concentrated on *capital share* since his basic thesis had to do with what he called the “rise of capital” in the twenty-first century and its various consequences. He was able to build up long time series (spanning over two centuries in some cases) for *capital share* in the advanced economies.

For convenience, we shall concentrate on *labour share* which is the obverse side of capital share. As can be surmised, Piketty's work on the long run trends of capital share involved painstaking historical research. Since we are concerned with India and countries which are similarly placed in terms of their levels of development, it is apprehended (in view of the state and the history of documentation in these countries) that building labour share time series of similar lengths would be practically impossible. Fortunately, our task is more modestly conceived. It is hoped that even in these economies national income data combined with such labour market surveys as may be available may give a reasonably clear picture of the time trend in labour share in the *past few decades*. In this context the attention given in the IMF's World Economic Outlook, April, 2017 to the issue of *labour share* deserves appreciation and a close look. How good an indicator of overall inequality (or equality) do we get here? On *a priori* grounds we clearly have reasons to expect a high degree of association between labour share and equality in the distribution of personal income. First, as has been emphasized by Piketty (2014), profits as well as incomes from savings and financial assets accrue to high-income individuals. A *fall* in labour share, therefore,

would tend to be associated with an increase in *inequality* between capital-owners and workers. Secondly, whenever labour share declines, there is a tendency for inequality within *labour income* to increase. For instance, when a downturn of a business cycle begins, it is usually the low-wage low-skill workers who bear the brunt of the impact. It is these workers who are thrown out of jobs first. (See, for instance, Autor and Dorn(2013).) It is only later that high-wage workers are affected. There are various reasons for this. In some cases the employers invest in training the workers. Dismissing a skilled worker would be a costly proposition for the employers. Moreover, in many economies there is persistent shortage of skilled workers. Employers, therefore, think twice before laying off skilled workers lest they may not get back the right kind of workers when eventually the upswing of the business cycle begins. It is not surprising, therefore, that the hypothesis of a high association between a low labour share and over-all inequality is borne out by empirical studies on countries for which data are available. For instance, Charpe (2014) reports that if the Gini coefficient is the measure of inequality, the movements of these two variables are very strongly correlated in Argentina, Brazil, Canada, France, Germany, Republic of Korea, Russia, UK and USA. For a much larger sample encompassing both advanced and other economies and for a longer time span, IMF(2017, Ch. 3) reports similar results.

Country-specific studies of this type for countries like India are difficult to carry out for reasons that we have already discussed above. (Note that attempts to augment the data size by using state-level data for the various years for which Gini coefficients are available would not be of much use here since the corresponding state-level labour shares are not available.) Nevertheless, in view of the strong theoretical reasons and the available statistical evidence mentioned above, in the rest of this presentation we shall proceed by taking labour share to be a reasonably good proxy for overall equality.

What do we gain by focusing on labour share rather than on inequality indices as such? There are two gains here. (1) Labour share is a macroeconomic variable. It can be reasonably well estimated by using national income statistics together with information on the wage rate (or rates). While its estimation is not entirely free of difficulties, construction of a time series for India for recent decades seems to be a less daunting task than in the case of inequality indices. (2) Related to this is the fact, it can be related to *other* macroeconomic magnitudes a little more transparently.

Labour share is defined as the ratio between labour income wL (where w is the money wage rate per worker and L is the number of workers) and PY (where Y is real output and P the price level or the GDP deflator). It is easily seen to be equivalent to the ratio between w/P which is taken to be the real wage rate and Y/L which is per capita output or the average productivity of labour. Thus, if per capita output rises but labour share *falls*, it means that the real income of a typical worker has not kept pace with economic growth. In almost all economies (including the advanced ones) the number of workers by far exceeds that of capital owners. The ratio, thus, is a transparent measure of the extent to which growth is *inclusive*: a falling labour share means that the major part of the population is not benefitting from the growth process to the extent to which the minority is.

II.4 Global trends in labour share: Causes and effects

How has the labour share behaved over time? For a long time, economists considered *constancy* of labour share to be one of the basic facts of economic history. Kaldor (1957) mentioned it among what he called “the stylized facts of economic growth”. The formulation of the hypothesis originated in the work of Arthur Bowley in the early parts of twentieth century. The so-called Bowley’s Law was based on an analysis of British data pertaining to the nineteenth century and the early years of the twentieth. Later, an analysis of US data led to a similar conclusion and led to the formulation of the Cobb-Douglas production function whose mathematical form was based on the assumption of constancy of labour share of the total output.

Not everybody, however, was convinced of the validity of this “law”. Keynes (1939) called the alleged constancy “a bit of a miracle” while Solow (1958) questioned the empirical evidence.

What do more recent data reveal? As usual, it is data for the advanced economies that are available relatively easily. IMF (2017, Ch. 3) reports that in 31 such economies the labour share has, on the average, trended downward since around 1975. The lowest level was reached just before the financial crisis of 2008-09. Since then until 2014, it has not risen significantly although there have been year-to-year fluctuations. In case of the emerging market economies data scarcity limits the sample size to 18 and the time span to 1992 – 2014. The pattern is one of a declining trend. India, however, does not appear in these samples.

The findings reported in the preceding paragraph are, however, based on what is called the *unadjusted* labour share. This share is simply the ratio between the wages of the employees and total income (which is taken to be GDP minus taxes (net of subsidies) for production and imports). The numerator of the ratio does not include *self-employed* workers. Even for the advanced economies this is a non-trivial omission. In countries like India, these workers, in fact, constitute the major part of the working population. They include not only people engaged in the various professions, legal, medical, accounting and so on, but also all farmers as well as workers engaged in the so-called informal sector.

A number of methods have been suggested for adjusting the labour share in order to take account of the self-employed workers. One option is to scale up the compensation of the employees by a multiplicative factor given by the ratio between the total number of workers and the number of employees (i.e. people on regular payrolls). This procedure assumes that the self-employed earn the same wages as the payroll employees. Needless to say, the assumption is unrealistic. It would obviously *overstate* the labour share. Some authors suggest using a hypothetical self-employed wage rate which is a fraction (usually, two-thirds) of the average regular wage rate. (See, for instance, Bentolila and Saint-Paul (2003).) However, since there is little microeconomic evidence in favour of any particular specification, any assumption in this respect is bound to be ad hoc.

A second suggestion is to measure the income of the self-employed from the national accounts. Usually, the operating surplus of unincorporated enterprises owned by members of households is taken to be the income of the self-employed. It is called the “gross mixed income” (GMI). As per this suggestion, GMI is added to the numerator of the unadjusted labour share ratio. However, this procedure, again, is seen to imply an overvaluation of the labour share: all of GMI obviously cannot be labour income.

A third suggestion seeks to address the issue by assuming that GMI is allocated between labour and capital income in proportions similar to the labour-capital split in the rest of the economy. It is seen that this is tantamount to subtracting GMI from the denominator of the unadjusted ratio (rather than adding it to the numerator). Most experts believe that while this method also may involve an overstatement of the labour share, the magnitude of the error is likely to be smaller than in case of the second suggestion referred to above.

Following Karabarbounis and Neiman (2014), IMF (2017) also argues for adjusting labour share for *capital depreciation*. Since depreciation of capital cannot be consumed by either the workers or the capital owners, we should talk about their shares in GDP net of depreciation. In other words, depreciation should be subtracted from the denominator of the unadjusted labour ratio.

These adjustments would obviously increase the *level* of the labour share (since we are increasing the numerator or decreasing the denominator of the unadjusted ratio). Charpe (2014) reports that in his sample of 6 low and middle income (LMI) countries (including India) the simple average of unadjusted labour shares for the years 1997 – 2010 was 36 per cent. Adjusting for self-employment would raise the figure to 60 per cent if GMI is added to the numerator. If GMI is subtracted from the denominator it works out at 53 per cent. (This exercise does not consider capital depreciation adjustments).

The question whether or to what extent the adjustments affect the *time trends* of labour share has also been investigated. IMF(2017) reports that in most of the cases adjusting for *capita depreciation* makes the decline in labour share less sharp. On the other hand, adjusting for *self-employment* leads to *steeper* declines. As noted before the sample used in the main part of this report does not include India. However, the finding regarding the adjustment for self-employment finds an echo in Charpe’s (2014) report. For the sample 6 LMI countries considered there, while unadjusted labour share show an *increase* of as much as 10 percentage points between 2000 and 2009, this surge in labour share disappears completely if we bring GMI into the picture in either of the two ways discussed above: the labour share then fluctuates around the level attained in the year 2000.

India-specific figures seem hard to find. ILO-OECD (2015) is the only reference that I have come across in course of my search. This report considers the time span 1995 – 2012 and finds that over these years labour share in India, adjusted for self-employment by applying the first of

the three types of adjustment procedures stated above, *decreased* by about 4 percentage points. (The change in *unadjusted* labour share, however, does not seem to have been reported.)

On the basis of this factual evidence, therefore, it seems safe to conclude that over the recent decades, labour share in output has been falling not only in the advanced economies but in many (in fact, most) of the others. India, unfortunately, fits this global pattern. (Russia and some of the East European economies are notable exceptions to the global trend.) Recall that the findings apply to the *adjusted* labour share. Since self-employment has been adjusted for, the workers here include small and marginal farmers and people engaged in the non-agricultural informal sector in addition to the formal sector payroll employees in both the public and the private sectors. Together with their family members they constitute almost the entire population of the country. (The “stylized” figure for India is 92 per cent.) Naturally the recent findings about the inter-temporal behavior of labour share have called into question the appropriateness of an exclusive concentration on growth as the objective of economic policy. What is the point of achieving a high growth rate if the share of the fruits of growth going to, say, 92 per cent of the population is falling over time?

For us, therefore, it is important both (i) to understand the main driving forces behind the dominant global trend and (ii) to see whether the interests of the country would be best served by swimming with the tide. I have nothing new to add to the *first* part of this task. The causes behind the behind the observed trends in labour share have been discussed extensively in the literature. (See, especially, ILO-OECD (2015), IMF (2017), OECD (2012) and Piketty (2014). I will only summarise the findings of these studies.

The reasons for falling labour share *in the advanced economies* are not far to seek. Technical progress and a high elasticity of substitution between capital labour seem to be primarily responsible, a suspicion confirmed by econometric studies (OECD (2012)). Technical progress in the relatively labour-scarce and capital-abundant countries, was expectedly labour-saving in character. The IT revolution has been an important development in this context. This led to a steep fall in the relative prices of investment goods and provided the *incentive* to substitute capital for labour. At the same time, high elasticity of substitution made such substitution *feasible*. As is well-known, the unit elasticity of substitution hypothesis which was behind by the Cobb-Douglas production function was falsified by empirical evidence as early as the late 1950's. The elasticity is now generally believed to be *higher* than unity in the advanced economies. The two factors mentioned above have resulted in substitution of capital for labour to such an extent that the resulting fall in the demand for labour has brought down the labour share in output, outweighing any possible indirect effect (of the fall in capital goods prices on the share of capital) in the reverse direction. See, for instance, Greenwood and Jovanovic (1999). Arpaia et. al. (2009), in fact, shows that while in the first half of the twentieth century technical progress in the Western economies was labour-augmenting in nature and, therefore, pushed up labour share in output, it has been *capital-augmenting* in the more recent decades.

The forces of *globalisation* and trade integration that came into prominence since the 1980's have interacted with these basic factors. Although, as noted above, the overall elasticity of substitution is greater than 1, it turns out that different parts of the process of production of a commodity often have different elasticities. Thus, even in the advanced economies there are *some* production-related tasks where the elasticity is low. Now, the dramatic decrease in the costs of transport and communication brought about by technical progress has enabled the producers of a commodity to divide the production process into different stages so that different parts of the process (as well as the final assemblage) can be carried out at their most cost-efficient locations. In the advanced economies this has led to off-shoring of those labour-intensive parts of the production process where the elasticity of substitution is low. The pro-free-trade ambience promoted by globalisation has made this arrangement feasible. This has reduced labour share in output in the advanced economies not only by reducing employment but also by reducing the wage rate by weakening the bargaining power of the workers.

The explanation of falling labour share in a *labour-abundant* country, on the other hand, has to be more nuanced. Traditional trade theory predicts that such a country would concentrate on the production and export of labour-intensive goods and services. The resulting increase in the demand of labour should push up labour share, rather than reducing it. However, an explanation of the falling labour share in these countries can be devised by referring to the new pattern of international trade noted above and the fact that in these countries elasticity of substitution between capital and labour is observed to be less (rather than greater) than unity. Given labour-abundance, producers would, of course, have an incentive to substitute labour for capital. Whether or to what extent this can actually be done depends, at least partly, on the elasticity of substitution. If this elasticity were high, such replacement would be more commonplace than is actually the case. The low elasticity of substitution prevents the process from working itself out.

Moreover, participation by the labour-abundant country in the “international value chain” (i.e. the system of spatial diffusion of the production process undertaken by producers in the advanced economies) would strengthen this hindering factor. Such participation entails importing components for assembly and re-exporting to the global value chain. However, it is precisely those parts of the production process in which elasticity of substitution in the advanced economies is relatively low that are “off-shored”. Indeed, if substitution of *capital* for *labour* was possible in these tasks, such substitution would have been carried out i.e. automation, rather than off-shoring, would have taken place. Now, low elasticity of substitution prevents substitution of *labour* for *capital* in the labour-abundant economy in the same way as it prevents substitution of capital for labour in these tasks in the advanced economies.

There is also the point made by Elsby, Hobijn and Sahin (2013) that it is often the case that a task that is considered to be labour-intensive in an advanced economy is actually more capital-intensive than the existing tasks in a labour-abundant economy. Moving into these lines of production would, therefore, push up capital share in output (i.e. push down labour share) in the country to which the task is off-shored.

Finally, the institutional reforms in the labour-abundant economies that have coincided with the emergence of the global value chain have also played their parts in reducing labour share. It is now widely acknowledged that the reforms (particularly, those related to the labour market) have weakened the bargaining power of the workers and have slowed down the growth rate of real wages with its deleterious effect on the labour share in output. Whether or not it has had any salubrious effect on investment and the growth rate is a different issue and does not affect the validity of the argument in the present context.

So much for the *causes* behind the falling labour share. Attempts have also been made to quantify the possible *effects*, especially its effects on the macroeconomic aggregates. If the marginal propensity to consume (MPC) of the workers exceeds that of the capital owners (as is likely to be the case), a *rise* in labour share would obviously boost *consumption demand*. Whether it exceeds the economy's marginal propensity to invest is less clear. If it does, then the increase in consumer demand will increase aggregate demand by crowding-out any possible negative effect on *investment demand*. Moreover, if the increase in labour share is caused by an increase in wage rate, the resulting increase in unit cost of production would reduce the (external) demand for the country's exports.

Economic common sense says that whether the effect on *actual* output would be expansionary or not would depend whether the economy is demand-constrained or supply-constrained. Ever since the global financial crisis of 2008-09 most of the advanced economies have remained demand-constrained. In countries like India the picture is less clear since supply-side constraints continue to be important in some sectors of the economy, notably agriculture. However, in view of the dwindling importance of agricultural GDP in total GDP, it seems permissible to hazard the guess that these economies too, on the whole, have been demand-constrained in this time span and will remain so in the near future.

It is hardly surprising, therefore, that one set of *projections*, undertaken in 2013, found that the projected values (for the six years from 2015 to 2020) of the so-called "labour share multiplier" (i.e. the effect of a 1 per cent *increase* in labour share on aggregate output) would be significantly different from zero for all countries described in the ILO classifications system as EE (emerging economies), LMI (low and middle income countries) or LDC (less developed countries). (India falls in the LMI category). In any given year, however, its value is highest in EEs where the contribution of agriculture to GDP is lowest (among these three types of economies) because that means that these economies are most clearly demand constrained. The multiplier is lowest in LDCs where agriculture still retains some importance. For LMIs it is in-between. For this category the 2015 figure for the multiplier was reported to be about 0.85 per cent. (See Charpe (2014) and Cripps (2013) for further details.) As per these projections, the effect on both investment and net exports are negative.

As per traditional wisdom, it is *investment* that is the prime mover of economic growth. Hence, the importance of the question of the direction of the effect of a change in labour share on

investment for a country like India can hardly be over-emphasised. It seems non-controversial that a rise in labour share would raise *consumer* demand. It is, however, sometimes argued that it would inevitably *reduce* investment by cutting into capital share and thereby discouraging investors. If the long run growth prospects of an economy are to be kept in view, it is argued, it may be necessary to induce a *fall* in labour share in order to boost investment. This argument is supposed to take on added force in an economy beset with a persistently high rate of unemployment because it is investment that can create new jobs on a sustainable basis. In this sense, in such an economy it may be in the workers' own *long run* interests to accept a fall in labour share, at least for some time until investment gains momentum.

This type of argument, however, does not seem to tally with either the experience of the advanced economies or that of countries like India. Moreover, on closer examination, it is seen to be based on an inadequate understanding of investment motivations. So far as the advanced economies are concerned, the actual effect on investment has been contrary to what this argument leads us to expect. As we have noted, labour share in these economies has unambiguously *decreased* ever since the 1980s. The expected boost to investment, however, seems to be missing. For instance, between 2000 and 2007 labour share decreased by 2 percentage points but investment as proportion of GDP remained stable around 22 per cent. After the crisis of 2008 until 2012, the investment-GDP ratio actually *fell* by as much as 3 percentage points although labour share continued to fall as before.

The weak link between labour share and the investment-GDP ratio in these economies has been sought to be explained by the rise of financial capital. The falling labour share has led to a rising profit share but most of the profits have gone to financial companies where the link between profits and investment (i.e. *capital formation*) has always been weak. Even in non-financial companies, there has been an increased tendency to use the profits to pay dividends at higher rates rather than for the purpose of investment. Moreover, in recent years productive investment has been adversely affected by weak household demand caused by the fall in labour share.

III. The Indian Scenario

In India, on the other hand, both the observed trend of investment and its correlation with the labour share trend have been quite different in recent decades. Confining attention to the post-2000 performance of the Indian economy, we see that during the high-growth phase (2003 to 2011), the trend of investment seemed to be in conformity with what conventional wisdom leads one to expect: labour share was decreasing and investment was on the upswing. The average annual growth rate of GDP over this period was 8.4 per cent. Even so, it was much lower than the average annual rate of *capital accumulation* (14.2 per cent). There was also a phenomenal rise in the investment-GDP ratio (at constant prices) from 24.5 per cent in 2002-03 to the dizzy height of 37.8 per cent in 2007-08. There was a slight fall in the following year 2008-09 (to 35.5 per cent). Most of us attributed this to the global financial crisis. However, it recovered quickly to reach 36.3 per cent and 37.4 per cent in the following two years. Again, many of us rejoiced at

that time at the fact that the slowdown of 2008-09 had been so short-lived. What has followed since then, however, is a story of persistent deceleration in investment. The year-on-year growth rate of Gross Capital Formation (GCF) which was 13.8 per cent in 2010-11 fell to 6.4 per cent in 2011-12, 0.2 per cent in 2012-13 and *zero* in 2013-14. Annual data for the following years are not yet available. The trend of GCF-to-GDP ratio is in conformity with this trend of GCF. At current prices this ratio fell steadily from 34.5 per cent in 2009-10 to 29.9 per cent in 2013-14. While the annual figure for 2015-16 is not available at the moment, the figure for the first two quarters of that year happens to be, again, 29.9 per cent again. (See Rajakumar and Shetty (2016).) A labour-share-based explanation would fail here since, as reported above, labour share has all along been falling.

In fact, if we delve a little deeper into the possible *reasons* behind the persistence of the economic slowdown in India, it seems that an *increase* in labour share with its positive impact on effective demand might have helped in rectifying the situation. As has been pointed out by Rakshit (2016), an investment boom of such magnitude and duration as was witnessed in India during 2008- 2011 could only have been based on expectations (on the part of investors) of a correspondingly high growth rate of aggregate demand. The dual role of investment plays a crucial role in this connection. On the one hand, investment is a component of *current* aggregate demand. On the other hand, it also adds to *productive capacity* of the economy but with a time lag. Capacity in the *current* period is the result of *past investments*. Thus, during the upswing when investment goes up, so does current aggregate demand and there is better utilization of capacity (created in the past). Profits rise, making further investment *possible*. The possibility, however, can materialise only if the expansion of demand is expected to continue. The exuberance of the high-growth phase was clearly strong enough to sustain such expectations, so much so that the economy even took the crisis of 2008-09 in its stride and showed signs of recovery surprisingly early.

After 2011, however, a combination of external and internal factors led to an end to the dream run. On the one hand, the fast rise in oil prices in the global economy together with the sharp rise in food prices caused by supply-side factors operating in the agricultural sector resulted in a high rate of inflation and forced the Reserve Bank of India to follow an unusually hawkish monetary policy. On the other hand, encouraged by the unusual investment exuberance of the earlier phase, the government ushered-in a fiscal consolidation programme, leading to sharp cutbacks in government expenditure. The resulting fall in public investment hit the agricultural sector particularly badly. It was the combination of all these factors that brought the high growth phase of the Indian economy to an end after 2011. It was now obvious to the private investors that in such a scenario it was unrealistic to expect aggregate demand to continue to increase. A phase of investment deceleration ensued.

Thus, for the Indian economy the importance of the observed trend in factor shares lies in its role in explaining the persistence of the deceleration in investment that has been observed since 2011-12. The important question is why the fall in labour share (i.e. the rise in capital share) has

been unable to arrest the decline in the growth rates of investment. The deceleration in *public* investment is apparently a consequence of the broader process of *privatisation*. Of greater curiosity is the question as to why privatisation has been unable to prevent the deceleration of *private* investment. We have tried to argue that the motivation for private investment is always linked to the expected future behavior of aggregate demand. The steps taken to stimulate private investment (such as the various monetary and fiscal measures taken so far in this connection) have apparently been unable to address this issue adequately. The fall in labour share has, if anything, made the problem worse by depressing consumer demand. In quest of demand sources, producers have turned increasingly to the international value chain. However, because of the sluggish state of global demand and stiff competition from other emerging economies (notably, China) this source of demand has been unable to compensate for the downward pressure on demand coming from the falling labour share.

IV. Need for a Restructuring of Economic Reforms

What does all this have to do with the issue of economic reforms which is the theme of this Conference? The point here is that our reforms need to be directed at the twin objectives of achieving a fast recovery of the growth rate as well as ensuring a more inclusive type of growth. In my opinion one of the most urgent tasks in this connection is to correct the well-known mismatch between the sectoral composition of GDP and that of the labour force as evidenced by the fact that agriculture contributes around 17 per cent of GDP while employing more than 50 per cent of the labour force. Given the fact that rural per capita income (for which the usual proxy is the rural MPCE estimated from the NSSO surveys) is less than its urban counterpart, this means that the major part of the population is engaged in a low-income occupation. This is a dual jeopardy: it makes the distribution of income highly unequal (with more than half the population accounting for only 17 per cent of GDP); at the same time, the low labour productivity in the sector that is pre-dominant in terms of employment keeps the over-all labour productivity in the economy at a low level, thus inhibiting fast growth in per capita income. Reforms should aim *both* at increasing productivity in agriculture *and* moving people from agriculture to non-agricultural occupations. The second of these two objectives would also call for increasing labour productivity in the urban *informal* sector, given the slow (near-zero) rate of growth of employment in the formal sector.

Specifically, in the short as well as the medium run, it is vital to increase *public* investment in agriculture. For reasons that are not far to seek, *private* investment in agriculture in India shows a remarkable degree of *complementarity* with public investment. Thus, an across-the-board cut in all types of public investment which seems to characterise the present era of privatisation does not seem to be the type of reforms that is the need of the hour. What is needed is a rational *restructuring of the reforms* in this respect. Increasing productivity in the urban informal sector would also require an increase in public investment in both the social and the economic sectors. For the self-employed workers who constitute the bulk of the work force in this sector, improvement in health and education has an even more direct *economic* relevance than for the population a

whole. Credit supply to this sector is also still a matter of concern. Despite the progress achieved in recent years in the matter of micro-credit, informal money-lenders with their exorbitantly high interest rates still infest the scene.

There are still other areas crying out for further reforms. For instance, labour market reforms undertaken so far seem to have concentrated on the one-point programme of facilitating the process of termination of services of the employees. I do not suggest artificially prolonging the life of an inefficient enterprise by means of subsidies. That certainly involves an economic cost which the economy can ill afford to bear. However, there is a dire necessity of putting into place a more effective social security system to minimize the vulnerability of the workers. Besides, more often than not, chronic loss making on the part of a firm is itself a result of being oblivious to the need for timely adoption of technical, managerial and marketing improvements.

Finally, the question whether or to what extent the main stated objective of economic reforms (viz. making the economy more competitive) has so far been achieved, remains to be investigated. While some specific sectors of the economy do show encouraging results in this respect, this does not seem to be the overall trend. In particular, there does not seem to be any evidence of a significant decline in the value of the index of concentration in Indian industries. In fact, one study finds that the *manufacturing sector* in India has become more skewed in terms of the distribution of market shares over the period 1999 – 2013. (Sedai (2016).)

I would, however, enter a disclaimer here. It is not my intention to suggest that the objective of inclusive growth does not find any place whatsoever in the government's policy pronouncements. In fact, the political compulsions faced by any government in a democracy would rule out that possibility. A number of anti-poverty measures undertaken by successive governments in India over the past two decades can be cited in this connection. Neither have these measures been entirely fruitless. For instance, as per various available estimates, poverty does seem to have declined in India in recent times. However, in the macroeconomic context it is the labour share in output that is the more relevant indicator of how inclusive economic growth has been in recent decades. More importantly, it is not only a matter of equity or fairness. As of this moment, a falling labour share stands out as a binding constraint on the path of growth recovery. Moreover, the turn that the course of economic policies in the advanced economies seems to be taking makes it unlikely that it will cease to be so in the future. It is not the case that nothing is being done to fight poverty. Rather, it is that much more remains to be done to ensure inclusive growth..

V. Conclusion

What is the prognosis for the Indian economy in this context for the near and the medium term? To a large extent, obviously, it depends on the promptness with which the needed reforms are carried out. External factors add to the urgency of the task. If Mr. Donald Trump has his way, globalisation of the type that we have witnessed in the recent decades (and, particularly, the new pattern of international trade based on off-shoring and the international value chain) may suffer a setback. Whether that is a good or a bad omen is a complex question to answer. On the one

hand, old-fashioned trade theory may have a resurgence. Producers in countries like India may again find that their comparative advantage lies in the production and export of labour-intensive goods and services. Job creation may get a boost. On the other hand, whether exports would continue to constitute as significant a source of demand as it currently does under the value chain system is not clear at all. In fact, there is a strong suspicion to the contrary. Given the huge current account deficit in the balance of payments of the USA, a strong wave of protectionism cannot be ruled out. Under that eventuality the demand constraint faced by the industrial sector of the Indian economy will bite even more viciously.

The fact is that of the *four* components of aggregate demand (viz. consumption, investment, government expenditure and (net) exports), as many as *three* have been in the low-growth mode in recent years: the growth rate of consumer demand has stagnated with a falling labour share; there has been deceleration in investment; and an ambience of privatisation has held government expenditure on leash. It is only net exports that have shown some buoyancy, thanks to a creditable performance of exports of services and a fortuitous drop in the import bill (brought about by the sharp drop in global oil prices over the past two years). If this source of growth in demand also dries up, there would certainly be cause of worry.

I have tried to explain why and how, in a structurally imbalanced economy such as ours, a more inclusive growth can help us in finding a way out of the current phase of slowdown in the rate of economic growth. What is needed is a faster pace and the right kind of reforms. My basic submission is that inclusive growth (or, more broadly, inequality) is not just a moral issue. It is the crux of the matter so far as the *economic* future of the nation is concerned.

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HIGHER EDUCATION IN WEST BENGAL – AN OVERVIEW¹**SEBAK KUMAR JANA*****Abstract**

Higher education plays a pivotal role in the social, economic and scientific development of a nation. Higher education in India has witnessed tremendous increase in institutions and enrolment in recent years. Some of the major issues and challenges of higher education system in India are access, regional disparity, social group disparity, gender representation, imbalance in the diversification of subjects, improving quality and public expenditure on higher education etc. The State of West Bengal has had a great legacy of higher education in the country. In the above backdrop, the present paper is on the look at for the present status of higher education in the state by delving deep into some important parameters in higher education and attempts to find the major areas of concern in the higher education sector in the state.

Key Words: Higher Education, West Bengal, Disparity, Diversification, Quality, Expenditure

JEL : I 121, I 123, I 125.

I. INTRODUCTION

*So far as I know about Giribala Karmakar (1928—1993) is that she was a pious woman. Though not well learned, she acquired learning and became well versed in the Ramayana, the Mahabharata, as well as the Puranas. She was born at Barisal, now in Bangladesh. Saw turmoil's like 'Chhiyattareer Mannantar' that came ghastly, staggering and horrible beyond words, and struggle for independence and the great Partition with innumerable sufferings of the people, which she often voiced boldly to her families and neighbours that 'BHARAT BHENGE BHAG KARA' was the mischievous activities of BURUKHOKA, so callous and disgraceful. She left no stone unturned to make her five sons a proper human being. Surprisingly enough, at the age of sixty, she first wrote four short-stories published in local Patrika and were highly acclaimed. She has had the sharp memory till she breathed her last. For this memorial lecture, I have chosen today the topic **Higher Education in West Bengal –An Overview**.*

From the days of Adam Smith, the role of education in economic development, as a possible contributor to greater social and economic equality and as an enhancer of development was

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extensively recognized. The 18th and 19th Century school reformers in the US like Horace Mann, Henry Barnard, James Carter, Robert Dale Owen and George Evans favoured educational opportunities to be extended to poorer groups of population. In the early 20th century, Marshall emphasized that “the most valuable of all capital is that invested in human beings” and that “knowledge is our most powerful engine of production; it enables us to subdue Nature and force her to satisfy our wants.”

The human capital theory propounded by Schultz (1961) laid a strong foundation for treating education as an investment in human beings and for treating it as an important source of economic growth. According to the human capital theory, education transforms raw human beings into productive ‘human capital’ by imparting knowledge and inculcating skills required by both the traditional sector and the modern sector of the economy, and makes individuals more productive members of the society, not only in the market place but also in the households and also in the whole society. Mincer (1974) have formalized the treatment of education as an investment and as a factor in growth theory. The seminal contributions of Arrow (1973), Spence (1973) and Stiglitz (1975) raised questions on the human capital theory and the possibility of treating education as a signal to the employer instead of having any economic value on its own, a thesis which remained as a hypothesis, and which did not last (Blaug 1985). Schultz and Denison’s growth accounting equations were again considered to be valid. According to the endogenous growth theories (Lucas 1988; Romer 1990), stock of human capital affects the growth rates of the economy by facilitating technological development, more innovations and higher efficiency or total factor productivity (TFP). These endogenous growth theories (Mankiw 1995) use two sector growth models and consider manufacturing firms as producing goods and (research) universities as producing knowledge, which is used in both sectors. Extensive empirical research during the last four decades has established that education makes a significant positive contribution to development directly as a factor of production, or indirectly through innovations, skill formation and technological development and through several externalities.

Higher education is a very important form of investment in human capital. It enables people to learn for themselves and think critically. In the present context of transformation into knowledge societies, higher education provides not just educated workers but knowledge workers. The higher education system plays an important role in the social, economic and scientific development of a nation. It equips people with skills for gainful employment and enhances productivity and earnings (Duraismy, 2002). Besides benefits to individuals, higher education confers several social benefits. Evidence shows that higher education plays a significant role in making income distribution more equal (Gregorio and Lee, 2002). It makes a significant contribution to the reduction in absolute as well as relative poverty, infant mortality and to the increases in life expectancy, thus contributing to human development. The development of higher education is thus important especially for India, which is currently experiencing a demographic dividend with a relatively higher share of youth in the population.

The post independence period in India has seen a number of policies in the field of higher education. National policy on Education (NPE, 1968) advocated a radical reorganisation of the education system and structure with enhanced for education progressively towards 6% of GDP. However it recommended for regulation of admission to maintain the quality. The Union Government came out with another comprehensive National Policy on Education (NPE in 1986) which recommended for expansion, and standard of education, equal access to neglected groups, management and financing of higher education (Thorat 2017). The National Knowledge Commission (NKC, 2006) in 2006 noted that enrolment in higher education in India is too low and it recommended for faster expansion of higher education. The Eleventh Five Year Plan (EFYP) was supposed to 'place the highest priority on education as a central instrument for achieving rapid and inclusive growth'. Concerned about the quality of higher education system in the country, the Government appointed two high-level committees (National Knowledge Commission and Yashpal Committee) to review the conditions of the education system and make recommendations for the improvement. Both these Committees recommended a drastic reform of regulatory system of higher education in the country (Agarwala 2014). Several new bills were introduced and policies were taken in India to improve the quality of higher education including (a) The Prohibition of Unfair Practices in Technical Educational Institutions and Universities; (b) The National Accreditation Regulatory Authority for Higher Educational Institutions Bill, (c) Foreign Educational Institutions (Regulation of Entry and Operations) Bill, 2010, (d) Central Educational Institutions (Reservation Admission) Act, 2006. Despite all these efforts, achievements are not satisfactory. In higher education elitism remains a central feature and the average performance remains low. Despite significant expansion of higher education, India exhibits substantial disparity in educational achievements across states, location (rural/urban), gender, religion and social groups. The privatisation of higher education with high tuition fees has aggravated the unequal access further. The NSS data show that the share of poor (first two lowest quintile) in private institutions was about 17 per cent, which was lower than non-poor, at 27 per cent (top two quintile) (Thorat 2017). The present paper highlights different issues relating to the present state of higher education in West Bengal.

History of the modern education system in West Bengal dates as far back as to 1817 when the Hindu College was founded in Calcutta, which was later renamed as the Presidency College. The bulk of the higher quality colleges in West Bengal were bunched along the banks of the Ganga-Bhagirathi, whose essentially monocrop and stagnant agriculture made it inevitable that large numbers of indigent lower gentry from higher status families would seek alternative occupations in whatever few opportunities there were, for junior service in trade, commerce and petty administration (Government of West Bengal 1984). Although the Hindu College was established in 1817 through the joint efforts of David Hare and Rammohan Roy and as carried on by a non-official body, it was taken over by the Government in 1855 and developed into the Presidency College. For nearly half a century after establishment of this college all significant attempts of extension of higher education were made by two agencies -the Government and the Christian Missions. Pandit Iswar Chandra Vidyasagar in 1869 founded the Metropolitan institution,

first private college undivided Bengal , which still continues with the name Vidyasagar College in Kolkata. One needs to recall that the province of Bengal, undivided till 1947, and later the state of West Bengal, had played a leading role in the country in spreading education at all levels, beginning with mass education and culminating in higher, professional and specialized education thanks to the colonial legacy and renaissance in the state (Jana and Ghosh 2011) .

II. EXPANSION OF HIGHER EDUCATION IN WEST BENGAL

The nodal ministry for education in India is the Ministry of Human Resource Development (MHRD). The MHRD has a Department of Higher education which is the apex department “for the overall development of the basic infrastructure of Higher Education sector”. The University Grants Commission (UGC) under the Department of Higher acts as the coordinator as well as prescriber of standards for education in the country. Administrative set up of Higher Education in West Bengal comprises of Department of Higher Education, Education Directorate, and Directorate of Technical Education. Department of Higher Education comprises of West Bengal State Council of Higher Education, Universities and West Bengal College Service Commission. The West Bengal State Council of Higher Education has been established in 1995 for Planning and co-ordination in the area of higher education in the State including co-operation with the UGC.

The statistics on HEIs, enrolment, public expenditure etc. are published by MHRD in the Selected Educational Statistics (SES) up to 2005-06 and statistics of Higher and Technical education (SHTE) for the period 2006-07 to 2009-10. The MHRD compiled the data using pre-prepared data capturing formats from the HEIs through the educational departments of the state governments and UTs. This is supplemented by the information gathered by UGC, AICTE and other regulatory agencies. To overcome limitations, the MHRD has initiated the All India Survey on Higher Education (AISHE) in 2010. The data collection here is through online mode with a dedicated portal and the survey tries to cover all educational institutions (universities, colleges and standalone intuitions). However, it is self-reported and the information submitted by the institutions is not cross-checked for accuracy. AISHE provides data on higher education from 2010-11 to 2015-16. We have used data for the present paper from AISHE, Department of Higher Education , Government of West Bengal and NSS data. Presently there are 44 universities in West Bengal including 20 state aided universities (Table 1). The names of the Central University, State Public University, Deemed University, Private University with their year of establishments and number of affiliated colleges have been given in Table 2. All the nine private universities in West Bengal have been established after 2013.

Table 1: Types of Universities in West Bengal (2017)

Category	Number of Universities
State-aided Universities	20
State Specialised Universities	6
Deemed University	1
Central Universities and Institutes of Higher Learning	8
Private Universities	9
Total	44

Source: Govt. Of West Bengal, 2017.

Table 2: List of Universities and Number of Affiliated Colleges

	University Name	District	Year of Establishment	No. of Colleges
Central University				
1	Visva Bharati, Shantiniketan	Birbhum	1951	1
State Public University				
2	Calcutta University, Kolkata	Kolkata	1857	148
3	Jadavpur University, Kolkata	South 24 Pgs	1955	2
4	Burdwan University	Bardhaman	1960	158
5	Kalyani University	Nadia	1960	67
6	North Bengal University, Darjeeling	Darjiling	1962	60
7	Rabindra Bharati University, Kolkata	Kolkata	1962	1
8	Vidya Sagar University, Midnapore	Paschim Medinipur	1981	108
9	Netaji Subhash Open University, Kolkata	Kolkata	1997	
10	Aliah University, Kolkata	Kolkata	2007	
11	University Of Gour Banga, Malda	Malda	2008	65
12	West Bengal State University	North 24 Parganas	2008	53
13	Presidency University	Kolkata	2010	1
14	Sidho-Kanho Birsa University	Puruliya	2010	31
15	Kazi Nazrul University, Asansol	Bardhaman	2012	21
16	Cooch Behar Panchanan Barma University	Koch Bihar	2012	15
17	Diamond Harbour Women's University	South 24 Parganas	2012	1
18	Bankura University	Bankura	2014	25
19	Raiganj University	Uttar Dinajpur	2015	
20	West Bengal University of Teachers' Training, Education Planning and Administration	Kolkata	2015	177
21	Sanskrit College and University	Kolkata	2015	
Deemed University				
22	Ramakrishna Mission Vivekananda University	Kolkata	2015	
Private University				
23	Seacom Skills University	Birbhum	2014	1
24	Amity University	North 24 Parganas	2015	
25	Techno India University	North 24 Parganas	2013	
26	Adamas University	North 24 Parganas	2015	
27	Neotia University	South 24 Parganas	2015	
28	University of Engineering and Management	Kolkata, New Town	2015	
29	Brainware University	North 24 Parganas	2016	
30	St. Xavier's University	Kolkata	2017	
31	JIS University	North 24 Parganas	2015	

Source: AISHE 2015-16 & Dept. of Higher Education, Govt. of West Bengal.

In Table 3 we have presented type wise universities in West Bengal compared to India.

Table 3: Type wise universities in West Bengal and India

Type of Universities	Number		%	
	India	WB	India	WB
Central Open University	1	0	0.1	0.0
Central University	44	1	5.1	2.4
Deemed University-Government	33	0	3.8	0.0
Deemed University-Government Aided	10	0	1.2	0.0
Deemed University-Private	79	1	9.2	2.4
Institute of National Importance	100	6	11.6	14.6
Institute under State Legislature Act	5	0	0.6	0.0
State Open University	13	1	1.5	2.4
State Private Open University	1	0	0.1	0.0
State Private University	231	8	26.9	19.5
State Public University	342	24	39.8	58.5
Grand Total	859	41	100.0	100.0

Source: AISHE, 2016-17.

In Table 4, we have presented the growth of number of colleges in West Bengal and India during the period 2002-03 to 2016-17. Table 4 reveals that though a number of colleges has been established in West Bengal in recent years, its share in India has only been slightly improved. It is a challenge for the government to enhance the access to higher education keeping in pace with the increasing number of students passing out in Higher Secondary Examination has increased from 1.49 lakhs in 2001 to 6.22 lakhs in 2017.

Table 4: Growth of Number of Colleges in West Bengal and India, 2016

Year	West Bengal	India	% of West Bengal
2002-03	537	16206	3.3
2003-04	541	16888	3.2
2004-05	603	18080	3.3
2005-06	621	19327	3.2
2006-07	774	21170	3.7
2007-08	805	23206	3.5
2008-09	889	25951	3.4
2009-10	891	31324	2.8
2010-11	889	32964	2.7
2011-12	896	35539	2.5
2012-13	942	37204	2.5
2013-14	1057	39671	2.7
2014-15	1061	40760	2.6
2015-16	1082	39071	2.8
2016-17	1229	42285	2.9

Source: AISHE (various years).

III. DIVERSIFICATION AND DISPARITIES IN HIGHER EDUCATION IN WEST BENGAL

We have discussed diversification and disparities in higher education in West Bengal in terms of caste, gender, gross enrolment ratio.

III.1 Caste-wise and Gender-wise enrolment pattern in West Bengal

Total enrolment (U.G. and P.G.) in general degree education in West Bengal including universities and colleges stood at 21.14 lakhs in 2012-13 of which U. G. Enrolment was 19.5 lakhs and P. G. Enrolment was 1.6 lakhs. The gender-wise distribution of these students and UG and PG Enrolment in West Bengal (2012-13) shown in Table 5.

Table 5: UG and PG Enrolment in West Bengal (2012-13)

Area of Study	UG			PG			UG & PG
	Boys	Girls	Total	Boys	Girls	Total	Total
Arts	433282	891729	1325011	26526	54416	80942	1405953
Science	103491	118196	221687	14307	23181	37488	259175
Commerce	92916	98196	191112	3659	5622	9281	200393
Education	5922	7415	13337	1660	3230	4890	18227
Law	4429	5050	9479	281	582	863	10342
Engineering	75317	97487	172804	3570	4286	7856	180660
Management	6020	7668	13688	2575	3597	6172	19860
Others	2696	3119	5815	4507	9967	14474	20289
TOTAL	724073	1228860	1952933	57085	104881	161966	2114899

Source: Govt. of West Bengal, 2012-13.

The highest percentage of students in combined U.G. & P.G. is occupied by Arts followed by Science, Commerce and Engineering. It is seen from the Table 6 that among the prominent disciplines 65.37 % of students obtain degrees in Arts, 14.15 % in Science, 9.89 % in Commerce, and 7.24 % in Engineering/Technology. The representation of SC categories is 17 % and that of ST categories is 3.22 % in the higher education in the state.

Table 6: Percentage of Enrolment (U.G. & P.G.) of Students in Different Areas of Study in Universities and Colleges (2012-13) in West Bengal

	BOYS				GIRLS				
Area of Study	GEN	SC	ST	TOTAL	GEN	SC	ST	TOTAL	GRAND TOTAL
Arts	25.26	7.70	0.11	34.48	30.21	5.29	0.97	36.46	70.94
Science	7.19	1.42	0.02	8.83	1.00	0.66	0.11	1.77	10.60
Commerce	6.55	0.60	0.00	7.24	0.40	0.11	0.03	0.54	7.78
Education	0.43	0.11	0.01	0.57	0.12	0.09	0.02	0.23	0.80
Law	0.30	0.04	0.00	0.35	0.04	0.02	0.00	0.07	0.42
Engineering	5.39	0.48	0.00	5.91	1.59	0.12	0.01	1.72	7.63
Management	0.61	0.03	0.00	0.64	0.19	0.01	0.00	0.20	0.84
Others	0.47	0.06	0.01	0.54	0.40	0.04	0.01	0.44	0.98
TOTAL	46.20	10.45	0.16	58.57	33.94	6.33	1.16	41.43	100.00

Source: Department of Higher Education, Government of West Bengal, Annual Report.

a. Gross Enrolment ratio in Higher Education

Gross Enrolment Ratio (GER) for West Bengal and India has been compared for castes and gender in Table 7. The gap between female and male GER is noticeable. In 2015-16, the West Bengal GER was 17.7 with all India average being 24.5. There is also wide discrepancy across gender and castes in GER. Therefore, more efforts to raise the GER for females would not only reduce the gap between male-female GER but would also improve the overall GER. The expansion of the higher education system not accompanied by affirmative action will fail to disparities in higher education.

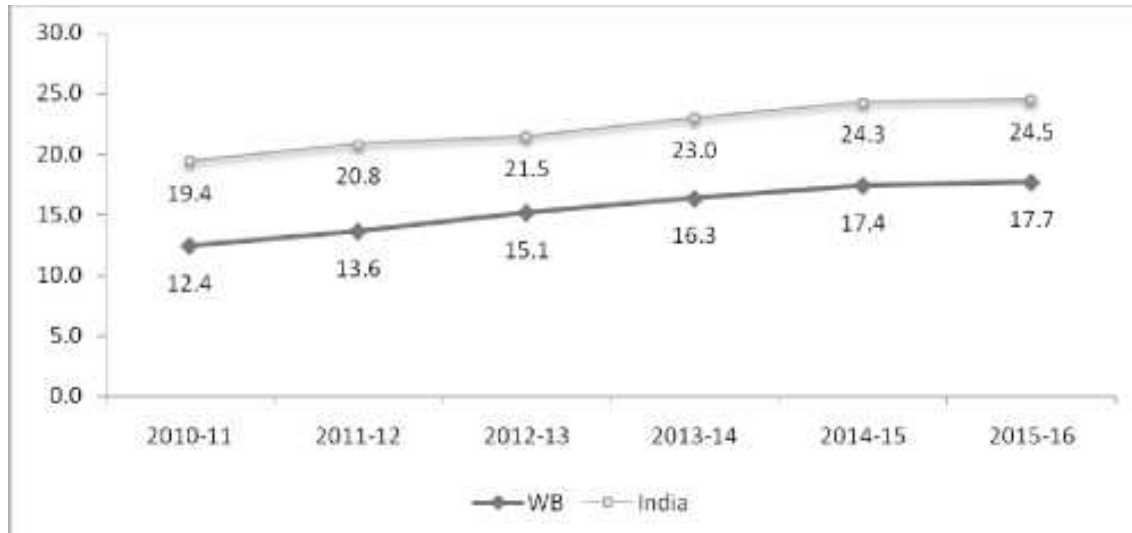
Table 7: Gross Enrolment Ratio (GER) in West Bengal and India

		West Bengal	India
All Category	Male	19.1	25.4
	Female	16.2	23.5
	Total	17.7	24.5
SC	Male	14.2	20.8
	Female	11.5	19.0
	Total	12.8	19.9
ST	Male	10.6	15.6
	Female	8.4	12.9
	Total	9.5	14.2

Source: AISHE, 2015-16.

Gross Enrolment Ratio (GER) in higher education in West Bengal and India during the period 2010-11 to 2015-16 have been presented in Figure 1

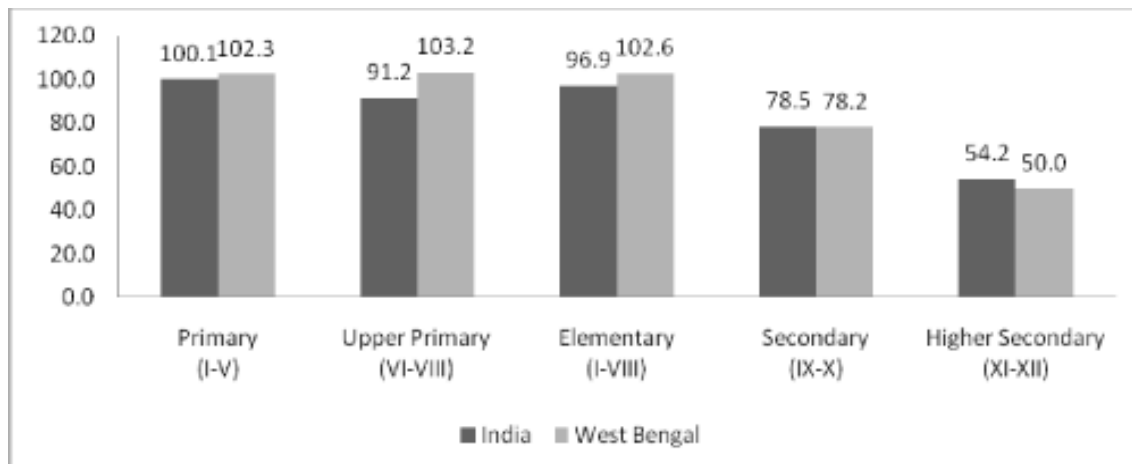
Figure 1: Gross Enrolment Ratio (GER) in West Bengal and India



Source: AISHE (Various Year).

We have shown in Figure 2 Gross Enrolment Ratio(GER) at different levels of school education in West Bengal and India in 2014-15 which shows that GER at higher levels is falling in West Bengal compared to India.

Figure 2: Gross Enrolment Ratio (GER) in School Education in India and West Bengal in 2014-15



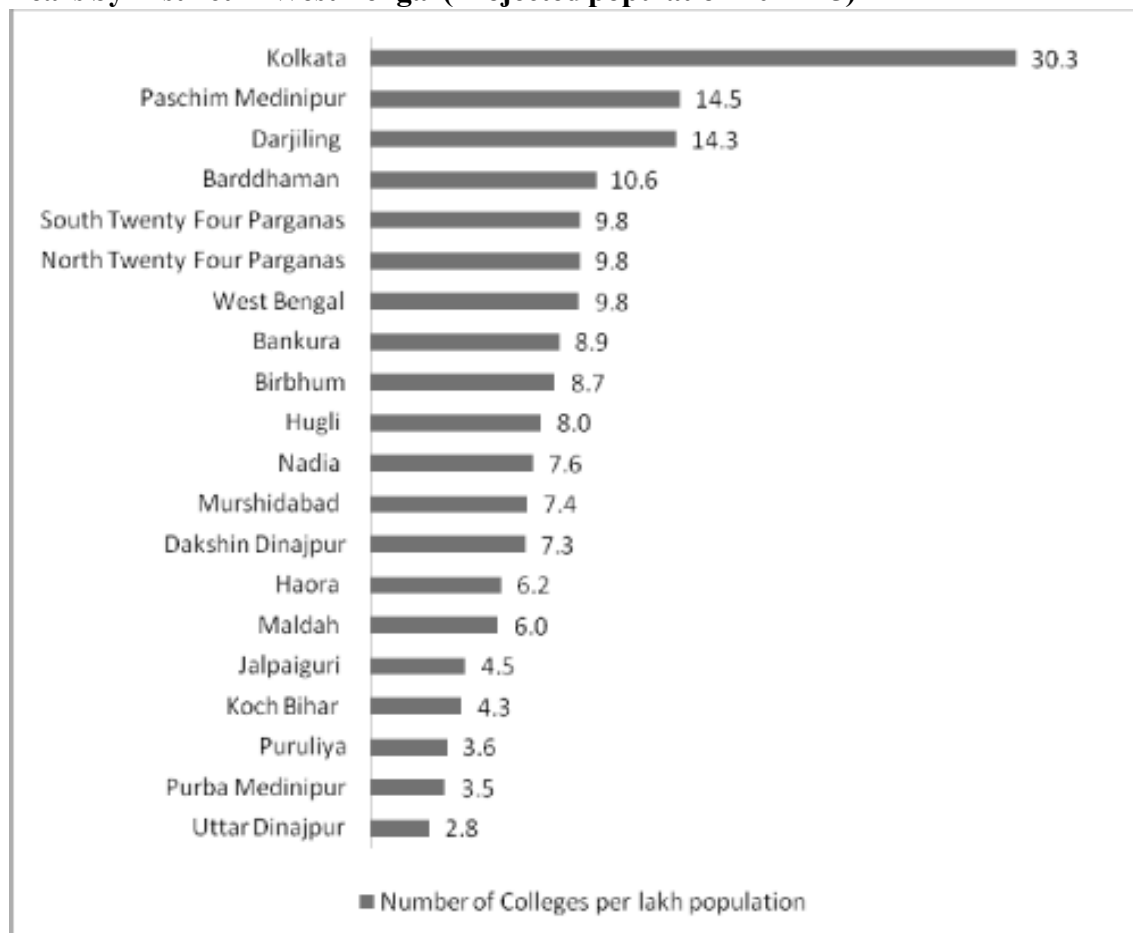
Source: DISE, 2014-15.

III.3 District wise Distribution of Colleges in West Bengal

In West Bengal, on an average, a college served a population of 2.44 thousand and an area of 249 square kilometres (Jana 2012). The number of feeder higher secondary schools was 10 per

college and that of secondary schools is 18 per college. The size of the population, area and number of institutions in the different districts vary widely. For a correct understanding, we have to relate the number of colleges to the size of the population in the respective districts. In an analysis of the regional imbalance in the facilities of higher education, the socio-economic factors like occupational distribution and age-composition of the population are important variables to be considered. Generally, the age group seeking admission in colleges is 18-24 years. Figure 3 reveals that there is wide disparity across districts in terms of population within (18-24) years per college. It is lowest in Dinajpur (N) with 208 lakh literate population per college and highest in Kolkata with 30.3 lakh literate population per college. Number of Colleges per lakh population belonging to the age group 18-24 by District in West Bengal (Projected population 2014-15) is shown in Figure 3.

Figure 3: Number of Colleges per lakh population Belonging to the age group 18-24 Years by District in West Bengal (Projected population 2014-15)



Source: AISHE, 2014-15, Census-2011.

In West Bengal under the administrative jurisdiction of Higher Education Department, there are different categories of colleges including general degree colleges, law colleges, teachers' training colleges and engineering and technological colleges affiliated to different universities. However not all the colleges are under jurisdiction of Higher Education Department. There are at present a total of 1079 colleges in West Bengal including general degree colleges. Specialization-wise number of Colleges (2015-16) in West Bengal & India shown is in Table 8. A diversified system channels students into various study programmes that are not equal in terms of prestige and employment opportunities. According to data available, there were nearly 42,000 seats in Bengal in 2014. But in 2017, the number is around 33,124, though the number seats in government engineering and state-run universities (3,747) has remained constant (The Hindu, 2017).

**Table 8: Specialization-wise number of Colleges (2015-16) in West Bengal & India
(Based on actual response)**

State	West Bengal	All India	% of West Bengal
General	666	24311	2.7
Agriculture	0	213	0.0
Architecture	0	132	0.0
Arts	10	770	1.3
Commerce	1	219	0.5
Computer Application	11	255	4.3
Education/Teacher Education	169	2390	7.1
Engineering & Technology	72	2250	3.2
Fine Arts	8	110	7.3
Fisheries	0	12	0.0
Hotel & Tourism Management	6	74	8.1
Journalism & Mass Communication	0	9	0.0
Law	22	504	4.4
Management	25	687	3.6
Medical-Allopathy	20	233	8.6
Medical-Ayurveda	4	167	2.4
Medical-Dental	2	190	1.1
Medical-Homeopathy	11	96	11.5
Medical-Others	6	155	3.9
Nursing	16	969	1.7
Oriental Learning	0	66	0.0
Para Medical	2	110	1.8
Pharmacy	8	589	1.4
Physiotherapy	3	119	2.5
Sanskrit	0	284	0.0
Science	2	202	1.0
Sports/Yoga/Physical Education	3	80	3.8
Veterinary	0	39	0.0
Others	12	432	2.8
Grand Total	1079	35667	3.0

Source: AISHE, 2015-16.

III.4 Correspondence/Distance Education

The system of correspondence education opens up the opportunities for students who want to continue higher education in spite of various adverse conditions. The flexible nature of the open university curriculum allows the students to pursue their desired courses and careers in a manner that takes care of each student's preferences as well his/her constraints. The open university system has also another advantage: it facilitates spread of higher education without putting too much stress and burden on the existing infrastructure. In West Bengal, to meet the demand for higher education from different groups of students, the University of Burdwan and Vidyasagar University had started correspondence courses in 1994. The state government has also opened an Open University, namely Netaji Subhas Open University, during the 9th plan. Netaji Subhas Open University (NSOU) started functioning with effect from July 1998 to provide an opportunity of higher education in the vernacular medium to various disadvantaged groups of aspiring learners. It is the tenth open university of the country and the ninth state open university. Presently, the NSOU is offering 15 subjects for Bachelor's Degree Programme (BDP) and have 118 study centres. Indira Gandhi National Open University (IGNOU) was established in the country by an Act passed in Parliament in 1985. Since then this University has been conducting different types of degree, diploma and certificate courses through its study centres. There are presently 58 study centres of IGNOU across West Bengal. Percentage of enrolment in different programmes in distance mode in West Bengal and India is shown in Table 9. The Table reveals that distance education in Under Graduate Programme is low compared to the whole India.

Table 9: Percentage of Enrolment in Distance Mode in West Bengal and India

State		Distance mode enrolment		% of Distance mode enrolment	
		West Bengal	All India	West Bengal	All India
Ph.D.	Male	0	87	0.0	0.0
	Female	0	49	0.0	0.0
	Total	0	136	0.0	0.0
Post Graduate	Male	46883	510526	25.0	13.3
	Female	69598	597836	37.0	15.6
	Total	116481	1108362	62.0	29.0
Under Graduate	Male	36900	1421708	19.6	37.2
	Female	29287	1077682	15.6	28.2
	Total	66187	2499390	35.2	65.3
PG Diploma	Male	690	41383	0.4	1.1
	Female	577	27252	0.3	0.7
	Total	1267	68635	0.7	1.8
Diploma	Male	1772	64175	0.9	1.7
	Female	1352	40053	0.7	1.0
	Total	3124	104228	1.7	2.7

Certificate	Male	658	17374	0.4	0.5
	Female	176	26775	0.1	0.7
	Total	834	44149	0.4	1.2
Integrated	Male	0	1	0.0	0.0
	Female	0	0	0.0	0.0
	Total	0	1	0.0	0.0
Grand Total	Male	86903	2055254	46.3	53.7
	Female	100990	1769647	53.7	46.3
	Total	187893	3824901	100.0	100.0

Source: AISHE, 2015-16.

III.5 Privatisation of Higher Education

Private colleges came into existence even before independence and these were created by philanthropists with the genuine intention of serving the community. The government came out with a grant-in-aid system during the 1950s and 1960s and these institutions became private-aided colleges. As a consequence, the government exercised control by regulating student admission and tuition fee. In India, education is in the concurrent list, where federal states and the central government share responsibilities. Until recently, legislations in higher education prohibited profit making in the sector. Higher education was defined as a not-for-profit sector. Private investments were to be made by sponsoring bodies that had to be a “Society registered under the Societies Registration Act 1860, or any other corresponding law for the time being in force in a state, or a public trust or a company registered under Section 25 of the Companies Act, 1956.” The State provided for tax exemptions for donations made to this sector (Loomba, 2014). It was only during the Twelfth Five Year Plan in India (2012-2017) that the state considered re-evaluating this status of higher education in India. However, until recently there has been no clarity on how this suggestion would be implemented. A 100 per cent Foreign Direct Investment (FDI) is promoted in higher education through the automatic route which requires no prior approval from the state. However, the regulatory environment prescribes several conditions for foreign universities including fixing of fees, or the need of foreign institutions to affiliate with an Indian counterpart, which has dissuaded investments. In 2015-16 in West Bengal, 58.6 per cent colleges were privately managed, out of which 38.1 per cent were private unaided colleges and 20.5 per cent were private aided colleges. While considering the total enrolment in colleges, it was observed that 9.7 per cent were enrolled in private unaided colleges, 26.8 per cent were enrolled in private aided colleges, and 63.5 per cent were enrolled in government colleges (Table 10). Government of West Bengal has taken the following two policy initiatives in respect of privatisation: West Bengal Government’s Policy and Guidelines for setting up the Private Universities, 2013 2 West Bengal Government’s Policy and Guidelines for setting up self-financing General Degree College, 2015 (Government of West Bengal 2016).

Table 10: Number and Enrolment in Private & Govt. Colleges

		Number of Colleges		% of Enrolment	
		West Bengal	All India	West Bengal	India
Number of Private and Government Colleges (based on actual response)	Private Un-Aided	411	22755	38.1	63.8
	Private Aided	221	4924	20.5	13.8
	Total Private	632	27679	58.6	77.6
	Government	447	7988	41.4	22.4
	Total	1079	35667	100.0	100.0
Enrolment in Private and Government Colleges (based on actual response)	Private Un-Aided	149257	11729224	9.7	45.6
	Private Aided	412303	5516630	26.8	21.4
	Total Private	561560	17245854	36.5	67.0
	Government	978503	8485309	63.5	33.0
	Total	1540063	25731163	100.0	100.0

Source: AISHE, 2015-16.

III.6 Position of West Bengal in terms of Different Educational Parameters

We have presented the ranks of West Bengal in the states of India for different parameters of higher education in Table 11. The Table reveals

Table 11: Different Parameter wise Number and Rank in West Bengal all over India

	Items	Number	Rank (All 36 states)
1	Total No. of Universities	31	9
2	No. of General Universities	20	9
3	Total College	1051	13
4	General Degree College	628	12
5	Govt. College	427	7
6	College per lakh population	10	32
7	Average enrolment per college	1455	6
8	GER (Total)	17.4	27
9	GER (Male)	19.1	28
10	GER (Female)	15.8	28
11	Gender Parity Index (GPI)	0.83	29
12	Number of Teachers	50435	12
13	Pupil Teacher Ratio (PTR)	38	6
14	Out turn	378005	8
15	Population (Projection 2014-15)	10925358	4
16	Percentage of ST Population (out of 28 States)	6	9
17	GER(XI-XII) (out of 28 states)	42.97	17

18	Public Exp on higher education per person (18-23) (Out of 28 states)	1912	19
19	Higher Education Institutions per lakh pop (out of 28 states)	9.6	26
20	Technical/ professional expenditure per student (Out of 28 states)	58436	18
21	Vocational Expenditure per student (out of 28 states)	21104	19

Source: AISHE, 2014-15.

IV. QUALITY OF HIGHER EDUCATION IN WEST BENGAL

Quality of higher education has been a major concern in India as well as the state of West Bengal despite significant expansion of higher education (Jana and Barman 2010). Some of the policy measures taken in this direction are redesigning academic programme to synchronise with the market demands, greater emphasis on interactive modes of learning, changes in the assessment procedure and examinations, introduction of the semester system, teachers' assessment, grade, credit system, faculty improvement programme, maintenance of national database of academic qualification etc (Panagariya et al 2014). National Policy on Education (NPE, 1986) laid special emphasis on advocating the quality of higher education in India and strengthening the quality initiatives with the establishment of accreditation agencies in India. Presently, there are three accreditation agencies functioning in India, National Assessment and Accreditation Council (NAAC) being set up by UGC in 1994 to monitor quality of HEIs in general education, National Board of Accreditation (NBA) by All India Council of Technical Education (AICTE) for technical education and Accreditation Board (AB) of Indian Council of Agriculture Research (ICAR) for accrediting agriculture institutions.

IV.1 NAAC Assessment

NAAC is considered as a major quality assurance (QA) body in India as it covers all kinds of HEIs unlike other bodies engaged in specialised accreditation. From the initial phase of apprehension surrounding the philosophy of external review, the NAAC has gradually been able to build a greater appreciation from the higher education community of the intrinsic benefits of accreditation. For example, the wider participation of academia in NAAC policymaking has been of great benefit in building a greater acceptance of the assessment process. The gradation system of NAAC has changed at different times. In Table 12, accreditation method at different years has been presented.

Table 12: Assessment and accreditation methodology adopted by NAAC

SL NO.	Scale	Grading system	Years	No of institutions assessed in India
1	Two-point scale	Accredited/not accredited with parameter scores	February, 1999	9 HEIs
2	Five-point scale	Star rating: A*, A**, A***, A****, A*****	1st march 1999 to February 2002	240 HEIs
3	Nine-point scale	Letter grades (each letter grade rated at three levels) C, C+, C++, B, B+, B++, A, A+, A++	March 2002 to March 2007	3495 HEIs (1 st cycle: 3374; 2 nd cycle: 121)
4	Three-point scale	CGPA with A, B and C letter grades	April 2007 till date	2909 HEIs (1 st cycle: 1671; 2 nd cycle: 1195; 3 rd cycle: 43)

Source : Patil and Pillai (2017).

In Table 13, we have presented grades achieved by different Universities in West Bengal over years.

Table 13: NAAC Assessment of Universities in West Bengal

		Cycle 1		Cycle 2		Cycle 3	
		Grade	Date	Grade	Date	Grade	Date
1	Jadavpur University	5	05-11-2001	A	16-09-2008	A	24-09-2014
2	Presidency University	A	16-12-2016				
3	Rabindra Bharati University	4	05-11-2001	A	19-02-2016		
4	University of Burdwan	4	22-03-2001	B++	31-03-2007	A	05-11-2016
5	University of Calcutta	5	21-05-2001	A	31-12-2009	A	23-01-2017
6	University of Gour Banga	B	25-05-2016				
7	University of Kalyani	3	21-05-2001	B	16-09-2008	A	16-12-2016
8	University of North Bengal	3	20-09-2000	B++	21-05-2006	A	02-12-2016
9	Vidyasagar University	3	12-02-2002	B	29-01-2009	B	10-12-2014
10	Visva-Bharati	B	11-05-2015				

Source: Self-review document of NAAC.

In Table 14, we have presented the state-wise results of NAAC assessment. The results reveal that out of 154 colleges assessed in West Bengal upto December 2016, the percentages of different grades of colleges in West Bengal are as follows- A:12.3%, B:83.1% and C:4.5%. The average grade point of the colleges in West Bengal is 2.52 which is below the all India average of 2.59 with rank of the state being 17 out of 32.

Table 14: State wise College Assessment (Percentage) (up to December, 2016)

	Name of State	Colleges Assessed	A	B	C	Average Grade
1	Chandigarh	9	55.6	44.4	0.0	3.02
2	Kerala	148	53.4	45.9	0.7	2.92
3	Goa	18	38.9	61.1	0.0	2.90
4	Delhi	36	52.8	47.2	0.0	2.89
5	Panjab	126	35.7	62.7	1.6	2.75
6	Meghalaya	11	36.4	54.5	9.1	2.74
7	Tamil Nadu	540	33.5	65.0	1.5	2.71
8	Sikkim	1	0.0	100.0	0.0	2.70
9	Telangana	123	32.5	58.5	8.9	2.62
10	Jammu & Kashmir	46	26.1	69.6	4.3	2.61
11	Maharashtra	674	25.5	68.5	5.9	2.61
12	Andhra Pradesh	175	33.1	62.3	4.6	2.61
13	Karnataka	397	21.4	72.3	6.3	2.56
14	Gujarat	190	19.5	74.7	5.8	2.55
15	Puducherry	17	29.4	70.6	0.0	2.54
16	Madhya Pradesh	139	18.7	70.5	10.8	2.52
17	West Bengal	154	12.3	83.1	4.5	2.52
18	Haryana	158	16.5	75.3	8.2	2.51
19	Uttarakhand	29	10.3	86.2	3.4	2.50
20	Arunachal Pradesh	5	20.0	60.0	20.0	2.49
21	Assam	77	7.8	87.0	5.2	2.49
22	Uttar Pradesh	298	13.8	74.2	12.1	2.46
23	Nagaland	9	11.1	88.9	0.0	2.42
24	Rajasthan	130	9.2	82.3	8.5	2.40
25	Manipur	14	14.3	78.6	7.1	2.39
26	Chhattisgarh	16	6.3	87.5	6.3	2.37
27	Odisha	74	6.8	81.1	12.2	2.34
28	Himachal Pradesh	27	7.4	77.8	14.8	2.32
29	Bihar	10	10.0	70.0	20.0	2.27
30	Mizoram	7	0.0	57.1	42.9	2.23
31	Tripura	7	0.0	71.4	28.6	2.20
32	Jharkhand	9	0.0	77.8	22.2	2.19
	India	3674	24.4	69.6	6.0	2.59

Source: NAAC website.

IV.2 National institutional Ranking Framework (NIRF)

National Institutional Ranking Framework (NIRF) is a methodology adopted by the Ministry of Human Resource Development (MHRD), Government of India, to rank all institutions of higher education in India. The Framework was approved by the MHRD and launched by Minister of Human Resource Development on 29 September 2015. There are separate rankings for different types of institutions depending on their areas of operation like universities and colleges, engineering institutions, management institutions, pharmacy institutions and architecture institutions. The Framework uses several parameters for ranking purposes like resources, research, and stakeholder perception. These parameters have been grouped into five clusters and these clusters were assigned certain weights. The weights depend on the type of institution. About 3500 institutions voluntarily participated in the first round of rankings.

Considering the fact that universities in India are essentially set-up for postgraduate education and research, NIRF decided to assign higher percentage (40%) weightage to “Research Productivity, Impact and IPR”, 30 % weightage to “Teaching, Learning and Resources”, 5% weightage to “Graduation Outcomes”, 5% weightage to “Outreach and Inclusivity” and lastly 10% weightage to “Perception” (Table 15).

Table 15: Parameters for Ranking Universities

	Parameters	Marks	Weight
1	Teaching, Learning & Resources (TLR)	100	0.3
2	Research Productivity, Impact and IPR (RPII)	100	0.4
3	Graduation Outcome (GO)	100	0.05
4	Outreach and Inclusivity(OI)	100	0.15
5	Perception(PR)	100	0.1
	Total		1

Source: NIRF.

MHRD has published ranks of the participating institutes for two years – 2016 and 2017. The universities in West Bengal ranked in top 100 for these two years with their scores have been given in Table 16.

Table 16: Scores and Ranks of the Universities in West Bengal in top 100 NIRF Ranking

		Score	Rank
NIRF 2017	Jadavpur University	57.52	5
	Calcutta University	48.90	16
	Visva Bharati	48.19	19
	Kalyani University	36.84	66
	Vidyasagar University	35.23	87
NIRF 2016	Visva Bharati	76.1	11
	Bidhan Chandra Krishi Vishwavidyalaya	66.3	31
	Precedency University	63.5	41
	Kalyani University	61.3	45

Source: NIRF.

IV.3 Research Publications

Research and publication is treated as an indicator of the excellence of its faculty. Usual parameters of evaluating the research output of institutions are citations and papers in reputed journals. International indices do not always take into consideration citations in Indian journals. The CII report (CII 2016) is based on 'Indian Citation Index (ICI)' database which currently indexes 950+ journals published from India covering all subject disciplines. ICI does not index journals published from foreign countries even if they publish articles of authors of Indian origin. The data depth of ICI database is 2004 onwards. In Table 17, we have presented first 20 states by ranks. Though in terms of total number of publications in ICI indexed journals, the rank of West Bengal is good, it is not so for citations per paper.

Table 17: State wise number of publications and citations in Journals indexed by ICI

		No. of article	Rank Articles	Citations	Rank Citations	Citations /paper	Rank citations /paper
1	Tamilnadu	51195	1	27611	2	0.539	22
2	Maharashtra	49223	2	27777	1	0.564	20
3	Uttar Pradesh	40593	3	23796	4	0.586	17
4	Karnataka	40140	4	23998	3	0.598	14
5	Delhi	33220	5	23005	5	0.693	5
6	West Bengal	22558	6	10641	6	0.472	31
7	Telangana	18942	7	9984	8	0.527	24
8	Gujarat	16543	8	10271	7	0.621	9
9	Andhra	16034	9	7612	11	0.475	30
10	Rajasthan	15954	10	9301	9	0.583	19
11	Haryana	14457	11	7426	12	0.514	26
12	Punjab	14399	12	7349	13	0.51	27
13	Madhya Pradesh	13808	13	8324	10	0.603	11
14	Kerala	12531	14	6118	15	0.488	28
15	Uttarakhand	11941	15	7126	14	0.597	15
16	Orissa	7604	16	4559	16	0.6	12
17	Jammu	6937	17	3252	20	0.469	32
18	Himachal	6232	18	3759	18	0.603	10
19	Assam	6103	19	3615	19	0.592	16
20	Chandigarh	5804	20	3802	17	0.655	8

Source: CII (2016).

In Table 18, we have presented top 30 institutes by the number of articles Published in the Journals indexed in ICI. The top performer is Bidhan Chandra Krishi Viswavidyalaya (BCKV) followed by Jadavpur University (JU), University of Calcutta and Indian Institute of Technology Kharagpur.

Table 18: Number of articles Published in the Journals indexed in ICI

		No. of article
1	Bidhan Chandra Krishi Viswavidyalaya (BCKV)	2498
2	Jadavpur University (JU)	2002
3	University of Calcutta (UC)	1878
4	Indian Institute of Technology Kharagpur (IIT Kharagpur)	1547
5	Institute of Post Graduate Medical Education and Research (IPGMER)	1207
6	West Bengal University of Animal and Fishery Sciences (WBUAFS)	1123
7	University of Burdwan (UB)	970
8	Nilratan Sarkar Medical College and Hospital (NSMCH)	861
9	University of Kalyani (UK)	824
10	Medical College (MC)	749
11	Calcutta National Medical College and Hospital (CNMCH)	734
12	Uttar Banga Krishi Viswavidyalaya (UBKV)	697
13	R G Kar Medical College and Hospital (RGKMCH)	620
14	Visva Bharati University (VBU)	594
15	University of North Bengal (UNB)	517
16	Vidyasagar University (VU)	451
17	Indian Statistical Institute (ISI)	436
18	North Bengal Medical College (NBMC)	405
19	Zoological Survey of India (ZSI)	379
20	Burdwan Medical College and Hospital (BMCH)	376
21	Presidency University (PU)	346
22	Seth Sukhlal Karnani Memorial Hospital (SSKMH)	323
23	Bankura Sammilani Medical College (BSMC)	311
24	Botanical Survey of India (BSI)	305
25	Midnapore Medical College and Hospital (MMCH)	302
26	Geological Survey of India (GSI)	295
27	National Institute of Technology Durgapur (NIT Durgapur)	278
28	Indian Association for the Cultivation of Science (IACS)	274
29	Central Research Institute for Jute and Allied Fibres (CRIJAF)	248
30	Bengal Engineering and Science University (BESU)	242

Source: Indian citation index, 2017.

IV.4.Higher Education and Employment

National Sample Survey (NSS) data allows an analysis of the workforce by the three types of employment: self-employed, casual labour or regular salaried work. It is not surprising that hardly any illiterate has regular salaried jobs. Most illiterate are either casual workers or in self-employment usually engaged in low productivity work. It has long been known that the rate of open unemployment of university graduates is greater than that of those with lower levels of education. This in itself is not surprising since those with lower levels of education cannot afford to be openly

unemployed. The major reasons for the quality problems that led to issue of employability (Mehrotra 2017) are: (i) Teacher and instructor shortage: one of the most serious problems that arose with rapid expansion of the higher education system – in fact its ‘massification’ – is the shortage of the teacher. (ii) Private sector growth with little regulation affected quality: the private higher education enrolment increased accounting for 59 percent of the total. Typically of this situation is the growth of engineering colleges across country, but especially in south India.

(iii) Accreditation system has a very narrow coverage: institutional accreditation through the National Assessment and Accreditation Council (NAAC) has been growing very slowly partly because accreditation is voluntary for higher education institutions. (iv) Skewed funding of public institution: first, household spending and private investment have grown more rapidly than government spending on higher education in recent years. Second, ‘government spending, and particular state government spending, has fallen far short of the funding requirement in the face of the dramatic expansion of the system and rising expectation of the people in terms of quality, access and equity’. Table 19 reveals that 98 graduates are unemployed per 1000 graduates where it is 100 for India. The major reason for unemployment has been found as non-availability of jobs matching with education/skill/experience.

Table 19: Per 1000 distribution of unemployed person having graduate level qualification aged 15 years & above by reasons of unemployment (Rural + Urban)

Name	Per 1000 distribution of unemployed person having graduate level qualification	Per 1000 distribution of unemployed persons having graduate level qualification by reasons of unemployment			
		non-availability of jobs matching with education/skill/experience	non-availability of adequate remuneration	family/personal problems	Others
Graduate					
West Bengal	98	590	76	20	314
India	100	583	228	53	135
Post Graduate					
West Bengal	139	492	76	1	431
India	98	624	215	38	124

Source: Govt. Of India, Ministry of labour and employment, 2016.

It should be pointed out that unless there is sustained high growth of SDP, the problem of educated unemployment cannot be solved. The problem of unemployment cannot be solved only by improving education system. It can only endeavour that the supply of different types of skill are in line with the demand for them (Government of West Bengal, 1984). In Table 20, we have presented unemployment rates in 2011-12 under different criteria.

Table 20. Unemployment rate among the youth (15-29 years) according to Different Status in 2011-12

Status	Region	West Bengal	India
Usual Principal Status (UPS)	Rural	103	65
	Urban	162	102
Current Weekly Status (CWS)	Rural	102	73
	Urban	146	107
Current Daily Status (CDS)	Rural	141	101
	Urban	170	120

Source: Government of West Bengal (2015).

It has also been sometimes found that suitable candidates are not available for particular job. For example, for the appointment of full time teachers in colleges, the vacancies declared by the West Bengal College Service Commission for ST categories were 607 whereas only 174 candidates were found to be empanelled. Subject-wise vacancies declared and number of empanelled candidates for ST categories have been given in Table 20.

IV.5. Vocational Education and Skill Development

For vocational training, the experience of India is dismal. Technical institutes have been ill equipped in hardwares with low teaching staff and low student interest. Business world is also found not having enough enthusiasm for cooperation in such training. Among the BRICS economies percentage of students in upper secondary education enrolled in vocational education in 2013 were (Karmkar and Jana 2015): Brazil: 7.6%, Russia:59.8%, India:2.4%, China: 47.8% and South Africa:13.7%. We can learn from Germany who has been successful in integration of vocational education and training (work based training by companies and school based training by government institutes). In recent years Government of India has taken various measures for skill development. Central government in December 2013 notified National Skills Qualifications Framework (NSQF). They offer programmes leading to certificates (after one year), diplomas or associate degrees (after two years) with option to transfer to regular degree programmes. Online platforms and ICT tools have opened the scope in taking higher education to millions of deserving students in far-flung areas who were earlier left out of the higher education system, or had to settle for lower quality alternatives. The push towards creating of courses under the massive open online courses (MOOCs) is intended to provide online courses to all who desire free of cost and in Indian languages; christened Swayam (Study Webs of Active – Learning for Young Aspiring Minds) (Sanjay 2017). National e-library is another initiative. The National Digital Library at IIT Kharagpur is a massive project intended to aggregate and make available institutional digital repositories of several institutions. This will open up access through single-node knowledge resources. SWAYAM Prabha – the 32 DTH channels is in operation for telecasting high quality educational content free of charge using the GSAT-15 satellite transponders. Presently, number of courses under this Programme are different Categories are: Engineering -

48, Science -18, Management -11, Arts and Recreation - 10, General - 7, Library - 6, Mathematics - 5, Humanities – 4 and Language - 4 Government of India (2017a). For career-oriented and skill-based education, Community College Scheme (CCS) has been introduced in five Degree Colleges in West Bengal. Tie-ups have been made with local industry partners in only five colleges so that students can be considered for absorption/employment in the market upon completion of the course (Government of West Bengal 2016). West Bengal is one of the states which has implemented Common Service Centres (CSCs) under National e-Governance Plan (NeGP). Presently there are about 250 ITI and 146 Polytechnic colleges in West Bengal. In 2015-16, 2833 number of Vocational Training Centres (VTCs) were imparting vocational education and training in West Bengal (Government of West Bengal, 2016).

IV.6 Pupil Teacher Ratio

Pupil-Teacher Ratio (PTR) is defined as average number of pupils (students) per teacher at a specific level of education in a given school-year. Table 21 reveals comparative disadvantageous position of West Bengal in terms of pupil-teacher ratio.

Table 21: Growth of Pupil teacher ratio in India and West Bengal

Year	Regular & Distance Mode		Regular Mode	
	West Bengal	India	West Bengal	India
2011-12	36	23	33	21
2012-13	38	23	35	20
2013-14	39	24	35	21
2014-15	38	23	34	21

Source: AISHE 2014-15.

As the number of departments is going up without corresponding increase in full time posts, colleges are becoming increasingly dependent on part time teachers and contractual teachers. This is particularly true for self-financing courses. The ratio of average number of teachers calculated for full time teachers, guest teachers and contractual teachers from NAAC reports for colleges come out to be 32:27:6.

IV.7 Students' attendance and Dropping Out

The poor students' attendance is a big problem in West Bengal particularly in rural areas. The students depend very much upon private tuitions, particularly in UG level, for the notes prepared by the tutor. Way back in 1991 Ashok Mitra Commission emphasized on the need to end the malpractice of extracting money in the form of private tuition (Majumdar 1993). Students rarely go to the library for reference books in most colleges. The situation has not improved even after the introduction new examination system and internal assessment. Dropping out in higher education is also a big problem. A Study on Vidyasagar University reveals that more than 50% students discontinue their studies from college at UG level (Jana 2017).

V. EXPENDITURE PATTERN OF HIGHER EDUCATION IN WEST BENGAL

V.1 Public Expenditure on higher education

It is true that public expenditures on education in India have increased remarkably in the post independence era. However the growth has not been impressive from the point of view of expenditure in real prices or in per capita terms (Jana 2012). Total budget expenditure on higher education in West Bengal in nominal terms has increased from Rs. 526.27 crores in 2000-01 to 1943.76 crores in 2010-11 i.e. expenditure on higher education in West Bengal has increased by about four times in 30 years. The share of educational expenditure in SDP may be taken as an indicator of state's priority to education. The percentage share of expenditure on education and higher education to Net State Domestic Product (NSDP) for the period 2000-2001 to 2010-11 have been presented in the Table 22. During this period, though percentage of budget expenditure on education with respect to state budget has improved, percentage of budget expenditure on higher education with respect to education sector has not increased. The share of Budget Expenditure (B.E.) on higher education in net state domestic product (NSDP) has improved slightly in recent years.

Table 22: Expenditure on Higher Education in West Bengal

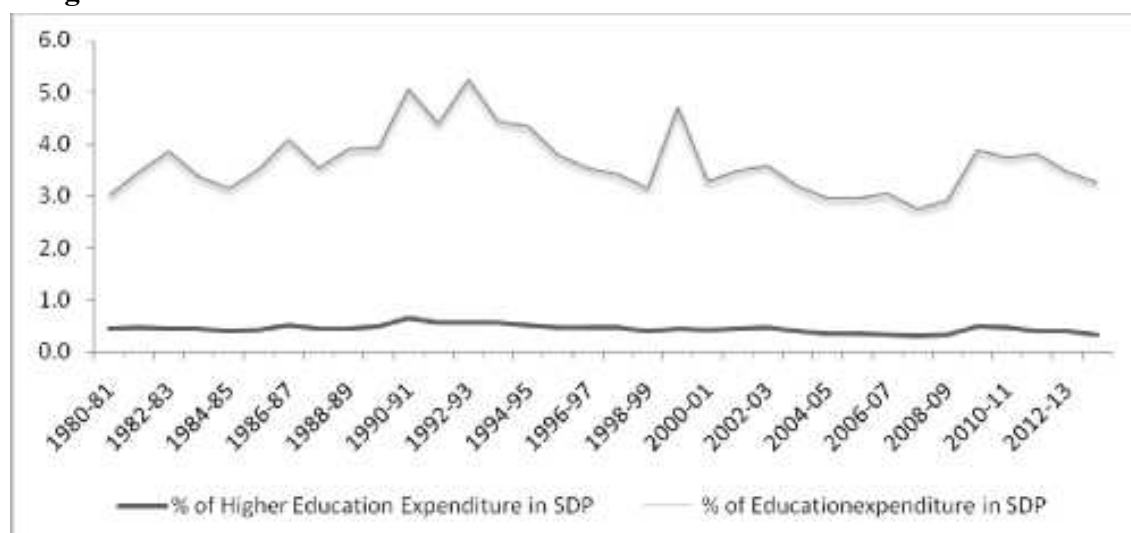
	Total Budget Exp. (BE) for Higher education	% of Budget Exp (B.E.) of higher education with reference to B.E. on Education	% of B.E. on education with respect to state budget	% of B.E. on higher education with respect to NSDP
2000-2001	526.27	14.21	15.13	0.408
2001-2002	604.87	13.94	14.84	0.419
2002-2003	677.26	14.20	15.42	0.440
2003-2004	665.15	13.88	13.56	0.384
2004-2005	663.73	13.43	12.83	0.349
2005-2006	721.95	12.90	14.81	0.344
2006-2007	801.64	11.94	15.92	0.336
2007-2008	836.39	12.16	14.99	0.306
2008-2009	986.95	12.28	15.6	0.318
2009-2010	1733.84	14.01	17.09	0.469
2010-2011	1943.76	14.01	17.94	0.449
2011-2012	1996.03	12.92	19.08	0.416
2012-2013	2479.3	13.33	20.21	0.445
2013-2014	2487.02	12.05	20.39	0.391

Source: Based on Department of Higher Education, Government of West Bengal.

In Figure 4 we have presented the percentage of education budget and higher education budget in SDP in the state of West Bengal. Figure 3 shows there is no substantial changes in

share of and higher education budget in SDP, though fluctuations are there for total education budget over the period 1980-81 to 2012-13.

Figure 4: Percentage of Education Budget & Higher Education Budget in SDP in West Bengal



Source: Government of West Bengal, Statistical Abstract various years.

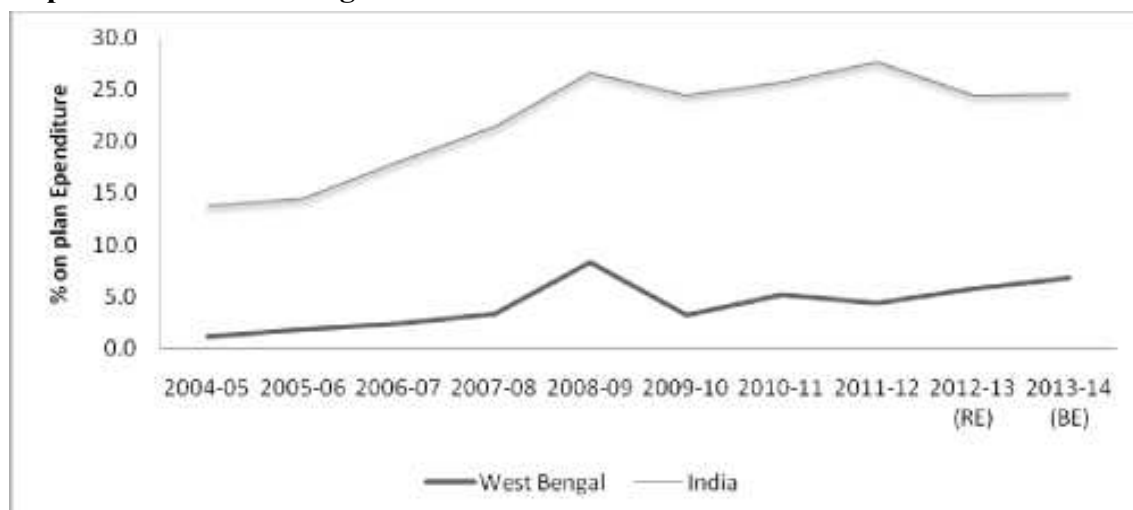
Budgetary expenditure on higher education in the state may be classified into two categories: plan and non-plan expenditures. Non-plan provision is mostly paid to the payment of salary in general degree colleges in the state. Major portion of plan expenditure is utilized for establishing new colleges and also for creating new infrastructure facilities in existing colleges. Declining plan expenditure, therefore, means declining effort for creation or addition of new educational facilities and swelling non-plan expenditure denotes increasing burden of salary payment and maintenance expenditure on the shoulder of the state government. Percentage on plan higher education expenditure to total higher education expenditure is shown in Table 23.

Table 23: Percentage of Non Plan and Plan Expenditure in Higher Education to Total Higher Education Expenditure

Year	Non Plan		Plan	
	West Bengal	India	West Bengal	India
2004-05	98.9	86.3	1.1	13.7
2005-06	98.2	85.6	1.8	14.4
2006-07	97.6	82.0	2.4	18.0
2007-08	96.6	78.6	3.4	21.4
2008-09	91.7	73.3	8.3	26.7
2009-10	96.8	75.6	3.2	24.4
2010-11	94.8	74.3	5.2	25.7
2011-12	95.6	72.3	4.4	27.7
2012-13 (RE)	94.2	75.5	5.8	24.5
2013-14 (BE)	93.2	75.4	6.8	24.6

Source: MHRD (Analysis of Budgeted Expenditure on Education) Various Year.

The changes of percentage of plan higher education expenditure to total higher education expenditure for West Bengal and India shown in Figure 5.

Figure 5: Percentage of Plan Higher Education Expenditure to Total Higher Education Expenditure in West Bengal and India

Source: MHRD (Analysis of Budgeted Expenditure on Education) Various Year.

Composition of Expenditure of Higher Education in West Bengal:

Table 24 shows that composition of Expenditure of Higher Education in West Bengal 2009-10 and 2012-13 in Percentages. The percentage share indicates that assistance to Non-Government colleges has increased while the assistance of Universities has declined.

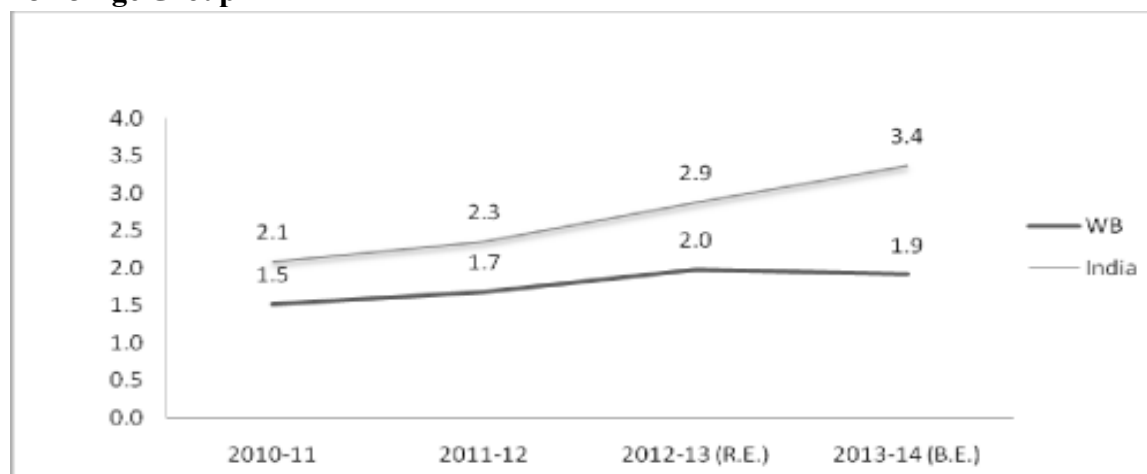
Table 24: Composition of Expenditure of Higher Education in West Bengal 2009-10 & 2012-13 in Percentages

Budget Heads	2009-10 (Percentage)			(2012-13) (Percentage)		
	Non-Plan	State Plan	Total	Non-Plan	State Plan	Total
Assistance of Universities	37.35	3.95	41.30	32.67	2.76	35.43
Government Colleges and Institutes	6.85	1.02	7.88	5.56	1.95	7.51
Assistance to Non-Government Colleges	41.16	2.95	44.11	47.42	1.57	48.99
Institutes of higher learning and Other Expenditure	0.43	0.60	1.04	0.38	0.35	0.73
Promotion of Modern Indian Languages	0.03	0.02	0.05	0.04	0.02	0.06
Research, Scholarships, etc.	1.50	0.02	1.52	1.72	0.01	1.73
Technical Education	1.84	1.40	3.24	1.55	2.87	4.42
Physical Education & Youth Welfare (Excluding N.C.C.)	0.14	0.14	0.28	0.23	0.19	0.42
Promotion of Art and Culture	0.36	0.18	0.54	0.49	0.17	0.66
Surveys and Statistics Gazetteers & Statistical Memories	0.04	0.00	0.04	0.05	0.00	0.05
% Total	89.71	10.29	100.00	90.11	9.89	100.00
Total (in Crore)	1743.758	200	1943.758	2186.7	240.00	2426.72

Source: Department of Higher Education, Government of West Bengal, Annual Report.

Per Head Higher Education Expenditure:

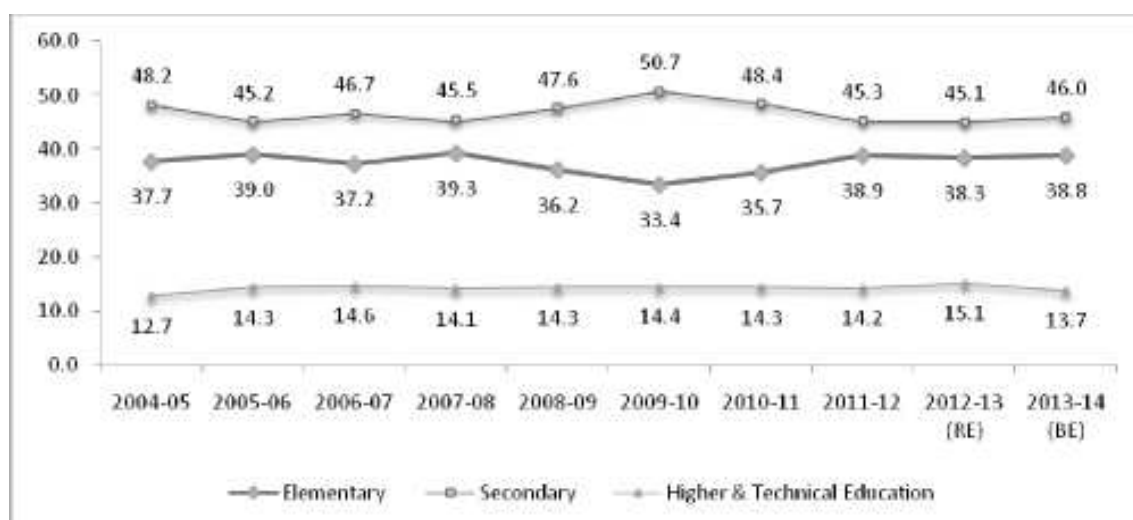
Per head higher education expenditure (In Thousand Rs.) in Population 18-23 age group in West Bengal and India is shown in Figure 6. The figure reveals wide disparity in per head higher education expenditure between India and West Bengal.

Figure 6: Per Head Higher Education Expenditure (In Thousand Rs.) in Population 18-23 Age Group

Source: AISHE, 2013-14.

Intra-Sectoral Resource Allocation to Education in West Bengal: State expenditure on education comprises of expenditure on elementary education, secondary education, higher education, adult education and language development. Of these elementary had got the highest priority though its share has declined over the years. As is evident from the Figure 7, proportion of budget expenditure on higher education in West Bengal has not improved in the post reform period. The relative importance of secondary education has increased compared to primary, secondary and higher education.

Figure 7: Year-wise Percentage Share in Primary, Secondary and Higher Education Level



Source: AISHE, 2013-14.

We have made a comparison in Table 25 among states in terms of three parameters of expenditure on higher education - Higher Education expenditure/GSDP, Higher Education expenditure/Education Expenditure, and Education Expenditure/SDP. It is found West Bengal is found to be behind the national average in terms of first and third parameter.

Table 25: State wise share of higher education in GSDP

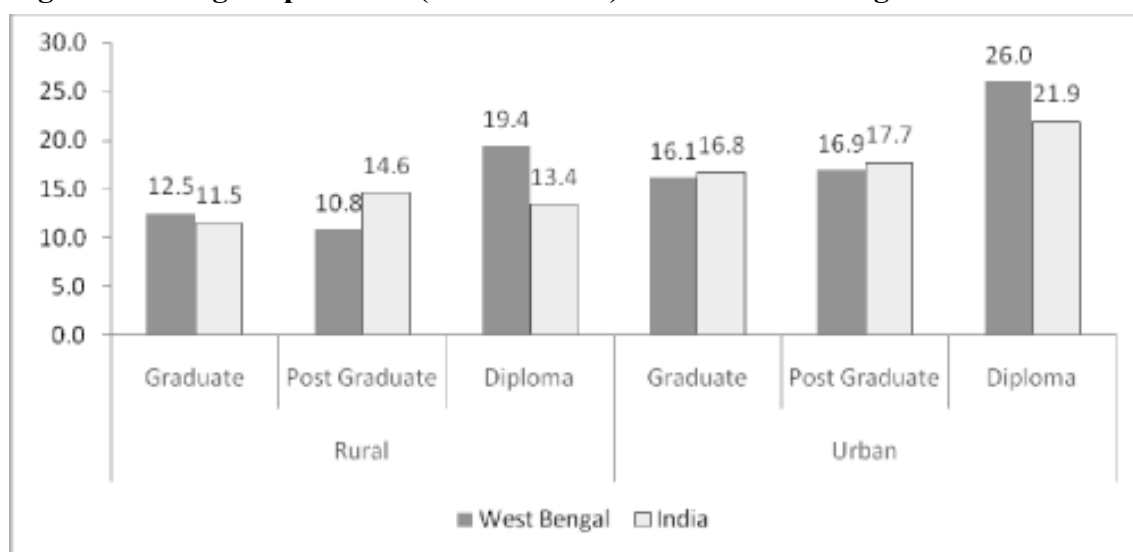
		Higher Education expenditure/GSDP	Rank	Higher Education expenditure /Education Expenditure	Rank	Education Expenditure /SDP	Rank
1	Andhra Pradesh	0.45	13	20.04	6	2.19	26
2	Arunachal Pradesh	0.42	15	9.26	23	2.75	20
3	Assam	1.02	4	17.82	9	4.25	8
4	Bihar	1.08	3	22.74	3	5.75	4
5	Chhattisgarh	0.4	16	10.14	20	3.25	14
6	Goa	0.51	10	23.54	2	4.51	7
7	Gujarat	0.25	26	13.58	17	3.83	10
8	Haryana	0.34	23	12.99	18	6.67	2
9	Himachal Pradesh	0.36	20	8.46	24	2.24	25
10	Jammu & Kashmir	0.61	7	16.28	13	2.87	19
11	Jharkhand	0.47	12	15.19	14	3.11	15
12	Karnataka	0.58	8	19.55	7	1.82	28
13	Kerala	0.65	6	22.74	4	4.76	6
14	Madhya Pradesh	0.35	22	11.10	19	6.98	1
15	Maharashtra	0.39	18	16.49	12	2.95	18
16	Manipur	1.18	2	21.82	5	3.96	9
17	Meghalaya	0.72	5	18.80	8	2.63	22
18	Mizoram	1.76	1	26.34	1	2.26	24
19	Nagaland	0.45	14	6.42	28	2.64	21
20	Odisha	0.57	9	17.56	10	3.72	12
21	Punjab	0.21	28	10.14	21	2.11	27
22	Rajasthan	0.23	27	7.46	25	6.07	3
23	Sikkim	0.48	11	17.55	11	3.08	16
24	Tamilnadu	0.34	24	15.10	15	2.37	23
25	Tripura	0.39	19	6.46	27	3.79	11
26	Uttarakhand	0.27	25	7.45	26	3.60	13
27	Uttar Pradesh	0.36	21	9.39	22	3.06	17
28	West Bengal	0.40	17	15.04	16	5.42	5
	Total	0.43		14.94		2.86	

Source: Based on AISHE, 2013-14.**V.2. Cost of Higher Education in West Bengal**

The private expenditure on education is calculated as spending by students in the form of payment of course fees (including tuition fees, examination fees etc.), purchase of books, stationery and uniforms, expenses on conveyance, private coaching, etc. Average Expenditure (Rs.) per

student pursuing general education is shown in Figure 8 for rural and urban areas for West Bengal and India. A student on an average spend around Rs 11.5 thousands from his/ her own pocket in an academic session if he/she opts for general education, Rs. 12.5 thousands for general education in rural areas and Rs. 16.1 thousand in urban areas. It is revealed that private expensed for post graduate studies is less in West Bengal compared to National average both for rural and urban areas.

Figure 8: Average Expenditure (Thousand Rs.) Per Student Pursing General Education



Source: NSSO, 71st Round.

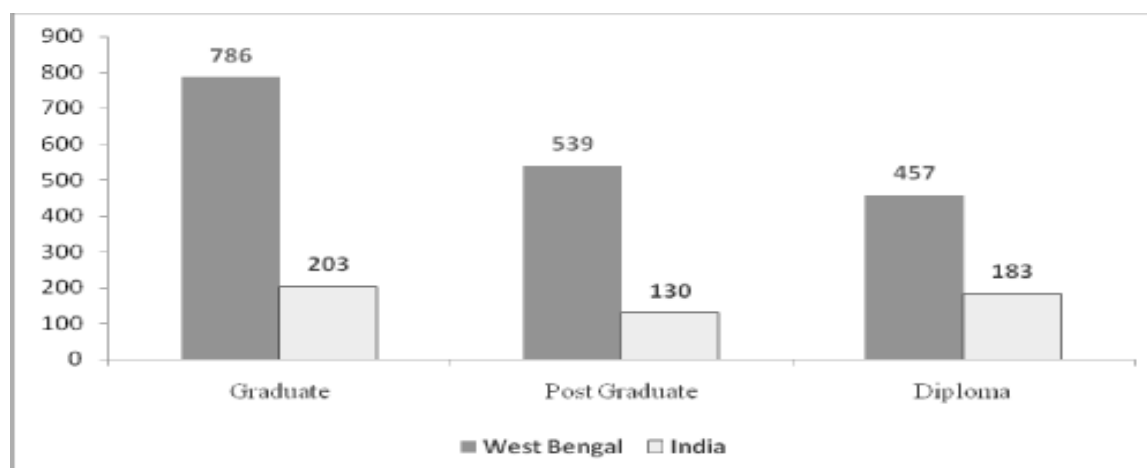
NSSO study reveals the private expenditure on technical/professional courses and vocational education is much higher compared to general education both for West Bengal as well as India. Average expenditure (Rs.) per student pursuing technical/professional education and types of institutions in West Bengal and India is shown in Table 26. The Table reveals that private expenses in the State is lower medical education and higher for Engineering, Law, management compared to national average.

Table 26: Average Expenditure (Rs.) per Student Pursuing Technical/Professional Education and Types of Institutions in West Bengal and India

		West Bengal	India
Medicine	Govt.	47897	64968
	Pvt. Aided	18367	90205
	Pvt. Unaided	73611	118657
Engineering	Govt.	45756	42401
	Pvt. Aided	95762	69696
	Pvt. Unaided	93215	78227
Law	Govt.	67238	39193
	Pvt. Aided	52366	31984
	Pvt. Unaided	19517	67392
Management	Govt.	157912	44519
	Pvt. Aided	101794	62124
	Pvt. Unaided	211384	105188
IT/Computer Course	Govt.	16949	28686
	Pvt. Aided	43981	48858
	Pvt. Unaided	55619	51051
Vocational Institute	Govt.	13905	13942
	Pvt. Aided	31655	31852
	Pvt. Unaided	30215	33773
Others	Govt.	24087	18330
	Pvt. Aided	63296	36466
	Pvt. Unaided	62729	43199
Total		55172	57094

Source: NSSO, 71st Round.

The high private education expenditure may be due to taking private coaching by students. Proportion of students (per 1000) taking private coaching for different levels of higher Education is shown in Figure 9.

Figure 9: Proportion of Students (Per 1000) Taking Private Coaching for Levels of Higher Education in India and West Bengal

Source: NSSO, 71st Round.

VI. CONCLUSION

Our analysis of the state of higher education scenario in West Bengal reveals that the state – which was once the foremost one in the country in educational attainment – has now been lagging behind the national average in terms of many of the performance indicators. Also, the higher education sector in the state is characterized by uneven regional or inter-district development as well as imbalance in the diversification of the streams or subjects. However, what is most important is that quantitative figures alone do not reflect the true performance of the state. If one takes into account the quality aspect of higher education sector, then the picture is also not comfortable. It needs to be emphasized that this sector is plagued by various problems – viz. dearth of eligible and quality teachers, infrastructure. While increasing private sector participation in higher education promotes educational opportunities, it has been the same time concern for the quality of higher education and raises question about equity. To improve the employability of graduates of general academic higher education or technical education, some actions are necessary: improving soft skills, updating curricular, better academic environment in the educational institutions, better regulation of private providers and more collaboration with industries and business world. Rising number of students need more vocational courses at school and tertiary level. It is true that some positive initiatives have been taken in some respects. About 1.78 lakh meritorious students in the state have been granted scholarships under Vivekananda Merit-cum-Means Scholarship scheme. A major e-governance initiative has been taken to bring in greater transparency and fairness in admissions to all UG and PG levels. All the state-run universities of West Bengal are in the process of introducing for uniform revised syllabus as per UGC model Syllabus in undergraduate courses from the session 2017-18. However much need to be done so that that West Bengal can come to the forefront in the higher education sector and contribute to the economic development of the country. India should try to develop its own form of integration between universities and business world. For forming the foundation of knowledge economy along with appropriate value system, school education should not be elitist and should be integrated in proper way with higher education system.

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SUSTAINABILITY OF INDIAN AGRICULTURE: CONSTRAINTS AND CHALLENGES#

DEBESH ROY*

Abstract

The criticality of agriculture for sustainable and inclusive growth of the Indian economy can be gauged from the fact that, the sector provides employment to about 48.9 per cent of the total workforce in India, but contributes only 15.2 per cent to the country's real Gross Value Added (GVA). The overdependence of agriculture on monsoons needs to be reduced, with a view to achieving agricultural sustainability. Climate change also poses a daunting challenge to produce enough food for the increasing population in the face of decreasing resources. This paper examines major constraints, challenges and policy perspectives towards achieving sustainability of Indian agriculture and doubling of farmers' income by 2022. It suggests creation of enabling environment for agricultural sustainability through massive investment in irrigation, with a focus on water-use efficiency, enhancement in total factor productivity of crops, adoption of climate-smart agriculture, development of efficient agri-value chains, market reforms, development of export market for agricultural produce, easy availability of credit, wider coverage of crop insurance, and enactment of tenancy laws.

Key Words : Sustainability of Agriculture, Investment in Irrigation, Efficient Agro-Value Chain, Credit Insurance and Tenancy Laws

JEL Classification Codes : Q10, Q13, Q14, Q15, Q16, Q17, Q18.

I. Introduction

The criticality of agriculture for sustainable and inclusive growth of the Indian economy can be gauged from the fact that, the sector provides employment to about 48.9 per cent of the total workforce in India, but contributes only about 15.2 per cent to the country's real Gross Value Added (GVA)¹. The green revolution, which introduced high yielding varieties (HYV) seeds to Indian farmers, especially in the northern states during the late 1960s and early 1970s, had led to significant increases in production and productivity of major crops, ensuring the achievement of food security in India. However, over the years, productivity of major crops remained stagnant due to the overuse of chemical fertilizers and pesticides leading to deterioration in soil quality, and overexploitation of ground water leading to water stress.

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¹Provisional Estimates of National Income 2016-17, Ministry of Statistics and Programme Implementation, Government of India (Press Note dated 31 May 2017).

About 85 per cent of operational holdings in the country are in the small and marginal categories, and the average size of an operational holding is only 1.15 hectare (ha). Due to fragmentation and disorganisation, farmers face constraints in procuring inputs like seeds and fertilizers at reasonable prices, lack bargaining power in the market for realising better value for their produce, and have inadequate access to technology, extension services, market, credit and crop insurance. As a result, majority of the smallholders are unable to realise optimal value from their farming operations, resulting in agrarian distress.

Indian agriculture continues to depend on the vagaries of nature. A couple of good monsoon years is usually followed by a year or two of poor monsoon. Also, rainfall is not evenly distributed across the country during a good monsoon year, resulting in flood and drought simultaneously in different regions, causing severe damage to crops. Therefore, the overdependence of agriculture on monsoon needs to be reduced significantly, with a view to achieving agricultural sustainability.

The problem of land and water degradation is a key constraint in augmenting agricultural production. It is estimated that about 121 million ha of land in the country (i.e. 37 per cent of the total geographical area) is degraded due to soil erosion. Also, about 8.4 million ha of land has soil salinity and water-logging problems. Moreover, huge quantities of nutrients are lost during crop production cycle. Further, water resources in the country are getting stressed and degraded. Another critical challenge is the impact of climate change on agriculture, which has deleterious effects on the availability of food, livelihoods, income of farmers and the economy as a whole.

The country needs a profound transformation in food and agriculture systems across regions, for achieving the goal of eradicating hunger and poverty. While India's population is likely to increase to more than 1.6 billion before near-stabilisation by 2030, the demand for food is expected to touch about 400 million tonnes (MT) by the year 2050 (IARI, 2015). Therefore, it is imperative for the agriculture sector to grow at 4 per cent per annum, not only to meet the growing demand for food but also to achieve an annual economy-wide growth rate of 8-10 per cent to reduce poverty.

The foregoing constraints and challenges need to be addressed urgently at the policy, planning, technological, institutional, and operational levels. Against this backdrop, this paper examines major constraints, challenges and policy perspectives towards achieving sustainability of Indian agriculture and doubling of farmers' income by the year 2022. Rest of the paper is organised as follows: Section II presents recent trends of the agriculture sector in India. Issues and challenges towards achieving agricultural sustainability are discussed in Section III. Strategies and policy perspectives for achieving Government of India's target of doubling farmers' income by the year 2022 are presented in Section IV. Section V concludes the paper.

II. Agriculture Sector in India – Recent Trends

After two years of back-to-back poor monsoons and drought conditions in several parts of the country, agriculture in India picked up momentum during 2016-17 due to normal monsoon. The

agriculture sector expanded robustly by 4.9 per cent during the year, after two consecutive years of sub-one per cent growth (Chart 1). While the industrial sector witnessed a significant loss of momentum, there was also a slowdown in the services sector. As the average annual growth rate of GVA in the agriculture sector during the last five years (2012-13 to 2016-17) was only 2.5 per cent, it is imperative to transform the sector through reforms in the production, value chains and marketing systems, enactment of land leasing laws, and also by addressing the impact of climate change on agriculture, in order to achieve a sustainable average annual growth of 4 per cent.



Note: PE – Provisional estimates.

Source: (1) Key Economic Indicators, April 2017, Ministry of Commerce and Industry, Government of India

(2) Provisional estimates of National Income 2016-17, CSO, Ministry of Statistics and Programme Implementation, GoI.

Foodgrains production during 2016-17 is estimated at an all-time high of 275.7 MT, compared to 251.6 MT achieved during 2015-16 (Table-1). Favourable monsoon encouraged farmers to increase the area under cultivation of foodgrains during the kharif season 2016-17 by 55.6 per cent over the normal area². The highest increase in acreage was in respect of pulses at 38.6 per cent over the normal area. Apart from good monsoon rains, farmers increased the acreage under pulses cultivation due to increase in minimum support price (MSP), including bonus. This was also in response to price signals from the previous year when the retail prices of *arhar* (pigeon pea) prices touched Rs.200 per kg. On the flip side, a 40.37 per cent year-on-year rise in pulses output—from 16.35 MT in 2015-16 to 22.95 MT in 2016-17—also led to wholesale prices dipping below Minimum Support Prices (MSPs) for varieties like *arhar* and *moong*, affecting farm incomes. The reported lack of procurement by state agencies added to the woes of farmers.

Table-1: Foodgrain production

(Million tonnes)

Crop	2006-07	2012-13	2013-14	2014-15	2015-16	2016-17 (4 rd AE)
Rice	93.36	105.24	106.65	105.48	104.41	110.15
Wheat	75.81	93.51	95.85	86.53	92.29	98.38
Coarse cereals	33.92	40.04	43.29	42.86	38.52	44.19
Pulses	14.20	18.34	19.25	17.15	16.35	22.95
Total foodgrains	217.28	257.13	265.04	252.02	251.57	275.68

Note: 4rd AE: Fourth Advance Estimate

Source: Agricultural Statistics Division Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmers Welfare, Government of India

Among commercial crops, oilseeds and cotton witnessed significant increase in production during 2016-17 (Table-2). However, the production of these crops were below the production achieved during 2013-14. While the production of jute and mesta increased marginally, the production of sugarcane declined during the year.

Table-2: Production of Commercial Crops

(Lakh tonnes)

Crop	2006-07	2012-13	2013-14	2014-15	2015-16	2016-17 (4 rd AE)
Oilseeds	242.89	309.43	327.49	275.11	252.51	320.97
Cotton #	226.32	342.20	359.02	348.05	300.05	330.92
Jute & Mesta ##	112.73	109.30	116.90	111.26	105.24	106.00
Sugarcane	3,555.20	3,412.00	3,521.42	3,623.33	3,484.48	3,067.20

Note: # Lakh bales of 170 kgs each ##Lakh bales of 180 kgs each 4rd AE: Fourth Advance Estimate

Source: Agricultural Statistics Division Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmers Welfare, Government of India.

III. Sustainability of Indian Agriculture – Issues and Challenges

III.1 Small Size of Holdings

Small and marginal holdings in India account for about 85 per cent of operational holdings, resulting in inefficiency in cultivation and low income to majority of farmers. The Situation Assessment Survey of Agricultural Households in India (NSS 70th Round) had observed that agricultural households in the lower size classes of holdings were mostly dependent on wage/ salary employment than farm business (cultivation and farming of animals) for their income (GoI, 2016). For the households belonging to the lowest size class, farming of animals fetched more income than cultivation. Percentage share of income from cultivation/ farm business in the average

monthly income increased with increase in land possession. Similarly net investment in productive assets per agricultural household increased with increase in land size. Further, net monthly income (farm and non-farm) in respect of size classes up to 1 ha was negative, and net income increased steadily with the increase in size class.

The average net monthly income in respect of farm households in the categories of landless (<0.01 ha), lower marginal (0.01-0.40 ha) and upper marginal (0.41-1.00 ha) was observed to be negative at Rs. (-) 547, Rs. (-) 1,249 and Rs. (-) 773, respectively (Table-3). In case of small agricultural households (1.01-2.00 ha), the average net monthly income was a meagre Rs. 891. The average monthly expenditure incurred on productive assets used in farm business showed a wide variation across the size classes of land possessed, ranging from less than one-third (Rs. 281) of the all India average (Rs. 1,013) in the lowest size class of land possessed, to more than nine times the all India average in case of the highest size class (Rs. 9,568) (Table-3).

Studies have shown that small-scale farming is inefficient in India (e.g. Foster and Rosenzweig, 2010). The lives of smallholding families can be improved only by building on their higher per acre agricultural productivity and by promoting off-farm rural employment (Chand et al, 2011). Therefore, strategies for promoting agricultural growth and sustainability, and significantly increasing income of small and marginal farmer households, should include a group approach through farmer producer organisations (FPOs), farmer producer companies (FPCs), cooperatives or collectives, by diversification to high-value agriculture, allied activities (especially dairy, poultry, fisheries, bee-keeping, etc.) and off-farm work in the rural areas.

A group approach can increase market access to land, and help spread the risk of farming among a larger number and increase production opportunities by experimenting with higher value, and more risk prone crops with larger payoffs (Agarwal, 2016). It also allows labour sharing and easy substitution. Further, a group would be better placed to enter into non-exploitative contract farming arrangements (*ibid.*).

Table-3: Average monthly income from different sources and consumption expenditure per agricultural household (July 2012-June 2013) for each size class of land possessed

(Amount in Rs.)

Size class of land (ha)	Average monthly income					Average monthly consumption expenditure	Net monthly income	Average monthly expenditure on productive assets in farm business
	Income from wages/ salary	Net receipt from agricultural activities		Net receipt from non- farm business	Total income			
		cultivation	Farming of animals					
Landless (<0.01)	2902(63.6)	30 (0.7)	1181(25.9)	447(9.8)	4561	5108	-547	281
Lower marginal (0.01-0.40)	2386(57.5)	687(16.5)	621(15.0)	459(11.0)	4152	5401	-1249	287
Upper marginal (0.41-1.00)	2011(38.3)	2145(40.9)	629(12.0)	462(8.8)	5247	6020	-773	837
Small (1.01-2.00)	1728(23.5)	4209(57.3)	818(11.1)	593(8.1)	7348	6457	891	1741
Semi- medium (2.01-4.00)	1657(15.4)	7359(68.6)	1161(10.8)	554(5.2)	10730	7786	2944	1667
Medium (4.01- 10.00)	2031(10.3)	15243(77.6)	1501(7.6)	861(4.4)	19637	10104	9533	2805
Large (>10.00)	1311(3.2)	35685(86.2)	2622(6.3)	1770(4.3)	41388	14447	26941	9568
All sizes	2071(32.2)	3081(47.9)	763(11.9)	512(8.0)	6426	6223	203	1013

Note: Figures in brackets indicate percentage share of total income.

Source: Statements 3.2 and 3.7 of *Income, Expenditure, Productive Assets and Indebtedness of Agricultural Households in India*, NSS 70th Round Report 576 (70/33/3), Ministry of Statistics and Programme Implementation, GoI, 2016.

III.2 Low Agricultural Productivity

The green revolution witnessed significant increase in crop productivity due to use of HYV seeds, chemical fertilizers and pesticides. However, stagnation in yield of major crops, with the exception of cotton, has been observed during the last three decades (Table 4). A sharp increase in yield of cotton was witnessed during 2009-10 (403 bales/ ha compared to 190 bales/ ha during 2000-01), due to the introduction of Bt cotton. The CAGR of yield for the period 1980-81 to 2016-17 was the highest in case of cotton at 3.34 per cent (Chart 2). Rice (1.75 per cent),

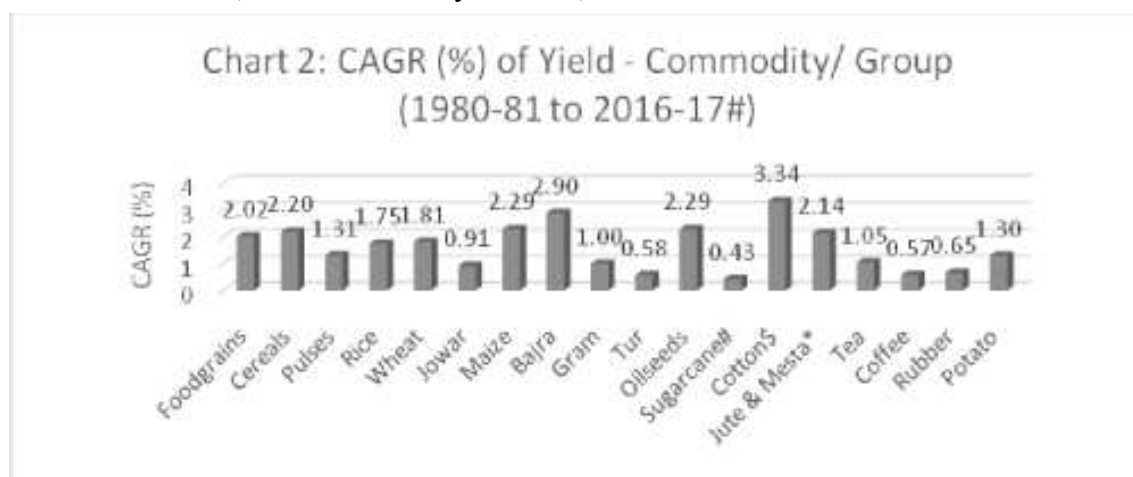
wheat (1.81 per cent) and pulses (1.31 per cent) experienced much lower CAGR of yield during the same period. Stagnation in productivity of agricultural crops has been observed due to the following factors: (i) decline in farm size and income; (ii) depleting natural resource base; (iii) increasing input costs, and adverse economics of farming; (iv) deficiency of micronutrients in the soil and deteriorating soil health; (v) inadequate post-harvest technology; (vi) uncertain market prospects; and (vii) high indebtedness of farmers. These issues need to be urgently addressed through technological and policy interventions, with a view to increasing agricultural productivity.

Table – 4: Yield (Kg/ha) of Major Crops

(Kg/ ha)

Crops	1980-81	1990-91	2000-01	2009-10	2010-11	2012-13	2013-14	2014-15	2015-16	2016-17
Rice	1336	1740	1901	2125	2239	2462	2416	2391	2400	2543
Wheat	1630	2281	2708	2839	2989	3117	3145	2750	3034	3172
Pulses	473	578	544	630	691	789	764	728	656	765
Oilseeds	532	771	810	958	1193	1168	1168	1075	968	1229
Sugarcane#	58	65	69	70	70	68	71	71	71	68
CottonS	152	225	190	403	499	486	510	462	415	513

Source: Table 1.17, Economic Survey 2016-17, Government of India

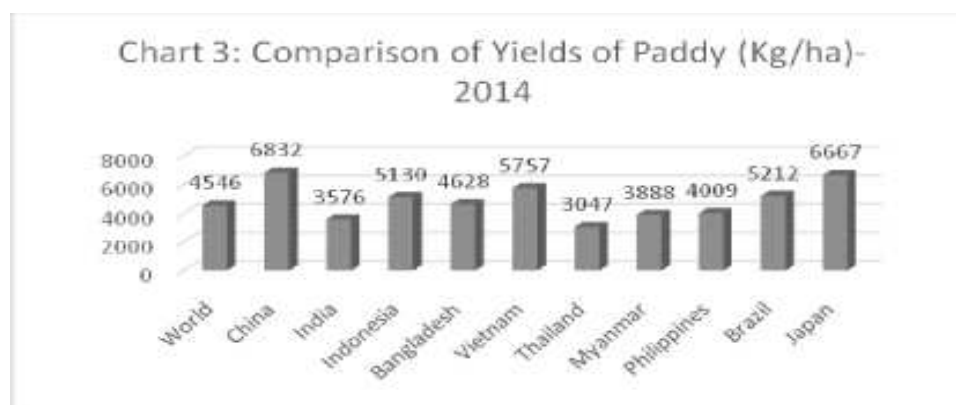


#CAGR (%) is for the period 1980-81 to 2015-16 in respect of Tea, Coffee and Rubber

Source; Author's calculation based on data accessed from Table 1.17, Economic Survey 2016-17, Government of India

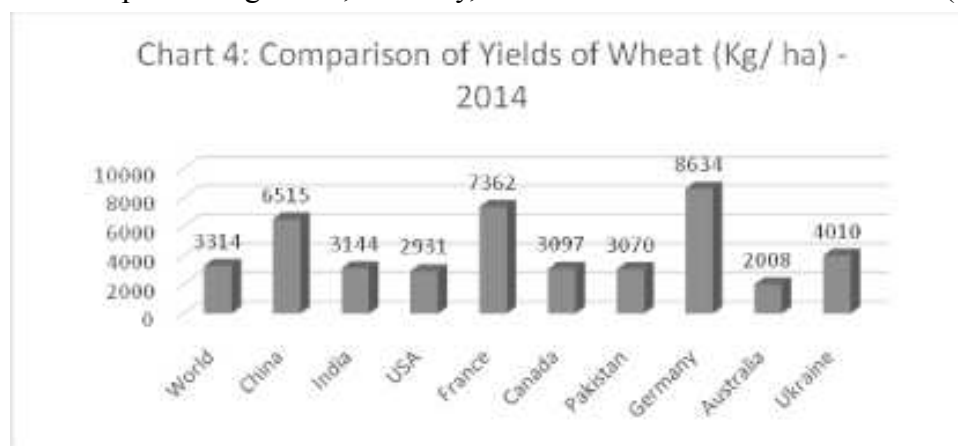
Huge yield gaps exist in case of major crops in India. Such gaps exist at two levels, viz. (i) between the best scientific practices and the best farm practices, and (ii) between the best field practices and the average farmer practices. It has been observed that the yield gaps (percentage difference between state average yield and average potential yield) in case of rice were higher than the national average (30.8 per cent) in case of Madhya Pradesh (57.6 per cent), Chhattisgarh (53.4 per cent), Maharashtra (49.7 per cent), Odisha (45 per cent), Assam (43.7 per cent), Karnataka (39.5 per cent), Haryana (35.3 per cent), Uttar Pradesh (34.1 per cent), and Tamil Nadu (32.5 per cent), during the period 2009-10 to 2013-14. The states with yield gaps lower than the national average were Jharkhand (30.5 per cent), Kerala (26.9 per cent), Gujarat (23.5 per cent), West Bengal (17.2 per cent) and Andhra Pradesh (13 per cent) (GoI, 2017). In case of wheat some of the states with yield gaps higher than the national average (20.5 per cent), were Karnataka (74.4 per cent), Maharashtra (52.5 per cent), Madhya Pradesh (46.2 per cent), Bihar (45.4 per cent), Uttar Pradesh (34.2 per cent), Rajasthan (32.6 per cent), and Gujarat (24.7 per cent). States with lower yield gaps were Haryana (12.6 per cent), Punjab (9.2 per cent) and West Bengal (6.2 per cent) (*ibid.*). There also exists considerable yield gaps in case of pulses and coarse cereals. The issue of yield gaps can be addressed by expanding irrigation, increasing use of improved and hybrid seeds, and better access to credit. However, special attention needs to be directed towards wheat and sugarcane, which are grown almost entirely under irrigated conditions, and all the area under wheat are sown with improved and hybrid seeds (*ibid.*). Various studies have shown that a significant contributor of output growth would be the total factor productivity (TFP). Technological changes due to investment in research, and creation of infrastructure like roads, electricity, markets, etc. are important factors for enhancing TFP.

Yield of major crops in India also compare poorly with that of other countries in the world. It may be observed from Chart 3, that among the top ten producers of paddy, India ranks ninth with an average yield of 3576 Kg/ha, which is significantly lower than that of China, Japan, Vietnam, Brazil, Indonesia, Bangladesh and Philippines. India's yield of paddy is also lower than that of the world average.



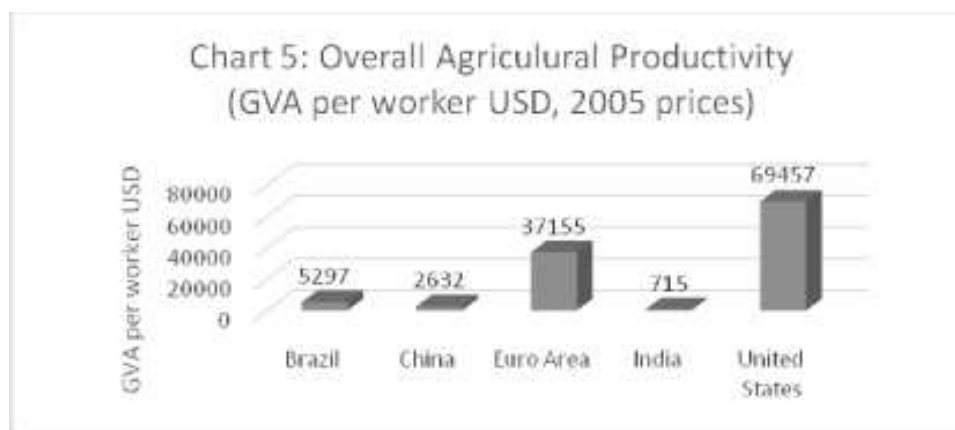
Source: Prepared from Table 7.1, Agricultural Statistics at a Glance 2016, Department of Agriculture & Cooperation, GoI

The yield of wheat in India (3144 Kg/ ha) is less than the world average, and just more than one-third of the best performing nation, Germany, and less than half of France and China (Chart 4).



Source: Prepared from Table 7.1, Agricultural Statistics at a Glance 2016, Department of Agriculture & Cooperation, GoI

The overall agricultural labour productivity of India in terms of GVA per worker is less than a third of that in China, about 1 per cent of that in the United States and about 2 per cent of that in the Euro Area (Chart 5). With appropriate technological and policy interventions there is significant scope for improvement in the yield of paddy, wheat and other major crops in India, as a means to increase income of farmers.



Source: Economic Survey 2016-17, Volume 2, GoI

III.3 Climate Change and Agricultural Sustainability

Climate change poses a major and growing threat to food security (FAO, 2016). It would be a daunting challenge to produce enough food for the increasing population in the face of decreasing resources and changing climate. Changes in rainfall patterns can result in severe water shortages

or floods. Rising temperatures can cause changes to crop growing seasons or even reduce the yields of crops. There will also be a further knock on effects on the environment which will impair agricultural production as a whole (FAO 2015).

The extent of the estimated adverse impact of climate change on crop yields in India and selected regions of the world is presented in Table 5. The estimated loss in yields in respect of major crops like rice (-30 per cent), wheat (-23 per cent) and maize (-31 per cent) during 2050-69 in India, due to climate change is quite alarming. Further, the net emissions from agriculture in carbon dioxide equivalent in 2014 in the world was as much as 5,241,761 thousand tonnes³. China (707,640 thousand tonnes), India (626,864 thousand tonnes) and Brazil (441,905 thousand tonnes) account for the major quantum of net emissions from agriculture.

It is felt that reactive adaptations like improving the markets, changing agricultural policies, enhancing social protection and preparing for disasters have their limitations. Therefore, more adaptive improvements like Climate-Smart Agriculture (CSA) are required instead. CSA is an integrative approach which pursues the triple objectives of: (i) sustainably increasing productivity and incomes; (ii) adapting to climate change; and (iii) reducing greenhouse gas (GHG) emissions (FAO, 2017).

Table – 5: Projected Changes (%) in Crop Yields Due to Climate Change

Geographical Location	Period	Crops (Estimated Yield Change)
China	2050-69	Soybean (-45.9)
India	2050-69	Maize (-31), Soybean (-32.9)
Central India, South India, Sri Lanka	2050-69	Rice (-30), Wheat (-23)
South Asia	2050-69	Major crops (-18.9)
World	2050-69	Major crops (-8.2)

Source: Table A.1 State of Food and Agriculture 2016, FAO

CSA entails greater investment in managing climate risks, understanding and planning for these adaptive changes that are required, and making use of opportunities for reducing or removing GHG emissions wherever possible. It relates to actions both on-farm and beyond, and includes technologies, policies, institutions and investments. The approaches include: (a) management of farms, crops, livestock, aquaculture and capture fisheries to manage resources better; (b) ecosystem and landscape management to conserve ecosystem services that are critical for increasing resource efficiency and resilience; and (c) services for farmers and land managers to ensure they are able to implement the necessary changes (FAO, 2015). However, the adaptive capacity of smallholder farmers in India is restricted by barriers to the adoption of CSA technologies and practices, on account of lack of access to market and credit for investment purposes, lack of security of land tenure, limited or asymmetric information, inadequate extension services, and lack of safety nets

against natural disasters. In this context, FPOs could play an effective role in adopting CSA for enhancement in farmers' incomes.

FAO has identified the following five key principles for sustainability for food and agriculture: (i) improving efficiency in the use of resources is crucial to sustainable agriculture; (ii) sustainability requires direct action to conserve, protect and enhance natural resources; (iii) agriculture that fails to protect and improve rural livelihoods, equity and social well-being is unsustainable; (iv) enhanced resilience of people, communities and ecosystems is key to sustainable agriculture; and (v) sustainable food and agriculture requires responsible and effective governance mechanisms (FAO, 2017).

While advocating the idea of 'evergreen revolution⁴' for India, Dr. M.S. Swaminathan (2010) had demonstrated that there is a need for agricultural renewal which would address the aspects of soil health, irrigation and water supply, technology transfer from 'lab to land' in post-harvest phases, and market advice to farmers. According to him, green agriculture involving integrated pest management, integrated nutrient supply and integrated natural resources management is the pathway to an evergreen revolution. Therefore, there is an urgent need to promote and propagate sustainable agriculture in order to transform the agriculture sector.

III.4 Capital Formation in Agriculture

Capital formation in agriculture is of critical importance for the sustainability of agricultural growth. The percentage share of Gross Capital Formation (GCF) in agriculture and allied sector in the Gross Value Added (GVA) from agriculture declined from 18.3 per cent in 2011-12 to 16.3 per cent in 2015-16 (Table - 6). Considering the importance of agriculture and allied sector in increasing income, employment and achieving inclusive growth, it is imperative to arrest the declining trend and increase investment in the sector.

Table – 6: GVA and GCF in Agriculture and Allied Sector

(Amount in ¹ crore)

Year	Agriculture and allied sector		Share of GCF in GVA of Agriculture & allied sector (%)
	GVA (at constant 2011-12 prices)	GCF (at constant 2011-12 prices)	
2011-12	15,01,816	2,74,432	18.3
2012-13	15,24,398	2,53,308	16.6
2013-14	15,88,237	2,84,134	17.9
2014-15	16,06,140	2,77,436	17.3
2015-16	16,17,208	2,63,147	16.3

Source: (1) National Accounts Statistics, CSO, MOSPI, GoI (Press Release 31 May 2017) (2) Key Economic Indicators, April 2017, (Table 10), Office of the Economic Adviser, Ministry of Commerce & Industry, GoI, www.eaindustry.nic.in

Public sector investment in irrigation, rural roads, power, telecommunications, market infrastructure, research, and extension services would result in high growth of the agricultural sector and reduction in poverty. Considering the existence of fiscal constraints, the state governments' investment strategies in agriculture should be guided by the efficient and equitable use of resources with high payoffs.

The advantages of improved technology in farm mechanisation, that help to overcome productivity challenges in agriculture, often elude small and marginal farmers on account of lack of affordability and bulkiness of investment. Custom hiring centres, especially of FPOs could facilitate hiring of machines and implements suited to the farm and crop requirements and enable timeliness and precision, leading to improvement of productivity per unit of crucial inputs. Also, in order to enable the acceleration of private sector investments in agriculture, banks could consider financing FPOs/ FPCs, large farmers and private companies, for warehouses, cold storages, food processing units, milk chilling plants, etc.

III.5 Research and Development and Extension Services

The needs of farmers in terms of information and technology support have become more complex, due to the rapid pace of developments in the agriculture sector. Climate change, depleting natural resources, scarcity of labour and volatile market forces are some of the concerns that have put tremendous pressure on both farmers as well as extension systems in the context of increasing the productivity, profitability and sustainability of agriculture.

India needs a vibrant, responsive, market oriented and globally competitive agricultural research ecosystem (NITI Aayog, 2017). Moreover, research strategy should be pro-nature and small farmer-oriented (Swaminathan, 2010). There is a need to shift the focus of the research and development agenda from crop-centric research in irrigated areas to location-specific cropping systems in dry lands, hills and tribal areas (*ibid.*). Greater attention needs to be directed towards horticulture crops, which are land and water-saving by nature. Efforts may also be made to harness remote sensing technologies to optimise the application of inputs, and explore areas in emerging capital-intensive biotechnology (*ibid.*).

Across the world genetically modified (GM) seeds have emerged as a powerful technology promising high productivity, improved quality and lower use of fertilizers, weedicides and pesticides in the last couple of decades. Farmers around the world have adopted GM seeds with good amount of success. The adoption of Bt cotton by Indian farmers during mid-2000s resulted in a sharp increase in yield of cotton. Recently, the Genetic Engineering Appraisal Committee (GEAC), the nodal regulator for GM crops in India, had recommended the commercial release of GM mustard, developed by the Delhi University-based Centre for Genetic Manipulation of Crop Plants. This could benefit the farmers immensely in terms of significant improvement in yield of mustard and also make the country less dependent on imports of the crop. Considering the immense potential of GM seeds in vastly improving productivity of crops and transforming Indian agriculture, it is imperative to continue to encourage research on GM crops, including their impact

on human health, with a view to their commercial development for the domestic as well as the export market. FPOs can be the conduit through which smallholder farmers could benefit from GM technology.

Further, there is a need to revitalise agriculture extension services by making it more relevant, useful and timely in order to improve agricultural productivity. Extension services also need to be done in an input, crop and region neutral way, and should aim at minimising wastage in inputs and in the produce, till it leaves the farm gate. Also, efforts need to be made to enhance post-harvest processing and value added activities at the farm. FPOs/ FPCs, Farmers Clubs/ Farmers' Federations could be developed into important agencies for providing extension services to farmers.

IV. Doubling of Farmers' Income by 2022 – Strategies and Policy Perspectives

Government of India has envisioned the achievement of Doubling Farmers' Income (DFI) by the year 2022. The following seven-point strategy for doubling farmers' income announced by the Hon'ble Prime Minister needs to be adopted by the central and state governments, and other stakeholders, viz. RBI, NABARD, banks, insurance companies, developmental agencies, research institutions/ agricultural universities, extension agencies, corporate sector, cooperatives, FPOs/ FPCs, etc., for achieving the target within the stipulated time: (i) irrigation with focus on water-use efficiency, viz. "per drop more crop"; (ii) quality seed and soil health, (iii) investments in warehouses and cold chains; (iv) value addition through food processing; (v) electronic National Agriculture Market (e-NAM); (vi) increase in the coverage and effective implementation of the new crop insurance scheme – Pradhan Mantri Fasal Bima Yojana (PMFBY); (vii) promotion of ancillary activities like dairy, poultry, bee-keeping and fisheries. DFI also calls for intensive focus on the eastern and north-eastern regions of the country, and ushering in an "evergreen revolution" and a "rainbow revolution"⁵.

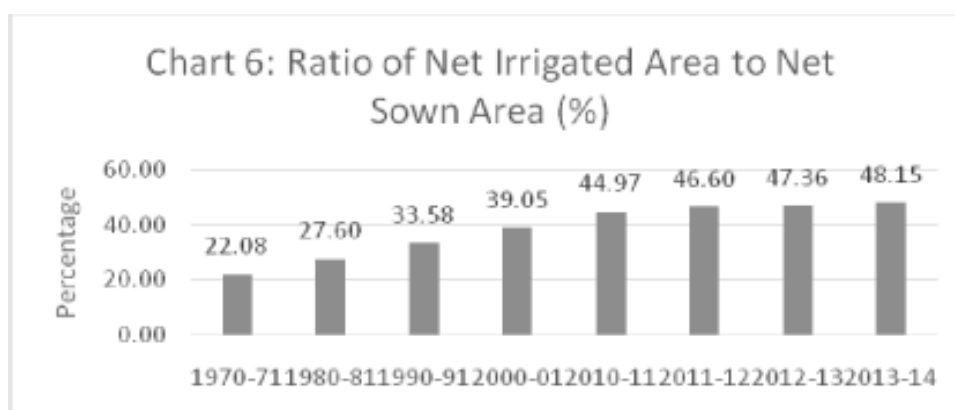
The strategy for DFI, aiming at doubling real income of farmers, involving increase in private investment by 6.62 per cent per annum from the base year 2015-16 at the national level, should also include: (a) increasing the ratio of farm income to the non-farm income from the present 60 per cent to 70 percent; (b) promoting higher agricultural growth in less developed regions, including rainfed areas, with a focus on marginal and small holders; (c) strengthening livestock related activities and crop diversification to high value produce like horticulture, in line with market signals; (d) shifting priority focus to post-production management and the agricultural marketing system; (e) sizeable increase in institutional credit to farmers; (f) allocation of more resources by state governments towards minor irrigation, which has higher marginal efficiency of capital compared to major and medium irrigation systems; and (g) incentivising private corporate sector to participate in investments in agriculture (GoI, 2017a). In order to achieve DFI, GoI can use income policy to protect the poor, free up prices for farmers, and allow private trade to stock and operate freely and have unhindered exports (Gulati and Hussain, 2017). The major strategies and policy perspectives for achieving DFI and sustainability of Indian agriculture are discussed in the following

sub-sections.

IV.1 Irrigation and Water-use Efficiency

Water is the most critical input for agricultural production. Huge investment in irrigation was a major factor which led to the green revolution. However, more than 50 per cent of the net sown area in the country is unirrigated and, hence, is vulnerable to the uncertainties of the monsoon. Further, while only 48.2 per cent of the net sown area in the country is irrigated, the depletion of groundwater, which accounts for about 60 per cent of the country's irrigated area, has adverse impact on irrigation cost and crop productivity. It is also a matter of concern that the net irrigated area in the country has remained almost stagnant during the period 2010-11 to 2013-14 (Chart 6).

The overall irrigation efficiency of major and medium irrigation projects in India is estimated at around 38 per cent (GoI, 2016a). GoI has formulated Pradhan Mantri Krishi Sinchai Yojana (PMKSY) with the vision of extending the coverage of irrigation (*har khet ko pani*, i.e. water to every farm) and improving water use efficiency, viz. 'per drop more crop' in a focused manner



Source: Based on data accessed from Table 13.2, Agricultural Statistics at a Glance 2016, Dept. of Agriculture & Coop., GoI

with end-to-end solution on source creation, distribution, management, field application, and extension activities. The scheme involves convergence of investments in irrigation at the field level, expansion of cultivable area under assured irrigation, improvement in on-farm water use efficiency to reduce wastage of water, enhancement of the adoption of precision-irrigation and other water saving technologies, enhancement in recharge of aquifers and introduction of sustainable water conservation practices. A dedicated Long Term Irrigation Fund (LTIF) has been instituted by GoI in NABARD, with a corpus of Rs. 40,000 crore, for fast-tracking the implementation of incomplete major and medium irrigation projects under PMKSY, in a mission mode, enabling the creation of additional irrigation potential of 7.6 million hectare by the year 2019.

A major initiative of GoI, aiming at generation of 34,000 megawatt of power, prevention of floods and droughts, and increasing the ultimate irrigation potential in the country from 140 million

ha to 175 million ha, is the Interlinking of Rivers (ILR) programme. Under this programme, the National Water Development Agency (NWDA) has already identified 14 links under Himalayan Rivers Component and 16 links under Peninsular Rivers Component for inter basin transfer of water based on field surveys and investigation and detailed studies. This programme has the potential to transform Indian agriculture, by significantly increasing agricultural production and productivity, as well as farmers' income, while reducing the risks of floods and droughts.

Water-use efficiency under conventional irrigation ranges from 30 per cent to 50 per cent, as against 80 per cent to 95 per cent in case of micro-irrigation, viz. drip and sprinkler irrigation. Water stress can be reduced and availability of water can be increased through cost-based water pricing. There is also a need to make a paradigm shift from use of input intensive technology to significantly enhancing input productivity, e.g. the use of water-saving technology like micro-irrigation, System of Rice Intensification (SRI), direct seeded rice, zero tillage, etc. While micro-irrigation techniques, owing to high fixed costs of adoption, have mostly been used for high value crops, recent research has shown its feasibility even in wheat and rice. Micro-irrigation system has reduced irrigation costs across states by 30 per cent, and in case of fertilizer use, the saving is about 28 per cent in consumption in the surveyed states (GoI, 2017b). A dedicated Micro Irrigation Fund has been instituted by GoI in NABARD, with an initial corpus of Rs. 5,000 crore to achieve the goal of 'per drop more crop'. FPOs, with their pooled resources, could be a cost-effective option for adoption of micro-irrigation techniques for the cultivation of wheat and rice, apart from high value crops.

IV.2 Criticality of Seeds and Fertilizers

There are multiple challenges to the development and adoption of quality seeds in India, viz. high cost of seeds for small and marginal farmers, inadequate supply of quality seeds, non-resolution of issues related to the adoption of genetically modified (GM) crops and lack of competition in the seed market. The Green Revolution was driven by indigenously developed high yielding varieties (HYV) seeds. Therefore, in order to achieve a second green revolution there is an urgent need to develop seeds/ seed technology in both public and private sectors. Further, a robust third party quality certification system for seeds should be encouraged (NITI Aayog, 2017). In this context, FPOs could be incentivised to play an important role in developing seeds and seed technology in a cost-effective manner.

Fertilizer use in the country is inefficient. Imbalances in the use of fertilizers are manifested by excessive dependence on urea owing to low/ distorted prices of urea. Further, there has been diversion of subsidised fertilizers to non-agricultural use. While the indiscriminate use of fertilizers has not improved the yield of crops proportionately, it has resulted in the depletion of soil fertility in many areas. Thus, there is a need to reform the present fertilizer subsidy regime, by moving towards an input, crop and region neutral format and also to minimize diversions. Linking the soil health cards to provide profile of the soil and fertilizer on the basis of the same profile utilizing fertilizer, even if not subsidized, can improve the yield of crops. Towards addressing these issues, the soil health cards initiative and the Direct Benefit Transfer

(DBT) on fertilizer have been introduced on a pilot basis in selected districts, which are steps in the direction to correct distortions (GoI, 2017b). Efficient nutrient management for improved productivity is a huge challenge, which can be addressed through information technology and also by providing soil fertility maps to FPOs.

IV.3 Agriculture Marketing Reforms

A critical problem faced by India's agriculture sector is the fragmented and distortions-ridden state of agricultural markets. Reforms in agriculture marketing system is the foremost among the policy reforms urgently needed in the agriculture sector to ensure remunerative prices for farmers. It was way back in 2003 that the model APMC act was prepared and shared with all states for enactment. However, efforts to reform agriculture markets have not been very successful. Keeping in view the contemporary issues and constraints in agriculture marketing, the NITI Aayog has prepared a new model APMC act, and is consulting state governments to initiate the process of enactment of the new APMC acts. The legislation of the new APMC acts by states is expected to protect farmers from market instability. While the enactment of reformed APMC acts may take time, states could exempt perishables from the APMC acts and replace licensees of APMC markets with open registration backed by bank guarantees, following the recommendations of the committee on Encouraging Investments in Supply Chains (NITI Aayog, 2017).

A path-breaking agriculture marketing reform initiative by GoI is the electronic National Agriculture Market (e-NAM), which envisages setting up of a common e-market platform that would be deployed in 585 regulated wholesale markets in states/union territories desirous of joining the e-platform. As at the end of July 2017, 455 *mandis* across 13 states had gone live under e-NAM. Further, in order to facilitate assaying of commodities for trading on e-NAM, common tradable parameters have been developed for 65 commodities. The e-NAM could lead to significant benefits to farmers through higher returns, while benefitting buyers through lower transaction costs, and consumers through stable prices. It will also facilitate the emergence of integrated value chains in major agricultural commodities across the country, and encourage the setting up of scientific storage and movement of agri-commodities. The benefits to buyers under e-NAM - be it large retailers, processors or exporters - are obvious, as they can log into the platform and source from any *mandi* in India connected to it. Smallholder farmers can benefit if they were to find ways for aggregating produce on their own, bypassing the *arhatiya* and even the local *mandi* in the process. This is where FPOs/ FPCs can play a key role, by facilitating aggregation and creation of volumes that is intrinsic to the success of e-NAM.

However, it has been observed that far from creating a seamless, unified national market for agriculture produce, as e-NAM is supposed to do, even a state-wide market has not been created anywhere (Sharma, 2017). The success of e-NAM would depend on GoI's efforts to influence state governments to dismantle the existing structure and operations of APMC *mandis* by amending the APMC acts and implement e-NAM as seamless national hi-tech markets competing with each other, and ultimately benefitting the farmers.

Minimum Support Price (MSP) is a mechanism to insure farmers against any sharp fall in farm prices. However, presently MSP has limited reach both in terms of commodities that the government procures and geographical area over which such procurement extends. Moreover, the existing agricultural marketing system through which the bulk of the farmers sell their produce places in their hands only a fraction of the price paid by the final consumer (NITI Aayog, 2017). Further, MSP has resulted in distortion of cropping patterns, with excessive focus on the cultivation of wheat, rice and sugarcane in the procurement states at the expense of other crops such as pulses, oilseed and coarse grains. It has also led to discrimination against eastern states, where procurement at MSP is minimal or non-existent. It has also resulted in depletion of water resources, soil degradation and deterioration in water quality in some states. A system of “Price Deficiency Payment” could be introduced to help remove distortion in the MSP system to some extent. NITI Aayog (2017) has suggested that while MSP may still be used for need-based procurement, under the deficiency payments system, a subsidy would be provided on other targeted produce in case the price falls below an MSP-linked threshold.

IV.4 Efficient Agri-Value Chains

India is the second largest producer of food in the world after China. The sector is a major generator of employment, and the strength of the sector lies in the fact that India is the leading producer of a number of commodities like milk, cereals, tea, and sugarcane. It is also the second largest producer of fruits and vegetables after China, and fifth in poultry production in the world. However, a major cause for concern lies in poor post-harvest management infrastructure facilities. The post-harvest wastage in the country has been estimated to the tune of Rs. 44,000 crore per annum. This could be due to crop damage, improper harvesting techniques, poor packaging, poor transportation, poor and multiple handling, lack of storage infrastructure, grading, sorting, and moisture loss at various stages of the value chain. Therefore, investment in agri-value chain infrastructure needs to be stepped up.

India is the largest producer of milk in the world, accounting for 17 per cent of the world’s production. The per capita availability of milk in India increased from 176 grams per day in 1990-91 to 322 grams per day by 2014-15. It is more than the world average of 294 grams per day during 2013 (GoI, 2016a). Dairying is an important secondary source of income for millions of rural households engaged in agriculture. The success of the dairy industry has resulted from the integrated co-operative system of milk collection, transportation, processing and distribution, conversion of the same to milk powder and products, to minimize seasonal impact on suppliers and buyers, retail distribution of milk and milk products, sharing of profits with the farmer, which are ploughed back to enhance productivity and needs to be emulated by other farm produce/producers (GoI, 2016a). A focus on dairy value chain could significantly improve the income of smallholder farmers. Therefore, in order to double income of farmers, it is important to focus on dairy value chain through FPOs/ FPCs and cooperatives.

India is the second largest producer of fruits and vegetables in the world. The productivity of horticultural crops increased by about 34 per cent between 2004-05 and 2014-15.⁶ Significantly,

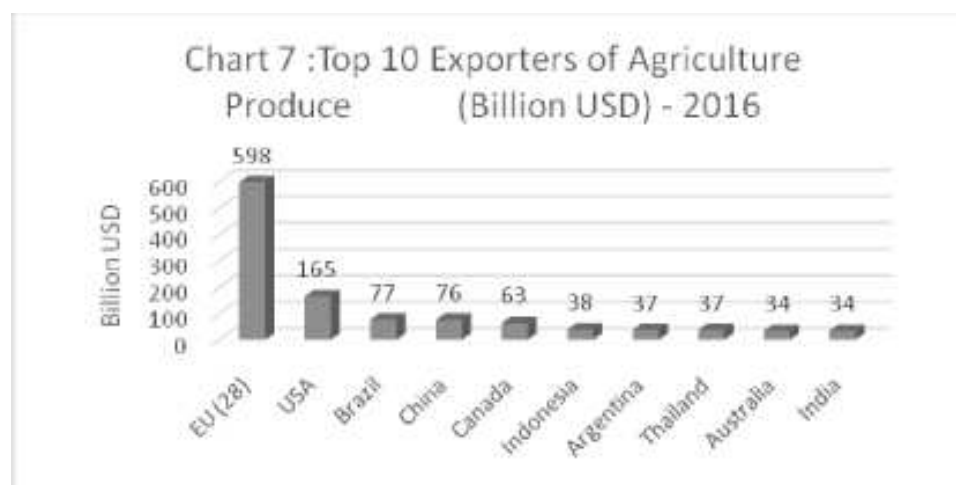
while the area under horticulture grew by about 3.8 per cent per annum, production rose by 7.6 per cent per annum over the last decade. In the poultry segment, the GoI's focus, besides framing suitable policies for enhancing commercial poultry production, is for strengthening the family poultry system, which addresses livelihood issues. Further, fisheries constitute about 1 per cent of the GDP of the country and 5.08 per cent of agriculture GDP. Promotion of value chains for horticulture, poultry and fisheries, involving FPOs/ FPCs, could significantly give a fillip to the income of small and marginal farmers.

The policy focus on agri- value chains needs to be on promoting inclusive value chain, which would benefit small and marginal farmers, through value identification, value creation, and value capture but more importantly, from value sharing with smallholders (Singh, 2016). An effective way to make it possible is through efficient FPOs/ FPCs.

Promotion of off-farm sector (OFS) activities (including MSME and services sectors) assumes significance in the context of reducing over dependence of the rural population on agriculture and to provide alternative livelihood options for farmers. These activities could be made profitable as part of food and agri-value chains. Therefore, doubling of farmers' income requires strong linkages with manufacturing and service sector to transform the 'agricultural units to agricultural enterprises' (GoI, 2017).

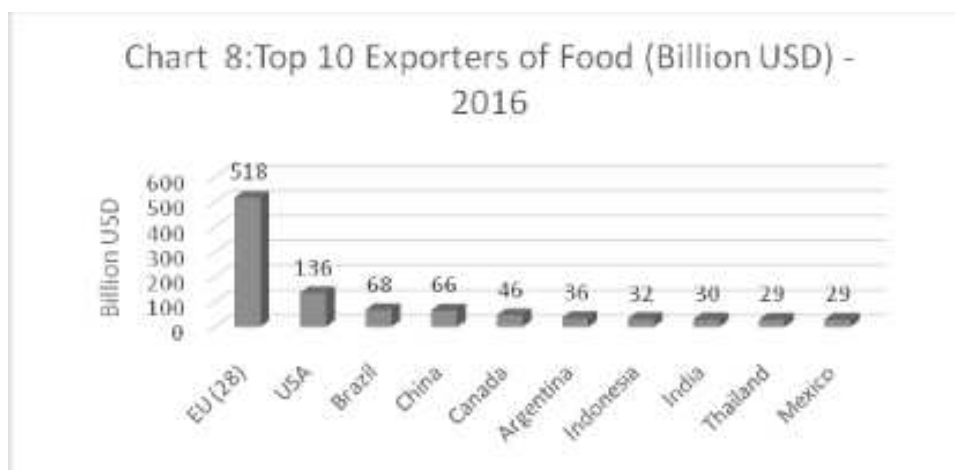
IV.5. Agricultural Trade

India is a leading exporter of agricultural commodities. Its agricultural exports were valued at USD34 billion in 2016 (Chart 7), and its share in total world exports stood at 2.1 per cent, having grown from 1.1 per cent in 2000. However, India's exports of agricultural products has been declining in recent years. In 2016 the annual change was -5 per cent compared to -19 per cent.⁷



Source: Based on data accessed from World Trade Statistical Review 2017, WTO

India is also a leading exporter of food. The country's food exports were valued at USD30 billion in 2016 (Chart 8), and its share in total world exports stood at 2.2 per cent, having grown from 1.3 per cent in 2000. However, India's exports of agricultural products has been declining in recent years. In 2016 the annual change was -4 per cent compared to -16 per cent.⁸



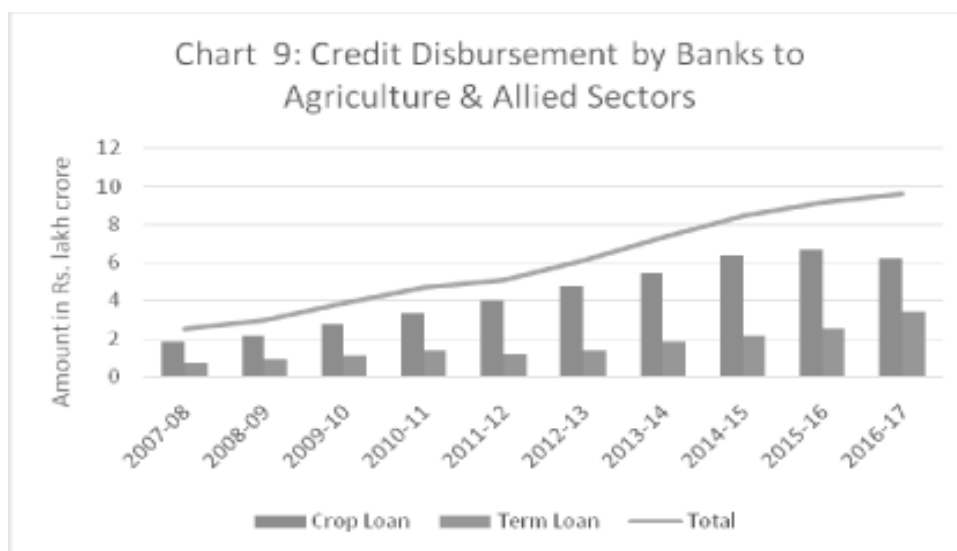
Source: Based on data accessed from World Trade Statistical Review 2017, WTO

Small and marginal farmers lack access to the export market, as well as the wherewithal and knowhow to move from subsistence farming to profitable hi-tech farming for high-value produce, which could match international standards. Globalisation can have the greatest impact on the rural poor through their influence on the agricultural sector terms of trade, availability and cost of inputs, and corporate investments in the agribusiness sector through mechanisms like contract farming and corporate farming (Singh, 2016). Therefore, agricultural policy needs to focus on creating the right ecosystem for opening up of the export market for agricultural produce of small and marginal farmers. According to the DFI Committee trade policy needs to move from a consumer-centric approach to a more farmer-centric one, to enable the farmers take advantage of lucrative price scenario at domestic as well as global arena (GoI, 2017). Integration with global markets can also contribute to poverty reduction through contract farming and FPOs/FPCs.

IV.6 Agricultural Credit

According to NSS 70th Round⁹ the incidence of indebtedness was about 31.4 per cent among the rural households, compared to 22.4 per cent among urban households. Also, the share of debt from non-institutional credit agencies in rural areas was 44 per cent, as against 15 per cent in urban areas. One of the major causes of agrarian distress is high indebtedness and over-dependence of farmers on non-institutional sources of credit. Therefore, timely availability and access to credit - both short term and long term from formal sources, at affordable rates of interest are essential to improve agricultural productivity. NABARD, along with Government of

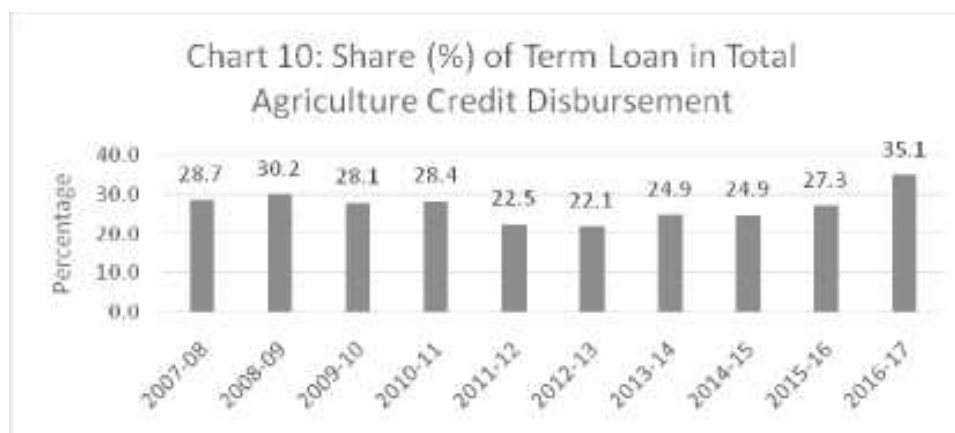
India (GoI) and Reserve Bank of India (RBI) has been consistently making efforts to ensure adequate and timely credit to meet the farming needs of farmers. As a result, there has been an impressive growth in agricultural credit flow from Rs.2.54 lakh crore during 2007-08 to Rs.9.60 lakh crore (provisional) during 2016-17 (up to end-February 2017) (Chart 9).



Note: Figures for 2016-17 are provisional

Source: NABARD Annual Report 2016-17

The share of term loan in the total agricultural credit disbursed declined steadily from 30.2 per cent in 2008–09 to 22.1 per cent in 2012-13, followed by a reverse trend, with the share of term loan touching 35.1 per cent 2016–17(Chart 10). A steady increase in the share of agriculture term loan is imperative for increasing capital formation in agriculture, which in turn, could lead to the much needed increase in agricultural productivity. Therefore, banks need to think out-of-the-box by providing investment credit for agriculture and allied activities through value-chain financing to large farmers, corporates and FPOs.



Note: Figures for 2016-17 are provisional. Source: NABARD Annual Report 2016-17.

IV.7 Risk Mitigation

According to NSS 70th Round, a very small segment of cultivating agricultural households insured their crops against possible crop loss during the reference period (July 2012-June 2013) (GoI, 2016b). In respect of wheat and paddy, the two most harvested cereals in the country, less than 5 per cent of the cultivating agricultural households insured their crops. The lack of awareness about crop insurance was the most prominent reason quoted by the cultivating agricultural households for not insuring their crops. Further, among the agricultural households which had additionally insured their crops and experienced crop loss, a small percentage only received their claims.

The PMFBY is a path-breaking scheme which aims to provide insurance coverage and financial support to the farmers in the event of failure of any of the notified crops as a result of natural calamities, pests and diseases. It also aims at stabilising the income of farmers to ensure their continuance in farming. Further, it encourages farmers to adopt innovative and modern agricultural practices, to ensure flow of credit to the agricultural sector. The Union Budget 2017-18 announced that the coverage of this scheme will be increased from 30 per cent of cropped area in 2016-17 to 40 per cent in 2017-18 and 50 per cent in 2018-19. FPOs and Farmers Clubs/ Federations need to educate and sensitise small and marginal farmers about the importance of PMFBY in risk mitigation in agriculture, compensating for significant loss in income of farmers due to natural calamities.

The prices of agricultural commodities are generally at their lowest during the harvest season as the supply far exceeds the immediate, short term demand, and increase significantly during the lean season when the demand exceeds the supply. This adversely affects the farmers who realise lower prices of their produce in the harvest season. Futures markets provide a market mechanism to balance this imbalance of the supply-demand pattern of agricultural commodities. Trading in futures not only provides price signals to the market of today, but also of months ahead, and

affords guidance to sellers (farmers/ growers/ processors) and buyers (consumers) of agricultural commodities in planning ahead and, in financing and marketing commodities from one season to the another. While commodity exchanges in India were allowed only futures trading in commodities, the Securities and Exchange Board of India (SEBI) has recently laid out rules for the introduction of commodity options. The launch of options will boost overall market participation and also complement the existing futures and make the commodities market more robust and efficient. The combination of futures and options can give market participants the benefit of price discovery of futures and simpler risk management of options.

IV.8 Agricultural Land Leasing Laws

A major problem confronted by small and marginal farmers in India is the absence of proper secured land titles and predominance of tenant cultivators. Enacted in the 1950s or 1960s, tenancy laws in most states of India no longer adequately serve the interests of either landowners or tenants (NITI Aayog, 2017). There is, therefore, a strong case for legalisation and liberalisation of land leasing as it would help promote agricultural efficiency, equity, occupational diversification and rapid rural transformation. According to the Report of the Expert Committee on Land Leasing (NITI Aayog, 2016), legalisation of land leasing would ensure security of land ownership right for the land owners, which in turn would provide security of tenure to the tenants; help improve tenant farmers' access to credit, insurance and input use and consequently productivity of leased in land; better utilisation of the available land and labour, and increased farm output; and help improve agricultural efficiency.

The Committee has also prepared a model agricultural land-leasing act, which needs to be enacted by state legislatures. Legalisation of land leasing would encourage large land owners to lease out land without fear of losing their land ownership rights and invest in non-farm enterprises, which is vital for occupational diversification and rapid rural transformation. This will reduce the pressure of population on agriculture and enable small farmers to augment their size of operational holdings by leasing in land (NITI Aayog, 2016). Further, the enactments of land leasing laws could encourage FPOs to facilitate aggregation of land leased out to small and marginal farmers, thereby enabling increase in agricultural production and productivity, and processing and marketing of agricultural produce.

V. Conclusion

Enabling environment for agricultural sustainability could be created through massive investment in irrigation, with a focus on water-use efficiency, enhancement in total factor productivity of crops, adopting climate-smart agriculture, improvement in rural connectivity, creation of value chain infrastructure and development of efficient agri-value chains, market reforms, development of export market for agricultural produce, easy availability of credit (especially investment credit), risk mitigation through wider coverage and effective implementation of Pradhan Mantri Fasal Bima Yojana (PMFBY), and futures and options trading by FPOs in commodity markets. There also needs to be concerted efforts to encourage farmers to diversify to high value crops, allied

activities, food processing, and off-farm activities, through FPOs/ FPCs. Effective and efficient implementation of these transformative strategies, could lead to sustainability of Indian agriculture, and facilitate the achievement of Government of India's goal of "Doubling farmers' income by 2022".

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LONG RUN SUPPLY CHAIN AND PRICE FLUCTUATIONS IN INDIAN AGRICULTURE: ISSUE OF SUSTAINABILITY WITH REFERENCE TO INFORMATION AND COMMUNICATION TECHNOLOGY

SUJATRA BHATTACHARYYA¹

Abstract

Sustainability in agriculture rests on a number of factors. The major hurdles in the path of prosperity to the average Indian farmer includes the existence of a long supply chain in agriculture that reduces farmer's income making him subject to exploitation by the traders. Another major problem that farmers face is the effect of cobweb phenomenon which leads to demand and supply mismatch resulting in sudden drop in prices in times of a glut and sudden upswing in prices in times of scarcity. Both the problems that threaten sustainability of Indian agriculture can be tackled with the efficient deployment of ICT in agriculture. Our study suggests that effective use of ICT in agriculture can reduce price fluctuations to notable extent. With the installation of online trading portals the glut in one region can be reduced by catering to the excess demand conditions in some other region. In addition to that the online trading system, either through e-NAM or through the commodity exchanges gives the big buyers the opportunity to purchase agricultural commodities directly from the farmers or a group of farmers through aggregators. All these factors can effectively reduce the fluctuations in agricultural prices. Our study points to the potential benefit of the use of ICT in reducing price uncertainties that renders agriculture unfavourable for investors. Rejuvenation of price fluctuations and improvement of supply chain will reduce the riskiness of agricultural invest and can foster higher growth as well as improvement of productivity in the agricultural sector.

Keywords: Price fluctuations, Supply chain, Cobweb model, Information and communication technology, Agricultural marketing.

JEL Classifications: C32, D83, Q13, Q55

Sustainability of agriculture in the Indian context appears with multitudinous dimensions. Climatic conditions, soil quality, agricultural technique, farmer's income and the productivity of land and labour and many such other factors interact with each other to determine the long term growth of the agricultural sector in India. Among the myriad aspects of Indian agriculture that give shape to the overall concept of sustainability of agriculture, farm income and price of agricultural products are two very important factors that affect the other determinants such as productivity, investment and efficiency of agriculture that in turn determines the performance of this sector in the long run. The presence of long run supply chain and frequent price fluctuations affect the productivity and the firm income adversely.

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In this paper we focus on these two aspects of agriculture which are two important links in the path towards agricultural sustainability in India. In this context we will also assess the role of information and communication technology in reducing long supply chain and the incidence of price fluctuations to ensure the sustainability of Indian agriculture.

To discuss the problems of agricultural sustainability we divide the entire paper into few sections. Section I deals with the twin problems of Indian agriculture which tend to reduce the productivity and encourage price fluctuations. Section II reveals the problem of long supply chain in Indian agriculture and its associated maladies. Section III emphasises the role of information and communication technology in improving the value chain. Section IV discusses the Cobweb phenomenon and price fluctuations in Indian agriculture. Section V promotes ICT as the instrument to rejuvenate the incidence of price fluctuations through improved marketing strategy. Finally section VI represents the empirical analysis where we observe the effectiveness of ICT in reducing the price fluctuations in the agricultural market. Section VII provides conclusions.

I. Problems of Sustainability in Indian agriculture

The element that adds to the woes of the farming sector is the existence of a long supply chain in Indian agriculture that directly affects productivity as well as farm income. The long supply chain cannot assure a good price for the product that a farmer has produced with his investment and labour. There is a wide difference between the price paid by the consumer and the price received by the farmer in India. Even in the event of an excess demand that leads to high prices the farmer hardly gets any benefit of the price rise. Thus there is limited improvement in the living condition of the farmer who shies away from investing in his field both in terms of labour and capital.

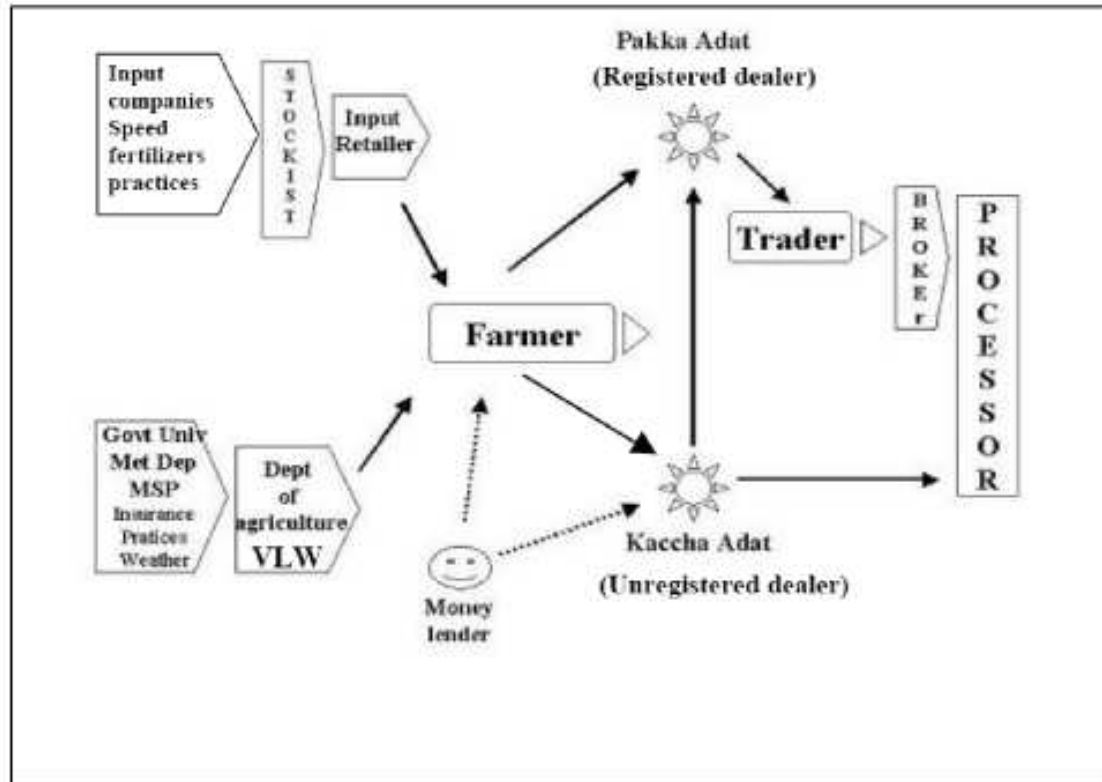
A major problem that the farming community faces in India is the fluctuation in the price. Price fluctuations lead to uncertainty in the income generated from production and sale of agricultural commodities. This uncertainty adds an element of insecurity to the farmers who tend to leave their farm activity and prefer to be engaged in odd jobs or work as manual labour in the urban centres. Studying the causes of price fluctuation we find that the 'cobweb phenomenon' in Indian agriculture is an essential feature that plays a dominant role in the waxing and waning of the prices of agricultural products. In the period of glut the price plunges to a rock bottom level turning a section of farm producers to destitution. In times of crop failure or lower production in general, the price shoots up making it difficult for the consumers to procure their necessary food items. This uncertainty not only affects farm income it also reduces the credit flow to agriculture as it makes investment in agriculture risky. Thus for long term growth of agriculture the price fluctuations brought about by the cobweb effect needs to be rejuvenated. This can be done by improved information inflow in the agricultural sector that gives prior estimates and projections of supply and demand and also allows forward contract in agriculture that may provide price support to the farmers and better deals to the buyers.

Better supply chain and reduced price volatility can increase productivity in Indian agriculture and improve the income of the farmers. The higher farm income will induce the farmers to adopt better cropping techniques and take measures to develop the land to retain and enhance its fertility. The improved supply chain can ensure good quality products being supplied on time to the final consumers and the agro-industries at a competitive price. The reduction in the difference between the price paid by the buyer and the price received by the seller will benefit both the buyer and the seller. In addition to that the efficiency of the supply chain will reduce the losses of farm produce while transporting and storing the products.

II. Long supply chain in Indian Agriculture

Agriculture in India has evolved over the years from traditional farming practices to more commercialised form of production. The nation has moved from an era of food crisis to a time of surplus cereals production. However our agricultural system is still not well developed as the productivity in agriculture is quite low compared to developed nations and other emerging nations. Around 51.7% of the labour force in India is engaged in agriculture and allied activities while the contribution is only 14% to the GDP. This implies low productivity both in terms of land and labour. This low productivity is the result of poor land development or population pressure on land, coupled with inefficient marketing of agricultural produce in India.

Due to a long supply chain and the existence of a number of intermediaries in between, there is a wide disparity between the price received by the farmers and the price paid by the final consumers. Matani (2007) accused poor supply chain for around 60% rise in agricultural prices in India. The inappropriate storage facility and logistics lead to the loss of and decay of the products in transit. The presence of a number of intermediaries results in price escalation as the middlemen at each level ensure their profit margin while transferring the produce to the next level. The farmer or producer, being at the bottom of the value chain receives the minimum price and margin for his produce. In addition to this the intermediaries are reluctant to encourage information flowing down to the farmer as it may act contrary to their rent seeking motives (Bowonder, Gupta, & Singh, 2003). The schematic diagram of a conventional value chain as depicted in figure 1 shows the existence of a number of intermediaries and how the farmer is entrapped between high input costs and low market prices with no bargaining power either in the input or the output markets.

Figure 1

Source: Bowonder, B., Gupta, V., & Singh, A. (2003)

The introduction of Information and communication technology (ICT) has the potential to reduce the impact of the long value chain in Indian agriculture. Information technology (IT) refers to the digital processing, storage and communication of information of all kinds. ICT can be used potentially in every sectors of the economy as it efficiently reduces the cost of information. ICT plays a major role in the service sector especially in the developing nations like India. However the intervention of ICT not only facilitates the service sector but also assists agricultural development. Sinha (2013) observed that the application of ICT in rural sector aims at agricultural growth, rural employment generation, enhanced productivity and happy livelihood along with entrepreneurship development. ICT-enabled agriculture has the potential to implement a framework for agricultural development strategies, investments and programmes (Kumar, 2005). Here our focus will be on the contribution of ICT in reducing the price fluctuations in the agricultural market and also in removing the problems associated with the long value chain.

Thus the ICT-enabled agriculture is expected to initiate improvements in agricultural competitiveness and also the management of technical information. The transparency in the ICT-mediated implement mechanism in the agricultural sector can ensure comprehensive agricultural development.

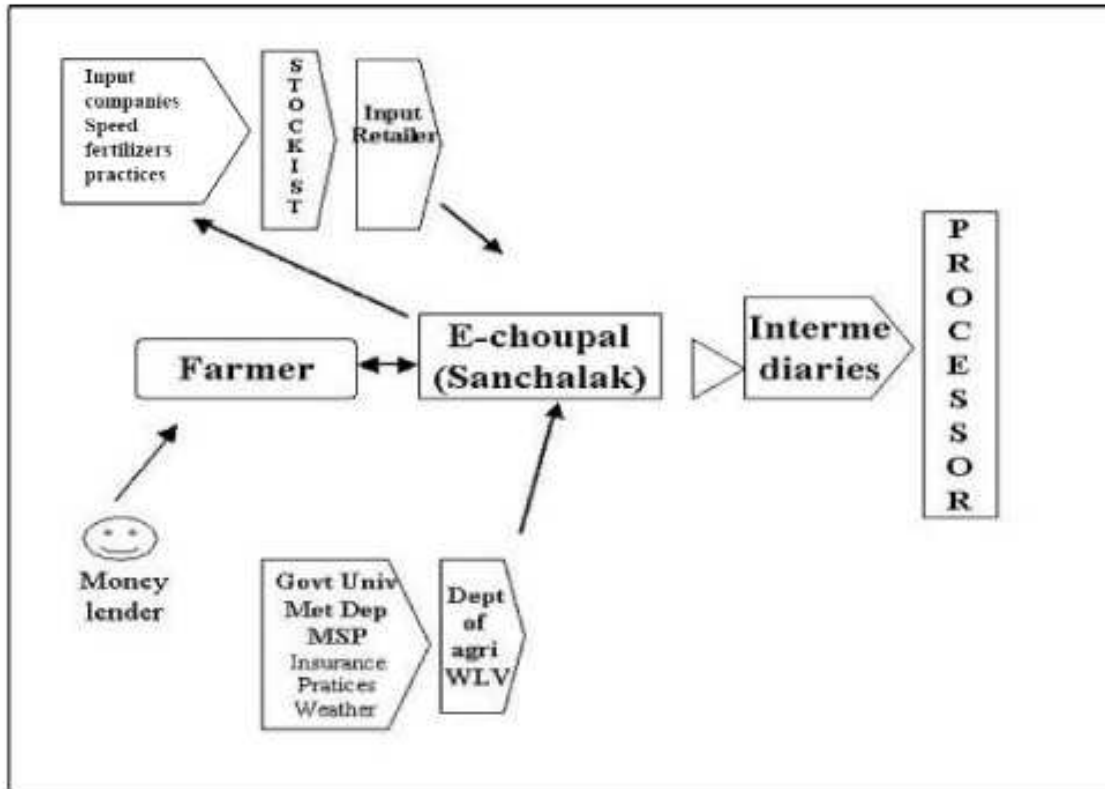
III. ICT and agricultural transformation in terms improving the long value chain

The advent of information and communication technology (ICT) provides solution to a number of problems that infects rural India especially rural livelihood attached to agriculture. The long value chain in Indian agriculture and its associated maladies can be addressed efficiently through the ICT-initiated e-choupal portal, launched at the beginning of the twenty-first century in some rural areas of the nation.

A choupal refers to a village market place where the farmers can sell their produce to the traders. An e-choupal is a virtual market place for the where they can directly sell to the probable buyers by making online contracts. The farmer here can avoid the trap of the monopsonistic local trader and intermediaries. With the farmers striking online contracts with the buyer, the farmers get a fair price for their produce and the buyers can purchase at a price which is not too far from the production cost.

The introduction of retail chains like ITC and Spencers' into e-choupal hub makes the value chain more efficient. The retailer provides the support in terms of input and investment. In this situation the farmer can take loans and purchase farm inputs through formal channels which are not exploitative.

An e-choupal allows faster, comprehensive and qualitative information inflow to the farmers. Through it, the farmers are made aware of various government policies and benefits provided to them along with information about improved farm inputs. Most importantly they can now have information on the prices of both inputs and outputs. Let us look at the value chain in the e-choupal system as shown in figure 2. We will find that the e-choupal acts as a common platform that allows the farmer to negotiate with the input sellers as well as the buyers of his produce. The ICT installations can help in providing latest information on weather forecasts, improved farm techniques as well as efficient inputs which lead to escalation in the agricultural productivity.

Figure 2

Source: Bowonder, B., Gupta, V., & Singh, A.(2003).

In this context we would like to emphasize on the importance of the retail chain in improving both the value chain and productivity of Indian agriculture leading to higher farm income as well as lower price for the ultimate consumers. The retail sector contributes 10% to the GDP in India providing employment to around 7% of Indian labour force. Of the total retail output food retailing comprises more than 60% (Singh, Badal, Kushwaha, Singh, Singh, & Sen, 2008). So, the interface between agriculture and retail chain becomes all the more important in the context of the overall development of the economy.

Another factor that can complement the e-choupal in improving agricultural marketing is commodity trading that has now included a large number of agricultural products like cereals and oilseeds. The ICT-enabled trading portal helps in determining spot process as well as futures trading. It ensures the farmer a fixed price of the produce. In case of a bumper crop the farmer runs the risk of huge losses due to fall in prices. But a futures contract provides assurance in terms of the contracted price. This process also reduces the necessity of government intervention in terms of minimum support prices, subsidies and such others. Both the e-choupal and commodity trading establishes a direct interaction between buyers and sellers that can improve market efficiency so that prices can reflect both demand and availability of the product. In the long term

supplies can be more demand oriented and reduce both surpluses and as well as scarcities that can lead to excessive rise in the prices. A market oriented price mechanism reduces distortion and makes government policies more targeted to the weaker and deprived sections of the rural economy.

IV. Cobweb phenomenon and price fluctuations in Indian Agriculture

Another burning problem of Indian agricultural sector is the presence of Cobweb phenomenon. This model is very much applicable to a situation when there is a significant time lag between demand and supply decisions. Thus Cobweb model has relevance in the agricultural market where we clearly observe a distinct time lag between planting and harvesting. When the price of an agricultural product fluctuates abnormally the concerned farmers spontaneously react by adjusting planting structure in the coming period. Thus the current production of an agricultural produce will be determined by the price of the product in the previous period. If in a particular year the farmers of a particular region turned up with abnormally small volume of a particular crop, say due to unfavourable weather, the shortage will lead to a leftward or upward shift of the relevant supply curve. This will result an escalation of price due to excess demand. The cobweb phenomenon begins if the farmers expect this escalated price to be prevalent in the future. In that case the farmers make valiant efforts to raise the volume of the product by investing high and opting for huge agricultural credit. Unfortunately the tremendous increase in the supply of the product is responsible for drastic reduction in the price. Most of the farmers are not able to cover the cost of production and hence unable to repay the loans taken for greater production. They have no option other than committing suicide in some cases.

Thus the problem of plenty or abundance ruins the farmers of India and reflect the cobweb phenomenon in Indian agricultural market. Since the economic reforms and policies of opening up beginning in the early nineties, India's agricultural prices have experienced a trend of frequent fluctuations. The price fluctuations have a considerably adverse impact on the production of food grains in the country and hence are not at all conducive to the growth of agricultural economy of India. A rise in the prices of food grains leads to the rise in the prices of other commodities, generating inflation in the economy. Thus price fluctuations ruin the economic stability also.

The price fluctuation of agricultural products is one of the main threats for the sustainability of Indian agriculture. These fluctuations not only affect the consumers but also the farmers. The fluctuation is hugely uncertain and hence the poor farmers do not have the adequate investment capital to sustain this unpredictability. So naturally the farmers ended up with suboptimal investment decisions and in most of the times their long term productions are compromised. In the developing nations like India, the benefits of higher prices of food grains are not transmitted into the farmers as the non-food essentials like transport, cooking fuel, fertilisers, other inputs, rent etc become expensive at the same time. Thus the increased input prices prevent the producers (here farmers) to reap the benefits of price fluctuations.

The Cobweb phenomenon in the Indian agricultural sector is one of the prime reasons for the price fluctuations. However the developing nations like India are experiencing price fluctuations for various reasons. Huka, Ruoja, and Mchopa (2014) mentioned the change of climatic conditions as one of the important contributors of the fluctuations in the agricultural prices. Annual weather differences often cause fluctuations in the production and prices. They also pointed out seasonal production as a causative factor. Prices rise at the time of scarcity and falls in the bumper time. Thus price fluctuation is based on the market fundamentals.

Government regulations and policies are also to be considered as the contributing factor for fluctuations in the price of the agricultural product. The farmers are provided with subsidy and at the same time importation and the exportation of the products are also allowed. These steps are not at all helping the farmers and hence cause price fluctuations. Moreover, the poor infrastructure is also responsible for the variations in price of the agricultural product. The conditions of roads in different seasons also create disturbances in the prices of the agricultural products due to variations in the transportation costs. The fluctuation of currency exchange rates often leads to the escalated price of fuels. This causes the cost of transportation to escalate when the farm products are being transported into the markets for sale.

In India, one of the main reasons for the price fluctuations of the agricultural product is the lack of appropriate storage facility and low production. The technical knowledge of the small farmers is still very poor. The storage facility is still not improved; thus surplus production is of no use in most of the cases. Apart from this, the perishable nature of the agricultural product has the capability to generate price fluctuations in the market. Due to its perishable nature, a particular agricultural product can not be stored and often it has to be sold at a lower price in the current period even if it has a high potential to be sold at a high price in the near future (Huka et al. 2014).

The market fundamentals lead to huge setback for the Indian farmers where Cobweb phenomenon is very much prominent. The agricultural sector experiences the same old story of the sufferings of the farmers due to the abundance of crops. In recent times, the price of tomatoes slashed from Rs 10000 per quintal to Rs 2500 per quintal in Kolar due to very good yield of the said crop. The farmers are complaining about the poor remuneration for their production relative to that in the previous year. However the agricultural economists pointed out “Cobweb phenomenon” as the reasons for the glut.

This pathetic experience of price crash due to crop abundance continues in Andhra Pradesh and Telengana this year when excessive production of red chilli ruins the fate of the farmers. The price of red chilli recorded Rs 13000 per quintal in 2016 which inspired the concerned farmers to produce more in the current year. The expectations of the farmers for good prices even in this year were not at all fulfilled. However the government has announced a market intervention plan to procure 33700 tonnes out of 7 lakh tonnes produced in Telengana with a support price of Rs 5000 per quintal along with another Rs 1250 per quintal for the other expenses (The Hindu, 2017).

The situation is even adverse in Maharashtra where the problem of plenty claimed at least two lives this year. The crash in the prices of grapes due to the robust growth is beyond the expectations of the farmers. The demand for the product is not up to the mark and the stock of the wine manufacturers is full to the brim. The sellers are bound to sell the grapes per acre at Rs 2 lakhs where as the input cost per acre is at least Rs 3 lakhs. At this time previous year 95% of the harvest was plucked by the wholesalers and the price was hovering near Rs 40-42 per kg. This year the price declined to Rs 8-10 per kg and still majority of the products are unsold.

The sharp increase in the price of tur dal in 2015-16 in Maharashtra inspired the farmers to expand this year and as a result production of tur dal has increased from 4.4 lakh tonnes to 20.35 lakh tonnes in 2016-17. This significant rise in the volume of production brought down the price by a huge margin. The price of tur dal has been reduced from Rs 220 per kg to Rs 45-50 per kg. The government intervention with the announcement of minimum support price (MSP) of Rs 5050 per quintal has taken care of the 4 lakh tonnes. Another 5 lakh tonnes were sold at a lesser price than MSP with the assistance of Agricultural produce Marketing Committee (APMC). Unfortunately, more than fifty percent of the total produce remained unsold.

This observed impact of price fluctuations on the small farmers' development in India calls for focusing on the ways of improvement of agricultural investment in order to sustain both the farmers' development and India's agricultural development. The problem of lack of demand emerging from overproduction is purely regional. The demand for the same product is high in some other part of the country. The connectivity of these regions can be very helpful for the development of the farmers as well as the economy. It can be felt that the improved agricultural marketing strategy can be useful in reducing the incidence of undulating prices of agricultural products in different regions of the country. In recent times we are analysing the role of information and communication technology (ICT) in developing an interconnected network throughout the nation so that all relevant information can be transmitted everywhere. ICT not only improves the storage facilities but also bring revolutionary change in the marketing of the agricultural produce in India. We will discuss this issue in the next section.

V.Role of ICT in rejuvenating agricultural price fluctuations

Immediately after the adoption of economic reform measures in 1991, the growth rate of agricultural output was markedly low relative to the growth of non-farm output due to the presence of fragmented and inefficient market dominated by low scale and multiple middlemen. However the introduction of Agricultural Product marketing (Regulation) Act (APMRA) brought radical changes in all the aspects of marketing of the agricultural produce (Acharyya 2004) which attributed hugely to the occurrence of green revolution. Unfortunately these benefits generated from APMRA were diluted due to incompatibility between volume of market arrivals and market infrastructure. The introduction of economic reforms in the early nineties put a challenge in front of Indian agricultural sector as the sector was exposed to international competition.

The changing macro environment indulged the government to bring a series of reform measures in the agricultural sector including removal of licensing requirements on specific foodstuffs order in 2002 and 2003. The permit or license was no longer required for trading, storage and movement of certain crops like paddy, wheat sugar, and edible oils etc. However these reform measures did not focus on the improvement of agricultural marketing strategy. An expert committee was constituted in 2000 by the ministry of agriculture to review the system of agricultural marketing. In 2003, GOI set up a committee under the chairmanship of K.M.Sahni to formulate a law on agricultural marketing in consultation with the states. Accordingly State Agricultural Produce marketing (Development and regulation) Act 2003 was passed and shared with all states for implementation. The states were requested to amend the APMC Act. The central government promised to provide some investment subsidy on market infrastructure development projects. Although majority of the states reported that they have adopted the key areas of reforms as suggested in the model, however except in the states like Karnataka, the reforms were diluted with due course of time.

Karnataka, apart from implementing Model APMC Act, also adopted serious initiatives to apply ICT to improve agricultural marketing and competitiveness. The state in 2012-13, planned spot exchange for automation of auction process in mandis, with the assistance of National Commodity and Derivatives Exchange (NCDEX). The plan focused on transparent integrated e-trading mechanism to restrict the price fluctuations in the agricultural market. The objective was to integrate all APMCs to ensure remunerative prices for the farmers. A unified market platform was constituted where all mandis in the state were involved in single trading. The unified online agricultural market initiative which was launched in 2014, was brought under Unified Market Plan (UMP) in 2016. Every farmer associated with APMC market is provided with an identification number for the lot bought in the mandi. Buyers and traders require unified market license and they are also given username and password after the payment of nominal registration fees. The traders or buyers can bid for the product online and after the end of the auction period the bids are flashed in the screen put up in the mandis. Then only the producer or seller will be required to accept or reject the bid. If the seller rejects the bid, a second round of bidding will occur on the same day. It is interesting to note that, traders from other states and big institutional buyers like ITC, Reliance, Metro Cash and Carry can also participate in the UMP after registering with the appropriate authority. This method of marketing reduces the possibilities of artificial price fluctuations by creating a competitive, transparent and efficient environment.

The overwhelming response and success of UMP in Karnataka inspired many other states like Maharashtra, Telengana, Gujarat etc to adopt the Karnataka model of ICT-mediated agricultural marketing. The Cabinet Committee on Economic Affairs introduced a scheme in 2015 to set up a common e-platform in selected wholesale regulated agricultural markets throughout the nation. The states were provided with free software and Rs 30 lakhs per mandi for setting up hardware infrastructure to extend the Karnataka model at the national level. In accordance with this view, GOI launched electronic trading platform for National Agriculture Market (e-NAM) on 14th

April, 2016 which covered 21 mandis from 8 states and 25 crops comprising wheat, pulses, potatoes, onions, etc. 585 wholesale regulated markets are targeted to be brought under the scheme within 2018. The states have to ensure a single licence to be valid across the state, single point levy of market fee, and provision of electronic auction mode for price discovery, in order to integrate with e-platform (Chand, 2016).

The introduction of ICT-mediated e-NAM is expected to take Indian agricultural marketing system to a higher level. The same old story of price fluctuations can be greatly removed with this price discovery system. The e-NAM is capable of eliminating the market imperfections and ensuring competitiveness, transparency and competence in agricultural marketing in India. The incidence of traders' cartel and price rigging can be drastically reduced with successful implementation of the project. Moreover with this strategy, the producers have the option of better price realisation which can act as a catalyst for improving productivity. Conversely the consumers also have the advantage to reap the benefits of lower price spread.

There are still some issues which are not included in e-NAM. The system does not allow direct sale by farmers to the buyers. The marketing committee still has the monopoly power. The market fees across different states are not yet rationalised. However the benefit to the greatest extent can be reaped when a single trading licence will be valid across the nation and a producer/farmer can sell his product in any market. This will definitely reduce the possibilities of price fluctuations even in the situation of surplus production. Thus ICT-mediated agricultural marketing strategy has the capacity to combat the incidence of price fluctuations. This will improve the possibilities of the sustainability of Indian agriculture.

Apart from this, food processing industries can provide an avenue for rejuvenating both the seasonal and random fluctuations of agricultural prices in India. In addition to that it reduces wastage when there is a bumper crop as it aids in increasing the shelf life of agricultural products. It offers a remunerative price to the farmers at the same time making the products affordable to the consumers.

The Vision 2020 document lays down the objective "to harness science to ensure comprehensive and sustained physical, economic and ecological access to food and livelihood security to all Indians, through generation, assessment, refinement and adoption of appropriate technologies". The document stresses the importance of food processing segment in India as an important vehicle for post production management in agriculture. It aims at reducing post production losses of perishable items by 50%. It emphasizes on value addition to the products. Promotion of byproducts utilization is another important aspect envisaged by the document as a potential for the FPI-agriculture interface. Finally it aims at providing support to the export oriented agriculture. The whole process is not only going to improve agricultural productivity but also improve farmers income by ensuring market determined prices and a price support in times of bumper crop by way of forward contracts. It also provides outlet for the excess production by allowing access to the international market. In all of these cases ICT plays a major role as it helps to establish a

future contract with a predetermined price between the producer and the industry (ICAR, 1999). Thus price fluctuations can not affect the farmer adversely.

VI. Price fluctuations and ICT: An empirical Analysis

A model can be formed in order to assess the impact of ICT on the rate of change of price i.e. the price fluctuations. Thus we take per capita ICT as the explanatory variable where as the rate of change in the price is considered to be the dependent variable. Here we assume agricultural production as the co-variate. The review period is 2005-2016.

Data source and methodology

We have obtained the data of domestic ICT from the Annual Report, Ministry of Information technology (2005-06—2016-17) at 2004-05 prices. We obtained the mid-year population figures for each year of the review period, from the CMIE National Income Statistics. Thus per capita domestic ICT revenue can be determined by dividing total domestic ICT revenue by population for the period 2005-06—2015-16. The data of agricultural production (2005-06—2011-12) is obtained from raitamitra.kar.nic.in/stat/24/.htm, Annual report, Ministry of agriculture (2012-13—2014-15), and Hindustan Times (2015-16—2016-17). The agricultural price index during the period (2005-06—2016-17) is obtained from indiabudget.nic.in/Web%20Excel%20Version/Tab54.xls.

The Model

$$p = \alpha + \beta_1 agri - production_i + \beta_2 pc - ict - dom_i + \varepsilon_i$$

Where –

P= rate of growth of price change/ price fluctuations

agri-production= Agricultural production

pc-ict-dom= per capita domestic ICT

Regression Result

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	-36.63602537	14.65649487	-2.499644403	0.036963
Agri_production	0.000222314	6.98899E-05	3.18091374	0.01298
pc_ict_dom	-0.06462653	0.015964402	-4.048164667	0.003694
Regression Statistics				
Multiple R	0.821064053			
R Square	0.67414618			
Adjusted R Square	0.592682725			
Standard Error	2.230289748			
Observations	11			

We can see that ICT has a significant negative impact on price fluctuations. This implies that increase use of ICT technology will lead to rejuvenation of agricultural price fluctuations. Agricultural production has a positive influence on price fluctuations. And the influence is statistically significant. But the coefficient is quite small indicating that the impact on fluctuations is not a considerable one. The impact of ICT is higher than the impact of agricultural production. Since the usage of ICT in agriculture encompasses only very small part of agricultural community its impact is not very high. It is evident that with a greater use of ICT in agriculture the price rejuvenation process will gain strength reducing the imminent volatility in price and income in the agricultural sector.

VII. Conclusion

Sustainability in agriculture rests on a number of factors. In the context of Indian agricultural scenario we find that climatic conditions play a major role in determining agricultural production. We find cases of farmer suicides and ensuing agitations even when there is a good harvest. This scenario points to the fact that sustainability does not solely depend on the quantum of agricultural production. When we talk about sustainability this sustenance should more importantly refer to the farming community whose well being can decide the fate of Indian agriculture in the long run. If the farmers are constantly at a distress, the agricultural sector cannot expect to look forward to long term increase in productivity with higher investment and growth. The major hurdles in the path of prosperity include the existence of a long supply chain in agriculture that reduces farmer's income making him subject to exploitation by the traders. Another major problem that farmers face is the effect of cobweb phenomenon which increases the uncertainty attached to agricultural production in India and further reduces the credit worthiness of the sector in general. This sort of problem which threatens the sustainability of Indian agriculture can be tackled with the efficient deployment of ICT in agriculture.

Our paper focuses on the twin issues of supply chain and cobweb phenomenon which is responsible for price fluctuations in agriculture. Our study suggests that effective use of ICT in agriculture can reduce price fluctuations to notable extent. Greater information interchange can put a check on the effects of cobweb phenomenon playing in the agricultural sector. With the installation of online trading portals the glut in one region can be reduced by catering to the excess demand conditions in some other region. In addition to that the online trading system, either through e-NAM or through the commodity exchanges gives the big buyers the opportunity to purchase agricultural commodities directly from the farmers or a group of farmers through aggregators. All these factors can effectively reduce the fluctuations in agricultural prices.

The empirical study presented in this paper suggests that the use of ICT has a significant impact on price fluctuations. Our study points to the potential benefit of the use of ICT in reducing price uncertainties that renders agriculture unfavourable for investors. Rejuvenation of price fluctuations will reduce the riskiness of agricultural invest and can foster higher growth as well as improvement of productivity in the agricultural sector. Improving the supply chain will increase farm income and also reduce the uncertainty attached to farmer's earning. Thus use of ICT can

ensure sustainability of agriculture by reducing price fluctuation and investment risks and improving farm income and agricultural productivity.

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GROWTH OF CASH CROPS AND ITS DETERMINANTS IN INDIAN AGRICULTURE: EVIDENCE FROM STRUCTURAL BREAK ANALYSIS

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ARPITAGHOSE**

Abstract

While the existing studies relating to growth performance in agricultural sector are relied on conventional econometric analysis of curve fitting; attempt to establish a structural break by performing the test for statistically significant difference in parameters across two periods, the present study applies recent rigorous estimation and testing of structural breaks procedure of time series econometrics to measure the growth performance of cash crops production in India using Sen (2003) approach involving estimation of equation having break in the growth as well as slope coefficient ; for the period 1970-71 to 2013-14; and also explains its determinants. The break points are not determined by the prior belief of the researchers, rather it is determined endogenously within the system. The results show that growth of output series for all the states and crops are Trend stationary implying the underlying series converges to a trend. Depending on the estimated coefficients, the states are classified into Good performer (Group-A), Moderate Performer (Group-B) and Bad performer (Group-C). Good performing states are those for which overall trend is positive and statistically significant and there has been a significant increase in both level and growth in the series after break. Moderate performers are those states for which either I) overall trend is positive and significant but the performance of the states after break either with respect to level or with respect to growth rate is not so satisfactory or; (II) overall trend is negative and Significant but the performance of the state after break with respect to both level and growth or either level or growth is satisfactory. Bad performing states are those for which performance of the states with respect to all three overall trends, break in level and break in growth rate is bad. The results show that (a) none of the states are good performer for all crops, (b) the performance is moderate for the following states (i) AP, GU, HA, KA, PU and RA in case of cotton; (ii) AP, GU, MP and TN for groundnut; (iii) HA, MP, RA, UP and WB in case of rapeseed/mustard oil (c) the performance is bad, for the following states (i) MP and MA in case of cotton; (ii) KA for groundnut; (iii) AS and GU in case of rapeseed/mustard oil. The determinant analysis suggests existence of a simultaneous kind of relationship between growth of output and growth of HYV uses and the variation of the major determinants of growth from crop to crop. The explanatory variables like government or private irrigation, government expenditure on agricultural research and extension, rural literacy and agricultural loan get greater importance in the

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policy suggestion because these variables affect the growth of HYV uses which in turn push up the growth of output.

Key Words: Indian Agriculture; Cash Crops; Regional Variation; Unit Root; Structural Breaks; Panel regression.

JEL CLASSIFICATION CODES : C 33,O13,Q12, R 11.

I. Introduction

Agriculture as the backbone of Indian Economy involves 65% of Indian population and it contributes for around 22% of GDP. The Indian agriculture has made great achievements over the years. The food grains production has increased more than fourfold - from 51 million tonnes in 1950-51 to 212 million tonnes during 2003-04 and 257 million tons during 2012-13 growing at an annual average rate of more than 2.4 % per annum. However, the recent trends in performance of Indian agriculture are not satisfactory one. During the 1990s, there has been a deceleration in production as well as the growth rate of all the principal crops.

The measurement of growth of agriculture production involves a number of issues like the choice of period, the selection of cut-off points for different sub-periods, estimation of growth parameters and proper interpretation of results. These points have been taken up in a number of studies made earlier (Sen, 1967; Narain, 1977; Rudra, 1982; Reddy, 1978; Das, 1978; Srinivasan, 1979; Vidyyanathan, 1980; Dandekar, 1980; Ray, 1983; Sawant, 1983; Dev, 1887; Boyce, 1987; Saha and Swaminathan, 1994; Sawant and Achuthan, 1995; Bhalla and Singh, 1997, etc.). The earlier studies on growth of agricultural output-expect one or two are based on the traditional time series analysis, i.e., to find a trend equation and then compare the trend between two period. However, the literature on the modern econometric time series analysis suggests that the growth process must be determined by the statistical properties of the series, and the break point of the series must be endogenously determined. Mukhopadhyay and Sarkar (2001) used structural break of modern time series specification technique to test for acceleration in food grains production in West Bengal. They also found that the underlying series is a Different Stationary (DS) series with drift implying that one cannot claim for the existence of a deterministic trend in the level of food grains production. However, their analysis is based on over all West Bengal economy. But West Bengal's agricultural production shows a great variability due to variability in land capacity, climate, fertilizer uses, irrigated area etc., from district to district. As a result one may not get a uniform growth rate for all the districts. Ghose and Pal (2007) measure inter-district disparity in growth of food grains production in West Bengal by applying both the exogenous and endogenous structural break analysis to test for acceleration in food grains production. Sengupta, Ghosh and Pal (2009) considered the interstate variation of food grains, non food grains and total agricultural production by considering exogenous structural break due to Perron and endogenous structural break due to Zivot and Andrews. Pal and Ghose(2012) made cropwise analysis taking into account all India data for the crops like **Food Crops:** Rice, Wheat, Maize (Corn), Jowar(Sorghum), Gram, Bajra(Peari Millets); **Cash Crops:** Cotton, Groundnuts, Jute, Rapeseed/Mustard Oil, Sugarcane, Tobacco.

The limitation of the above studies is that all have employed the method of detecting structural break. But they are not analyzed whether growth performance of these crops are satisfactory or not. Further they are not employed determinant analysis to find out the major determinants of growth.

Thus the major objective of this study is to check first of all to check whether the series of output of major selected cash crops / non food crops and states converges to a path having trend preserving properties or not in the presence of one time structural break by Sen (2003) approach. Secondly, depending on the estimated results of Sen (2003) about the growth performance of output of major selected cash crops / non food crops and states, the major selected crops and states will be classified into different groups and intercrops and interstate comparison is made. Finally, after determining the growth rate, break points etc. it is important to identify the reasons behind the variation in growth of output.

The major selected cash crops and states are as follows:

Cash crops or Non Food Crops: Cotton, Groundnuts, Rapeseed/Mustard Oil.

Again for each of the crop we will consider the major states producing these crops.

- ü Cotton- Andhra Pradesh (AP), Gujarat (GU), Haryana (HA), Karnataka (KA), Madhya Pradesh (MP), Maharashtra (MA), Punjab (PU), Rajasthan (RA).
- ü Groundnuts- Andhra Pradesh (AP), Gujarat (GU), Karnataka (KA), Madhya Pradesh (MP), Tamil Nadu (TN).
- ü Rapeseed/Mustard Oil- Assam (AS), Gujarat (GU), Haryana (HA), Madhya Pradesh (MP), Rajasthan (RA), Uttar Pradesh (UP), West Bengal (WB).

The study period is from 1970-71 to 2013-14

The structure of the present paper is as follows: Section II describes the methodology of studying the growth performance of the major selected variables using Sen (2003) approach of endogenous structural break and the methodology of comparison of different crops and states on the basis of their performance. Section III discusses the results of estimation. Some concluding remarks are made in Section IV.

II. Methodology and Data Source

II.1 Methodology for Testing the Unit Root under the Presence of Structural Break using Sen (2003) approach of endogenous structural break

Perron (1989) in his path breaking work showed that the standard unit root test is not consistent against TSP in the presence of structural break and has suggested a procedure for testing unit root in presence of one time structural break in the series. The structural break is assumed to be exogenously determined from consideration of visual examination of the plots of the data. Zivot

and Andrews (1992) criticized Perron's procedure for finding out the break point, as it was based primarily on visual inspection of data and further argued that the break point should be endogenously determined (rather than exogenously determined, Perron (1989)) and can be evaluated by applying OLS considering models as follows:

$$\textbf{Model A: } Y_t = a^A + b^A DU_t + c^A t + d^A Y_{t-1} + \sum_{j=1}^k \delta_j Y_{t-j} + e_t \quad (3.1)$$

$$\textbf{Model B: } Y_t = a^B + g^B DT_t + c^B t + d^B Y_{t-1} + \sum_{j=1}^k \delta_j Y_{t-j} + e_t \quad (3.2)$$

$$\textbf{Model C: } Y_t = a^C + b^C DU_t + c^C t + g^C DT_t + d^C Y_{t-1} + \sum_{j=1}^k \delta_j Y_{t-j} + e_t \quad (3.3)$$

e_t is the error term in the model and is assumed to be independently and identically distributed random variable with zero mean and constant variance i.e. $e_t \sim \text{iid}(0, \sigma^2)$.

Here **Model A** permits an endogenous break in the level of the series, **Model B** allows an endogenous break in the rate of growth & **Model C** permits an endogenous break both in the level as well as rate of growth.

The dummy variables of the three models can be defined as under:

$$\begin{aligned} DU_t &= 1 & \text{if } t > T\tilde{e} \\ &= 0 & \text{otherwise} \\ DT_t &= t - T\tilde{e} & \text{if } t > T\tilde{e} \\ &= 0 & \text{otherwise} \end{aligned}$$

Here T stands for total time period and T_b is the break point.

Then, $\tilde{e} = T_b/T$ is the break fraction and ranges from $2/T$ to $T-1/T$.

According to Zivot and Andrews (1992), out of the $(T-2)$ regressions, that year is chosen as break year which gives the minimum value of 't' statistics corresponding to the coefficient of Y_{t-1} . In addition to it, that model is chosen as the best fitted one which gives the minimum 't' value of the coefficient of Y_{t-1} . After finding out the best fitted model and the break point, to test for the hypothesis $d^i = 1$, $i = A, B$ and C i.e. coefficient of Y_{t-1} is equal to one and to compare it with the critical values given by Zivot and Andrews (1992) to determine the nature of the series (TSP or DSP).

Sen (2003) criticized the Zivot and Andrews (1992) conventional Unit Root procedure and argued that it may suffer from power distortion. Three types of characterizations are there in Zivot and Andrews (1992) namely Crash Model, Changing Growth Model and Mixed Model of the form of break under the alternative of TSP. For all the three characterizations of the alternative, minimum t-statistics are used to test for a Unit Root, when the location of break is unknown (assuming endogenous structural break). Sen (2003) argued that since the form of break is treated as unknown, the appropriate alternative should be the Mixed Model. When the form of break is wrongly specified, there are serious implications for the power of the minimum t-statistics. Simulation suggests that Crash Model (Changing Growth Model) minimum t-statistics fail to reject the Unit Root null hypothesis, provided that the break occurs according to the Changing Growth Model (Crash Model). Some loss of power is also found for Mixed Model minimum t-statistics, when the break occurs following the Crash Model or Changing Growth Model. Thus Sen (2003) applied his test on the Mixed Model which simultaneously allows for a break in the level as well as rate of growth and test for the existence of endogenous structural break (expression for Model C-equation (3.3)). The test statistic used by Sen (2003) is SupWaldstatistic, originally put forth by Murray (1998) and Murray and Zivot (1998). It actually gives the joint null hypothesis of a Unit Root with no break in the intercept and the slope of the trend function. To calculate the maximum F-statistic for the null hypothesis, Sen (2003) applied the F-statistic in accordance with

Here τ is the break point which is a constant fraction of the sample size T i.e. $\tau = \lfloor T\lambda \rfloor$ with the current break fraction λ and the smallest integer function.

Thus Sen (2003) suggested the Mixed Model (Model C) having higher power than either Model A or Model B and also the F-statistic for testing the Unit Root hypothesis being more powerful than the traditional t-statistic and the power of F-statistic is more or less consistent. After getting the maximum F-statistic amongst the alternative regression equations, the estimated F-statistic () is compared with the asymptotic critical values of $F_{\alpha, k, T-k}$ given by Sen¹. Finally by analyzing the nature of series, conclusion can be drawn whether the series follows TSP or DSP.

While estimating equation 3.3 (Model-C) logarithms of the dependent variables are taken as regressands and thus γ i.e. the coefficient of time (in Model C) represents growth rate. The growth rates obtained can provide a performance report of different crops and different states over the sample period 1970-71 to 2013-14 with respect to the growth of output and thus helps to identify the better and the worse performing states. Now from the model C, one can get the statistical significance of DU_t (Post Break Dummy in the Level), DT_t (Post Break Dummy in the Growth) and t (Overall Trend in the series). Now **Positive/negative DU_t (Sig)** implies increase/decrease in the level of the series at the break point. **Positive/negative DT_t (Sig)** implies change (increase/decrease) in growth rate after the break point and **Positive/negative t (Sig)** implies Deterministic Trend (Positive/negative) for the entire sample period. Now on the basis of the sign and the statistical significance of DU_t , DT_t and t the performance of different crops across the states can be classified into three categories, i.e., **Good Performer, Moderate Performer**

and **Bad Performer**. The criterion of the Good Performer, Moderate Performer and Bad Performer crops are given in Table 1.

II.2. The methodology of simultaneous panel method for finding out the major determinants of growth of output

Indian states have its individuality that influences the growth and performance of different cash crops in several counts. Thus the growth and performance of different cash crops in different states do not always move in the same path. A second-stage regression analysis of growth of output of different cash crops can help to identify factors that enhance or hinder it. This, in its turn, becomes helpful for policy formulation for improving growth of output of different cash crops. In this second-stage regression, states with no unit root are only considered. As we have considered different major producing states under each crop so for analyzing the determinant of growth rate we need to construct a panel model for each of the crop. Further, while considering the determinant for growth it is found that there exist some explanatory variables which in turn depends on the dependent variable, i.e. growth of output. For example in the present case one of the explanatory variable taken for growth of output is the growth of HYV uses which in turn depends on the growth of output. Thus in order to explain the growth of output, one need to formulate a simultaneous equation kind of frame work in the panel setup showing two way dependency between the dependent variable and the explanatory variable. So, to get a comprehensive picture about the possible determinants influencing growth of output of different cash crops a simultaneous panel regression analysis has been used in order to find out major determinants of growth for the period 1970-71 to 2013-14. The parameters are thus estimated by considering a panel model under a seemingly unrelated regression (SUR) framework where each regression was adjusted for contemporaneous correlation (across units) and cross section heteroscedasticity is adjusted. While estimating the present panel model the chapter test whether fixed effect model is a better fitted model over the random effect model using Hausman test. For regression purpose this chapter considers both the dependent variable and explanatory variables in growth terms.

Equation Specifying Growth of Output:

In this paper growth of HYV uses, Government irrigation or Private irrigation, Rainfall, Government expenditure on agricultural education, research, and extension, Rural literacy, Agricultural Loan, Regional Variability and Distribution of Land Holding are taken as possible determinants of growth of output and adopts a simultaneous relationship between growth of output and growth of HYV uses in this context it may be mentioned that Gupta (2006) has also used a simultaneous relationship between growth of output and HYV uses. However he has not used simultaneous panel approach. In order to explain the variation in growth rate of output following explanatory variables are considered:

- **Growth of HYV Uses (HYV):** The earlier studies reported that in the post-Green Revolution period the introduction of high yielding variety seeds and chemical fertilizers have increased the efficiency of the food crops and non food crops in the Indian agriculture

(Ray and Ghose, 2014). So, it will be interesting to see whether the use of HYV has any role to play in promoting output growth of major crops. The variable HYV is measured by the percentage of the cultivated area using high yielding varieties of seeds in logarithmic form.

- **Growth of Government irrigation (GI) or Private irrigation (PI):** Another important determinant of the growth of output is the irrigation. In order to test the role of Government irrigation vis-s-vis Private irrigation in promoting growth the variable GI representing share of Government irrigation in total irrigation and the variable private irrigation measuring share of Private irrigation in total irrigation is taken into account because in the post-Green Revolution era, the newly introduced high yielding variety seeds and chemical fertilizers have greatly enhanced the importance of assured supply of water through deep well and canal irrigation. Both variables are taken in logarithmic form.
- **Growth of Rainfall (RF):** A significant important factor in this reverence is the amount of rainfall. It is well known that the production in Indian agriculture is heavily dependent upon the monsoon rain of the country. So to find out whether rainfall is significant factor in promoting growth the variable RF i.e. the log value of amount of annual rainfall in a state in a given year is taken into account as an explanatory variable.
- **Growth of Government expenditure on agricultural education, research, and extension (E):** Government expenditure on agricultural education, research, and extension has a positive role on the production because they provide more information about the input uncertainty to the farmers. So if the expenditure on agricultural education, research, and extension have increased then farmers are became more aware about the production uncertainty and they can take more preventive measures in the farming and get higher growth. Government expenditure on agricultural education, research and extension (E) is the amount of expenditure divided by total area under agricultural operation in log value.
- **Growth of Rural literacy (RL):** Similarly Rural literacy also has a positive impact on the production of crops. Rural Literacy Rate (RL) collected from the Census. Growth of Rural Literacy is the log value of Rural Literacy.
- **Growth of Agricultural Loan (AL):** Another important determinant is the agricultural loan because agricultural loan for the farmers is necessary for purchasing more HYV seeds, Chemical Fertilizer, Tractors, Pumps, Electricity etc. When a farmer uses these kinds of modern technologies the growth of the output must increased significantly. Agricultural loan (AL) is measured by the total amount of credit issued by rural banks and agricultural cooperatives per acre of cultivated area in the state in logarithmic form.
- **Growth of Inequality in Distribution of Operational Land Holding (G):** In agriculture, land reforms and lowering of concentration of ownership occupies an important position for output growth. From the data of marginal holdings of land and number of farmers one

can construct the Gini co-efficient for the distribution of operational land holding. Several country level studies looked at the likely relationship between land distribution and productivity. For example Besley and Burgess (2000) argued that in India, land reforms had their maximum effect in states with greatest initial land inequality. Jeon and Kim (2000) found significant productivity gains from land reforms in Korea during 1950s. Banerjee and Iyer (2005) while investigating the historical nature of land distribution in India locate that states initially having higher land inequality had lower productivity even after land reform took place. A study by Vollarth (2007) using cross country data on inequality in operational holding of agricultural land reform from Deininger and Squire (1998), pointed out the land distribution issue and also the matter of international agricultural productivity. While estimating agricultural production function he found the Gini coefficient for land holdings to have a negative significant relationship with productivity. Now all the above mentioned studies have found significant relationship between distribution of land holding and either efficiency or productivity. So, it will be interesting to see how the distribution of operational land holding affects the growth of output. The inequality of distribution of operational land holding is measured by the Gini ratio (**G**) and was constructed from the data on Census of agriculture and for growth purpose log value is considered.

· **Regional Variability:** Apart from these determinants this chapter has also included regional dummy to incorporate the regional variation in the growth process.

So, $D_i = 1$ if states belong to the i th region.

$= 0$ otherwise.

Using these above explanatory variables and some preliminary estimate one can specify growth of output (GR) equations for different crops:

Growth of output equation in case of Cotton:

Growth of output equation in case of Groundnut:

Growth of output equation in case of Rapeseed/ Mustard Oil:

Equation Specifying Growth of HYV Uses:

In this chapter growth of output, Government irrigation or Private irrigation, Government expenditure on agricultural education, research, and extension, Rural literacy, Agricultural Loan and Regional Variability are taken as possible determinants of growth of HYV uses. So, the variation of HYV Uses is explained by considering the following variables:

· **Growth of Output (GR):** It is well known that with the introduction of Green Revolution policy in 1966 specifically the use of HYV seeds had increased the growth of output in case of rice and wheat in the northern states in India. With this sudden hike in the growth

of output farmers were used more and more HYV seeds to get more and more output. So, it will be interesting to see whether the growth of output has any role to play in promoting growth of HYV uses in case of rice production.

- **Growth of Government irrigation (GI) or Private irrigation (PI):** Another important determinant of HYV uses is Government irrigation vis-s-vis Private irrigation, because in the post-Green Revolution era, in order to use HYV seeds efficiently the importance of assured supply of water through deep well and canal irrigation is needed. So, it will be interesting to see the effect of Government irrigation vis-à-vis Private irrigation on the growth of HYV uses.
- **Growth of Government expenditure on agricultural education, research, and extension (E):** Government expenditure on agricultural education, research, and extension has a positive role on the HYV uses because as Government expenditure on agricultural education, research and extension increases then new variety of HYV seed are invented and thus uses of more and more HYV seed has increases.
- **Growth of Rural literacy (RL):** Rural literacy also has a positive impact on the HYV uses because as rural literacy goes up farmers become more and more educated and as farmers became more and more educated they can use HYV seed more efficiently and thus the use of HYV seeds increases.
- **Growth of Agricultural Loan (AL):** Another important determinant is the agricultural loan because agricultural loan for the farmers is necessary for purchasing more HYV seeds, Chemical Fertilizer, Tractors, Pumps, Electricity etc. So, there exists a positive relationship between growth of agricultural loan and HYV uses.
- **Regional Variability:** Apart from the above mentioned determinants this chapter has also included regional dummy to incorporate the regional variation in the growth of HYV Uses.

So, $D_i = 1$ if states belong to the i th region.

$= 0$ otherwise.

Using these above explanatory variables and some preliminary estimate one can have the following specification of Growth of HYV Uses:

Growth of HYV uses equation in case of Cotton:

Growth of HYV uses equation in case of Groundnut:

Growth of HYV uses equation in case of Rapeseed/ Mustard Oil:

Now these set of two equations for each of the crop satisfy both order and rank condition of simultaneous equation system. In fact the model is over identified. We have solved the identification

problem by imposing exclusion restriction. It is found that each of the two equation contain separate variables and hence the mongrel equation can easily differentiable from the growth equation and growth of HYV equation and hence both the equation are identified.

Method for Estimation:

Problem of Simultaneity

Now from equations (1A...1C) and (2A...2C) used for finding out the factors determining growth rate of output one can conclude that there exists a simultaneous relationship between growth of output and Growth of HYV uses. To address this issue, a two stage method of estimation is adopted for the panel model.

Two stage estimation method:

Stage 1: Replacing the Growth of HYV uses from equation (2A...2C) into corresponding equation (1A...1C) one can express Growth of output as a function of other variables except growth of HYV uses. This is the reduced form equation of growth of output. Similarly, replacing growth of output from equation (1A...1C) to corresponding equation (2A...2C) one can get Growth of HYV uses as a function of other variables except growth of output. This is the reduced form equation of Growth of HYV uses.

Now, from the reduced form equations of growth of output and HYV uses one can get estimates of the parameters of both these two equations.

Stage 2: Replacing this estimated value of growth of output as obtained from stage 1 in corresponding equations (2A...2C) one can get the final estimate of the growth of HYV uses using the panel model under SUR framework. Similarly, one can replace the estimated value of growth of HYV uses as obtained from stage 1 in corresponding equation (1A...1C) to get the final estimate of the growth of output also uses the panel setup. The proposed setup of the panel model uses seemingly unrelated regression (SUR) framework as described below.

Seemingly unrelated regression model (SUR)

SUR is appropriate when all the right hand side regressors X are assumed to be exogenous, and the errors are heteroscedastic and contemporaneously correlated so that the error variance matrix is given by. Zellner's SUR estimator of $\hat{\alpha}$ takes the following form:

Where $\hat{\alpha}$ is a consistent estimate of α with typical element s_{ij} for all i and j . If autoregressive terms are included in the equation, then the following equation is estimated:

where ϵ is assumed to be serially independent, but possibly correlated contemporaneously across equations.

Now, one can estimate GLS specifications that account for various patterns of correlation between the residuals. In this chapter contemporaneous covariances is taken into the consideration.

Cross Section SUR or Contemporaneous Covariances:

This class of covariance structures allows for conditional correlation between contemporaneous residuals for cross section “i” and “j”, but restricts residuals in different periods to be uncorrelated, specifically that:

$$E(\epsilon_{it}\epsilon_{jt} / x_t^*) = \sigma_{ij}$$

$$E(\epsilon_{is}\epsilon_{jt} / x_t^*) = 0$$

For all “i”, “j”, “s” and t with s ≠ t. The error terms may be thought of as cross-sectionally correlated. Alternatively, this error structure is sometimes referred to as clustered by period since observations for a given period are correlated.

Using the period specific residual vectors one may rewrite this assumption as :

$$E(\epsilon_t \epsilon_t' / x_t^*) = \Omega_M$$

For all t, where

$$\Omega_M = \begin{bmatrix} \sigma_{11} & \cdots & \sigma_{1M} \\ \vdots & \ddots & \vdots \\ \sigma_{M1} & \cdots & \sigma_{MM} \end{bmatrix}$$

This is a cross section specification because it involves covariances across cross section as in a seemingly unrelated regression type framework. Cross section SUR generalized least squares on this specification is simply the feasible GLS estimator for systems where the residuals are both cross sectionally heteroscedastic and contemporaneously correlated. EViews employs residual from first stage estimates to form an estimate of Ω_M . In the second stage, they perform feasible GLS.

i. White Cross-Section or Cross Section Heteroscedasticity:

The White Cross-Section method assumes that the errors are contemporaneously (Cross-Sectionally) correlated (Period Clustered). The method treats the pooled regressions as a multivariate regression (with an equation for each cross section) and computes robust standard errors for the system of equations. The coefficient covariance estimator is as follows:

$$\left(\frac{N^*}{N^* - K^*} \right) \left(\sum_t X_t' X_t \right)^{-1} \left(\sum_t X_t' \hat{\epsilon}_t \hat{\epsilon}_t' X_t \right) \left(\sum_t X_t' X_t \right)^{-1}$$

Where the leading term is a degrees of freedom adjustment depending on the total number of observations in the stacked data, N^* is the total number of stacked observations and K^* is the total number of estimated parameters.

II.3 The Data sources

All the data has been collected from the different issues of the Statistical abstract, Agriculture at a Glance, Agriculture in Brief, Handbook of Statistics on Indian Economy, www.indianstat.com (an online commercial data service) and Cost of Cultivation data published by the Government of India.

III. Results of Estimation

III.1 Results of test on convergence of the different series and their break points

The results of the nature of the series i.e. whether the growth process converges to a path having trend preserving properties, for each of the crops like Cotton, Groundnut and Rapeseed/Mustard Oil are presented in Table 2. It is found that for all selected crops and also for all selected states the underlying series is Trend stationary. Thus, it can be concluded that for all selected crops and states the underlying series converges to a trend stationary process. Now, in case of **cotton** for the states AP, GU, HA, KA, MA, MP, PU and RA the major breaks are 1976-79, 1999-2003, 2004, 2005, 1993-95, 2004, 2000-04 and 1988-1990 respectively. For **groundnut** the major breaks are 1978, 2001-03, 1991, 1977 and 2006 for the states AP, GU, KA, MP and TN respectively. In case of **rapeseed/mustard oil** the major breaks occur at or between 1980-81, 1982-85, 1980-81, 1979-80, 1978-81, 1989-90 and 1978 for the states AS, GU, HA, MP, RA, UP and WB respectively.

By analyzing the results of the break points it can be concluded that in case of cotton and groundnut most break points occurs in the first half of the last decade. In case of Rapeseed/Mustard Oil most break points occurs in the last half of the 70's decade.

III.2 Performance of different crops on the basis of their growth pattern

The results of overall growth rate and the change in the growth rate as well as the level of the series after the break point for all crops and all states are presented in Table 3 to Table 5.

Depending on the growth performance of all crops following TS process, states are classified into different groups: (i) Group A (Good performer), (ii) Group B (Moderate performer) and (iii) Group C (Bad performer). The criteria for belonging to different groups A, B, or C are defined in Table 1.

It is found that there is wide variation among the growth of major selected crops across states which can be summed up as follows:

First of all, the estimated results suggest that none of the states are good performer for all crops.

Secondly, the performance is **moderate** for the following states (i) AP, GU, HA, KA, PU and RA in case of cotton; (ii) for groundnut AP, GU, MP and TN; (iii) in case of rapeseed/mustard oil HA, MP, RA, UP and WB.

Finally, the performance is **bad**, for the following states (i) in case of cotton MP and MA; (ii) KA for groundnut; (iii) AS and GU in case of rapeseed/mustard oil.

Table 2 represent the overall performance of the crops and also the corresponding states belonging to the moderate and bad performing groups. Tables 3 to Table 5 represent the detailed performance of the states. We have also calculated the share of production for those states whose performance is bad to check whether the performance of the state may affect the overall performance of the crops or not. In case of cotton the joint average share of MA and MP is 12.07%. In case of groundnut the average share of KA is 14% and in case of rapeseed/mustard oil the average share of AS and GU is 4.9%. So by analyzing the share it can be concluded that the share of production for the states whose performance are bad is not large enough to make these crops a moderate performer.

So, by analyzing these results it can be concluded that there exist a strong intercrop as well as interstate variation and since break point for some of the cases occurs either in the period after 1991 (the time point where the first liberalization process started for the Indian economy) or after 2000 (the time point where the New Agricultural Policy was introduced). Thus, the introduction of these policy changes by the central government may affect the growth of the crops as well.

Results of Determinants of Growth of Output

The results of the determinant analysis by considering only technological and policy variables as the explanatory variables are presented in Table 6 to Table 17.

While estimating the panel model, to test for appropriateness of the assumption of fixed effect vis a vis the random effect model, Hausman's specification test is performed for each of the regression which strongly rejects the assumption of random effect model and supports the assumption of fixed effect model.

For finding out the determinants of Growth of Output using simultaneous panel model, a panel regression has to be considered. For constructing the panel data major producing states has to be considered under each crop over the period 1970-71 to 2012-13.

It may be mentioned that all the estimated equations are found to be nonlinear with some variables. Thus the sign of marginal effects will help to understand the positive or negative relationship for those variables which are nonlinearly related with the dependent variable in each equation. Needless to mention, those variables having linear relationship with the dependent variables in the different equations, sign of the corresponding coefficients will matter for finding out whether the concerned variable has a positive or negative relationship with the dependent variable.

The estimated models also reports Adjusted R^2 which represents the overall fit of the model, which is based on the difference between residual sum of squares from the estimated model and the sum of square from a single constant only specification, not from a fixed effect only specification. High value of Adjusted R^2 shows that the fitted models are reasonably good.

The statistical significance of those variables which are non linear in nature has been checked by Wald test.

Since this chapter uses simultaneous equation kind of framework having two endogenous variables: (i) for growth of output and (ii) the growth of HYV, for each of the crop two equations is estimated; the growth of output equation and the growth of HYV equation.

In case of **cotton** the results are similar as in case of gram. Only the government irrigation and agricultural loan has a interaction effect which is significant and positive for the growth of cotton.

For the determinants of growth of HYV uses the results is same as in case of gram except the result of regional dummies. In case of cotton western region, northern region and southern region has positive and significant effect on growth of HYV uses.

In case of **groundnut** there exists non-linear relation between the growth of groundnut and rainfall, HYV uses and operational land holding. The interpretations of these results are same as earlier. The other variable which are significant and positive are private irrigation and government expenditure on agricultural research and extension.

On the other hand the major determinants of the HYV uses are growth of groundnut, agricultural loan, government irrigation, rural literacy and government expenditure on agricultural research and extension.

In case of **rapeseed/mustard oil** the major determinants of the growth of rapeseed and mustard oil are rainfall, HYV uses, private irrigation, government expenditure on agricultural research and extension, agricultural loan, rural literacy and operational land holding.

On the other hand, major determinants of the growth of HYV uses are growth of output, agricultural loan, rural literacy and government irrigation. Apart from this in case of rapeseed and mustard oil eastern, northern and western region uses more HYV than the middle region.

Thus, although there exists a strong inter crop variation in terms of the determinant of growth of output some common results also exist. For example too much rainfall is not good for the growth of output. Although there exists on linear relationship between growth of output and HYV uses and the marginal effect of growth of HYV uses is positive implying that if HYV uses increase then growth of output also increase. On the other hand too small holding of land also effect the growth of output in the reverse way. Again agricultural loan is significant and positive for almost all crops implying that availability of more money may push the farmers for using more and more HYV seeds. Government or Private irrigation, government expenditure on agricultural research and extension and rural literacy has significant positive effect on the growth of output for almost all crops. One significant result is that, the marginal effect of growth of HYV uses on growth of output is highest among the all explanatory variable for all crops.

IV. Conclusion

This paper applies a recent development in estimation and testing of structural breaks in the econometric time series model to measure the growth performance of cash crops production in Indian agricultural sector by applying Sen (2003) approach. Apart from this study also tries to find out the possible determinants of growth of cash crops production. While the existing studies relating to growth performance in agricultural sector are relied on conventional econometric analysis of curve fitting; attempt to establish a structural break by performing the test for statistically significant difference in parameters across two periods, the present study is based on the rigorous trend analysis procedure of the time series econometrics developed in the last two decades. The distinguishing feature of the method is that the break points are not dependent on the prior belief of the researchers rather it is determined endogenously within the system. The study uses the data for the period 1970-71 to 2013-14. The following conclusions emerge from the analysis:

- Inference can be drawn from the results of the Sen(2003) that growth of output series for all the states and crops are Trend stationary. Thus, one can conclude that for all selected crops and states the underlying series converges to a trend.
- By analyzing the results obtained from Sen (2003) regarding the break point it can be concluded that in case of cotton and groundnut most of the breaks occur after the introduction of New Agricultural Policy². In case of Rapeseed/Mustard Oil most of the breaks occurs immediately after green revolution.
- From the results of Sen (2003) approach one can classify the selected states for each crops into three categories. (1) Good Performer, (2) Moderate Performer and (3) Bad Performer. Now, the results suggest that **(a)** none of the states are good performer for all crops. **(b)** the performance is **moderate** for the following states (i) AP, GU, HA, KA, PU and RA in case of cotton; (ii) for groundnut AP, GU, MP and TN; (iii) in case of rapeseed/mustard oil HA, MP, RA, UP and WB and **(c)** the performance is **bad**, for the following states (i) in case of cotton MP and MA; (ii) KA for groundnut; (iii) AS and GU in case of rapeseed/mustard oil.
- Finally one can find the major determinants of growth for each crop. The results suggest that major determinants of growth vary from crop to crop. But there are some common factors which are (i) Too much rainfall is not good for the growth of output. (ii) Too small holding of land affect the growth of output in the reverse way. (iii) Agricultural loan is significant and positive for almost all crops on the growth of output and also on the growth of HYV uses (iv) Government or Private irrigation, government expenditure on agricultural research and extension and rural literacy has significant positive effect on the growth of output as well as on the growth of HYV uses for almost all crops and (v) Although there exists a non-linear relationship between growth of output and growth of HYV uses the marginal effect of growth of HYV uses is positive implying an increase in growth of HYV uses may increase the growth of output.

Thus Government or Private irrigation, government expenditure on agricultural research and extension, rural literacy and Agricultural loan has positive effect on both growth of output as well as growth of HYV uses. In this present paper there exists a simultaneous kind of relationship between growth of output and growth of HYV uses. The growth of HYV uses has a positive and significant effect on the growth of output and growth of output in turn positively and significantly affect the growth of HYV uses. Thus the explanatory variables like Government or Private irrigation, government expenditure on agricultural research and extension, rural literacy and Agricultural loan may get the greater importance in the policy suggestion because these variables affect the growth of HYV uses which in turn may push up the growth of output.

Thus the analysis reveals that in order to foster growth, any policy changes that will lead to increase in the availability of agricultural loan, government and private irrigation rural literacy, government expenditure on agricultural research and extensions should be emphasized. Again the policy of land reform should be implemented effectively so that targeted growth rate may achieve.

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Table-1: Criterion of Good, Moderate and Bad Performer:

Good	Moderate	Bad
T is positive and Significant DU and DT are also positive and Significant	T is positive and Significant DU and DT are insignificant	T is negative and Significant DU and DT are negative and Significant
	T is positive and Significant Among DU or DT one is positive and significant and other is insignificant	T is insignificant DU and DT are insignificant
	T is positive and Significant Among DU or DT one is positive and significant and other is negative and significant	T is insignificant DU and DT are negative and Significant
	T is positive and Significant DU and DT are negative and significant	T is insignificant DU or DT is negative and Significant
	T is insignificant DU or DT is positive and significant	
	T is negative and Significant DU and DT is positive and significant	
	T is negative and Significant Among DU or DT one is positive and significant and other is negative and significant	

Table-2: Nature of the Series Non-Food Crops

Table 2: Nature of the Series Non Food Crops

STATES	F-statistic	YEAR	NATURE OF THE SERIES	STATES	F-statistic	YEAR	NATURE OF THE SERIES
COTTON				GROUNDNUT			
AP	13.74648*	1996	TS	AP	25.81887*	1978	TS
GU	12.86483*	1999	TS	GU	43.34496*	2001	TS
HA	18.22866*	2004	TS	KA	30.07818*	1991	TS
KA	20.53156*	2005	TS	MP	12.89686*	1977	TS
MP	20.69743*	2011	TS	TN	29.70058*	2006	TS
MA	18.08383*	1995	TS				
PU	11.85244*	2000	TS				
RA	15.91827*	1990	TS				
REPSEED AND MUSTER OIL							
AS	17.0635*	1981	TS				
GU	18.52542*	1985	TS				
HA	23.75654*	1981	TS				
MP	16.95276*	1979	TS				
RA	18.26959*	1978	TS				
UP	15.08033*	1989	TS				
WB	20.59057*	1978	TS				

*Significant at 1%, ** Significant at 5%, *** Significant at 10%*

Table-3: AmitSen's Results Cotton

	AP		GU		HA		KA	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
C	0.169758	0.235765	-0.77434	-0.59792	-0.687	-0.78276	-2.25946	-2.19842*
DU	0.23876	2.09637*	0.492805	2.437705*	0.322951	2.929339*	0.630089	3.54782*
T	0.010493	0.390425	-0.02392	-1.54759	-0.00977	-1.4544	-0.00752	-2.31142*
DT	-0.00241	-0.12779	0.009581	0.375281	-0.03053	-1.74781	-0.06204	-1.90753***
Y1	-0.01934	-0.12114	0.128358	0.761663	0.133342	0.90086	0.364871	2.277242*
D1LNY	0.50069	5.502886*	0.517756	5.476971*	0.587434	7.109011*	0.623896	7.691488*
	MP		MA		PU		RA	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
C	-0.12241	-0.20123	0.614182	0.438883	-1.87783	-2.0466*	0.023401	0.025308
DU	0.339045	0.986997	-0.17412	-1.22693	0.527769	3.485321*	1.22346	2.83764*
T	0.002044	0.568802	0.004782	0.42807	-0.01213	-2.57773*	-0.00084	-0.15929
DT	-0.00512	-0.0237	0.020796	1.373956	0.03101	1.95523**	0.66445	3.467284*
Y1	0.018135	0.159557	-0.08691	-0.4054	0.282244	2.151012*	0.002234	0.014455
D1LNY	0.507638	6.654194*	0.473535	5.033539*	0.589356	6.326449*	0.501569	5.670852*

*Significant at 1%, ** Significant at 5%, *** Significant at 10%*

Table-4: AmitSen's Results Groundnuts

	AP		GU		KA	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
C	-0.49947	-0.41245	-1.48582	-1.47387	-0.40581	-0.32395
DU	0.381545	2.643127*	-0.79412	-2.62125*	-0.21186	-1.61406
T	-0.09183	-1.79341***	0.343999	3.038164*	0.010738	1.111054
DT	0.080916	1.55654	-0.33838	-2.98817*	-0.00655	-0.37371
Y1	0.1259	0.75845	-0.02976	-0.23671	0.048551	0.237732
D1LNY	0.542535	7.450771*	0.493808	9.579686*	0.517424	6.661863*
	MP		TN			
	Coefficient	t-Statistic	Coefficient	t-Statistic		
C	-0.39324	-0.47381	-0.81044	-1.20407		
DU	-0.3062	-2.64226*	0.244726	2.197654*		
T	0.13744	2.493946*	-0.00421	-1.86632***		
DT	-0.13409	-2.43188*	-0.02066	-0.964		
Y1	-0.03468	-0.24908	0.124201	1.275715		
D1LNY	0.462274	4.99522*	0.523997	10.30163*		

*Significant at 1%, ** Significant at 5%, *** Significant at 10%*

Table-5: AmitSen's Results Rapeseed/Mustard Oil

	AS		GU		HA		MP	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
C	0.000427	0.000869	-0.36237	-1.058	0.458625	0.869901	0.815545	1.303765
DU	-0.17125	-3.19296*	-0.47238	-2.87515*	0.317136	1.885268***	0.519763	2.892678*
T	0.003083	0.339117	0.007569	0.273758	-0.00475	-0.15778	-0.13079	-2.45002*
DT	0.002897	0.275245	-0.01147	-0.45953	0.004445	0.140485	0.127511	2.359366*
Y1	0.006435	0.050563	0.139127	1.00296	-0.10383	-0.97316	-0.02678	-0.22565
D1LNY	0.494013	6.37709*	0.557752	7.150045*	0.459042	7.60922*	0.518166	7.103271*
	RA		UP		WB			
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic		
C	0.494963	0.863343	1.105618	1.019627	0.647645	2.481405*		
DU	0.473603	2.642862*	0.186567	2.356584*	0.415626	4.198493*		
T	-0.07458	-1.14563	-0.0121	-1.52874	-0.08515	-2.46978*		
DT	0.071402	1.079545	0.007458	0.875698	0.083536	2.401653*		
Y1	-0.0404	-0.46513	-0.14732	-0.98079	-0.06764	-1.356		
D1LNY	0.456667	7.268154*	0.420224	5.156288*	0.419954	6.825748*		

*Significant at 1%, ** Significant at 5%, *** Significant at 10%*

Table-6: Estimated Results of Simultaneous Equation Model: The Case of Growth of Output Equation in case of Cotton

Variable	Coefficient	t-Statistic	Prob.
C	-4.05539	-0.79703	0.426
RF	3.436668**	2.268374	0.024
RF*RF	-0.24045**	-2.13383	0.0336
HYV	0.482939*	6.624914	0
HYV*HYV	-0.15532*	-4.05961	0.0001
GI	0.649751*	2.598172	0.0098
AL	0.193362**	2.321526	0.0209
E	0.065547*	2.630478	0.0089
G	-0.02324*	-5.24795	0
G*G	0.031594***	1.687299	0.0925
GI*AL	0.15167*	2.932996	0.0036
Adjusted R-squared	0.901894		
F-statistic	182.1563		
Prob(F-statistic)	0		

*significant at 1%, **significant at 5%, ***significant at 10%

Table-7: Estimated Results of Simultaneous Equation Model: The Case of HYV Equation in case of Cotton

Variable	Coefficient	t-Statistic	Prob.
C	-16.2187*	-17.476	0
GR	3.1969*	13.85241	0
GR*GR	-0.2269*	-14.556	0
GI	0.079413*	3.052349	0.0025
AL	0.051534**	1.922343	0.0554
E	0.012231*	4.413511	0
RL	0.027739*	19.70711	0
DW	0.538147*	19.00642	0
DN	0.239632*	6.423261	0
DS	0.091537**	2.543811	0.0114
Adjusted R-squared	0.911351		
F-statistic	265.9182		
Prob(F-statistic)	0		

*significant at 1%, **significant at 5%, ***significant at 10%

Table-8: Marginal Effects of the Explanatory Variables from the Simultaneous Equation Model: The Case of Growth of Output Equation in case of Cotton

RF	0.206489
HYV	0.713412
GI	0.038148
AL	0.020561
E	0.065547
G	-0.10574

Table-9: Marginal Effects of the Explanatory Variables from the Simultaneous Equation Model: The Case of HYV Equation in case of Cotton

GR	0.06464
GI	0.079413
AL	0.051534
E	0.012231
RL	0.027739

Table-10: Estimated Results of Simultaneous Equation Model: The Case of Growth of Output Equation in case of Groundnut

Variable	Coefficient	t-Statistic	Prob.
C	12.6256*	4.089749	0.0001
RF	1.729194**	1.911294	0.0574
RF*RF	-0.12077**	-1.83196	0.0685
HYV	0.435812*	2.771758	0.0061
HYV*HYV	-0.17833***	-1.65516	0.0995
PI	0.080116*	4.267565	0
E	0.156833*	4.514909	0
G	-0.07433	-5.49111	0
G*G	0.112784***	1.928147	0.0553
AL*E	0.028522*	3.730265	0.0003
Adjusted R-squared	0.897798		
F-statistic	142.2277		
Prob(F-statistic)	0		

*significant at 1%, **significant at 5%, ***significant at 10%

Table-11: Estimated Results of Simultaneous Equation Model: The Case of HYV Equation in case of Groundnut

Variable	Coefficient	t-Statistic	Prob.
C	233.0498*	3.406512	0.0008
GR	7.7143*	3.426829	0.0007
GR*GR	-0.55871*	-3.35942	0.0009
G1	0.12254*	3.31153	0.0011
AL	0.026789*	6.440737	0
E	0.041818*	4.500627	0
RL	0.001848*	15.30145	0
Adjusted R-squared	0.910035		
F-statistic	212.4138		
Prob(F-statistic)	0		

*significant at 1%, **significant at 5%, ***significant at 10%

Table-12: Marginal Effects of the Explanatory Variables from the Simultaneous Equation Model: The Case of Growth of Output Equation in case of Groundnut

RF	0.050855
HYV	0.65618
PI	0.080116
E	0.034162
AL	0.043833
G	-0.26032

Table-13: Marginal Effects of the Explanatory Variables from the Simultaneous Equation Model: The Case of HYV Equation in case of Groundnut

GR	0.208563
GI	0.12254
AL	0.026789
E	0.041818
RL	0.001848

Table-14: Estimated Results of Simultaneous Equation Model: The Case of Growth of Output Equation in case of Rapeseed/Mustard Oil

Variable	Coefficient	t-Statistic	Prob.
C	-310.236*	-5.35662	0
RF	0.066198*	5.734011	0
HYV	0.687731*	5.442236	0
HYV*HYV	-0.0029*	-5.40263	0
PI	0.296189*	3.238134	0.0013
AL	0.019322*	5.566765	0
E	0.087182*	4.997716	0
RL	0.00889*	5.477466	0
G	-0.00368*	-5.9219	0
G*G	0.123528*	4.635437	0
Adjusted R-squared	0.929899		
F-statistic	260.1117		
Prob(F-statistic)	0		

*significant at 1%, **significant at 5%, ***significant at 10%

Table-15: Estimated Results of Simultaneous Equation Model: The Case of HYV Equation in case of Rapeseed/Mustard Oil

Variable	Coefficient	t-Statistic	Prob.
C	-4.19827*	-6.21469	0
GR	0.224605**	1.883762	0.0606
GR*GR	-0.01009***	-1.6688	0.0963
GI	0.023473**	2.020195	0.0443
AL	0.155964*	3.485019	0.0006
RL	0.086916*	7.08328	0
DN	0.386939*	5.10903	0
DE	0.403713*	4.807767	0
DW	0.674578*	12.23741	0
Adjusted R-squared	0.931463		
F-statistic	363.0085		
Prob(F-statistic)	0		

*significant at 1%, **significant at 5%, ***significant at 10%

Table-16: Marginal Effects of the Explanatory Variables from the Simultaneous Equation Model: The Case of Growth of Output Equation in case of Rapeseed/Mustard Oil

RF	0.066198
HYV	0.692579
PI	0.296189
AL	0.019322
E	0.087182
RL	0.00889
G	-0.22735

Table-17: Marginal Effects of the Explanatory Variables from the Simultaneous Equation Model: The Case of HYV Equation in case of Rapeseed/Mustard Oil

GR	0.108427
GI	0.023473
AL	0.155964
RL	0.086916

DEMOGRAPHIC DIVIDEND, HEALTH OUTCOMES AND ECONOMIC GROWTH IN INDIA-A CRITICAL ANALYSIS

SUSHIL KR. HALDAR¹

Abstract

Using NFHS and DLHS data, the present study tries to explore the role of reproductive and child health across the major states of India in the context of demographic dividend which is expected to be enjoyed by India around 2025. Reproductive and child health across the major states are found to be poor and it varies to a large extent; future human capital accumulation largely depends on current health status of the mothers as well as children, therefore, we can conclude that India has enormous potential to extract economic returns from demographic dividend if some corrective measures be undertaken in respect of health in general and reproductive and child health in particular immediately at the policy level.

Keywords: Demographic Dividend, Reproductive and Child Health, Economic Growth.

JEL Classification Codes : I15, I18, J24.

I.Introduction

Good health and nutrition enhance workers' productivity. Healthier people who live longer have stronger incentives to invest in developing their skills, because they expect to reap the benefits of such investments over longer periods. Better health increases workforce productivity by reducing incapacity, debility and number of days lost due to sick leave. Moreover, good health helps to forge improved levels of education by increasing levels of schooling and scholastic performance. Health affects economic growth through its impact on demographic factors. Shorter life expectancies inhibit investment in education and other forms of human capital, since there is greater risk that each individual will not survive long enough to benefit from investment. In addition, a larger proportion of the population which is dependent has a detrimental effect on rates of savings and capital investment and hence on subsequent growth (Kelly and Schmidt, 2007). Healthier workers are more productive for a variety of reasons – increased vigor, strength, attentiveness, stamina, creativity and so forth. Ill health and malnutrition reduce the physical capacity of the laborer, leading to lower productivity and resulting in lower wages (Zimmer et al., 2000).

Zon and Muysken (2005) have argued that economic growth is driven by knowledge accumulation in the traditional Lucas Model (1988) and as such is based on on labor services supplied by healthy people.

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The health state of the population at the aggregate level (the share of healthy people in the population) determines the extent to which potential labor services embodied in the population can be used effectively. Moreover, knowledge accumulation requires the spending of 'healthy hours', wherein the embodiment of knowledge can take hold in individual people. The state of health in a country affects its economic growth through various channels. If health improves, the country can produce more output with any given combination of skills, physical capital and technological knowledge. One way to think about this effect is to treat health as another component of human capital incorporated in formulating the endogenous growth models (Thomas et al., 1997, Bloom et al., 2001). The effects of human capital variables (namely, health and education) imply that the investment rate tends to increase as levels of education and socioeconomic status of health rise. Longer life expectancy encourages larger investments in human capital, which in turn accelerates the per capita income. The explanation of larger investments on human capital due to longer life expectancy is offered by Stark (1995) in terms of intergenerational transfer of assets. The provision of public resources for better health in a developing country can assist the poor to release resources for other investments, such as in education, as a means to escape poverty. The long-term relationship between income and health is examined by Arora (1999) considering the developed countries in the world and has observed the hypotheses that health of the population has influenced economic growth and that it should be an integral component of the productivity of economies and supporting the endogenous growth models.

India has been experiencing a rapid decline of fertility that results rising share of working population; it is projected that India will witness the demographic dividend after 2025 but the disaggregate picture is different (Registrar General, Govt. of India 2006). There exist two views whether India is capable to enjoy the benefit of demographic dividend or it will create a burden. The recent Latin American experience provides that the age transition does not lead to economic growth (Bloom et al 2003). The pessimists like Mitra and Nagarajan (2005), Chandrasekhar et al (2006) and Bhattacharya and Haldar (2015) have argued that demographic changes are not sufficient to provide an upward push to the rate of economic growth; this is because India has been facing a major deficit in the area of health and education sector which is assumed to be necessary for human capital accumulation. India has been sharing roughly 17.5% of total world's population, but she has to share about 20.6% of world's poor (Donnan 2014). Moreover, there is wide regional variation in respect of health and educational outcomes among the major states (Kurian 2000, Bhattacharya and Haldar 2013).

Using state level decadal data, James (2008, 2011), Utsab (2014) and Aiyar et al (2011) have observed a positive effect of the share as well as growth of working age population to economic growth in India. Despite the fact that the educational achievements and health conditions of the population are far from desirable and employment creation is well below the required level in India, one can predict a powerful positive impact of the boom of the working age population on economic growth; but, in order to enjoy the benefit of demographic dividend, the necessary condition is effective human capital formation and opening of employment opportunity. The present

paper critically evaluates the reproductive and child health status across the major states using NFHS and DLHS survey results in the context of future demographic dividend and economic growth in India.

II. Importance of the Study

Recent global estimates of maternal mortality indicate that more than half a million of women died due to pregnancy related causes in 2005 (The World Bank 2008). Large proportion of these maternal deaths is concentrated within developing countries. Among developing countries, India shares 17.5 percent global population but the share of disease burden is disproportionately higher in India. India contributes largest sum of births per year (27 million) in the world and alone accounts for 20 percent of global maternal deaths, 23 percent under five mortality rate and 26 percent deaths preventable with childhood vaccinations (Mavlankar et al 2008). India, at the aggregate level is expected to enjoy the benefit of demographic dividend roughly after 2025 but only the numbers of working age cohort cannot guarantee to generate sufficient income if the health status of the future working population remains poor. Thus, in order to get the real benefit of demographic dividend in near future, we must know about the present health status of the mothers and children so that appropriate measures can be undertaken at the disaggregate level. This is because future working population and their health largely depend on the health status of the mothers belonging to the reproductive age cohort and the current health status of the children. Here lies the importance of the present study. Therefore, in order to get the real benefit of demographic dividend in future, accumulation of effective human capital is necessary which is possible through an urgent health intervention towards improving the health status of the current mothers belonging to reproductive age group and children since these two groups are fundamental source of attaining the quality as well as quantity of the future working population.

III. Research Questions, Data and Methodology

Following are the research questions of the present study:

How do we assess the health (as human capital) in general and reproductive and child health in particular in aggregate economic growth, especially in the context of demographic dividend? Is our future demographic dividend uniform at the disaggregate level? Another objective is to explore and to highlight the major constraints of demographic dividend that India would face at the disaggregate level in near future.

Data used in the present study are collected from various secondary sources like various Census Reports- Govt. of India, RBI, Sample Registration System-RGI, various rounds of National Family and Health Survey (NFHS) and District Level Household Facility Survey (DLHS)-MHSW, Govt. of India. Unit of our analysis is 15 major states where about 94 percent populations do live.

Different indices can be estimated to study the pattern of reproductive and child health status in the states of India. One can estimate the reproductive health (RH) and child health (CH) or

reproductive and child health (RCH) achievement index (AI) or deprivation indices (DI). In case of AI, one can use Range Equalization Formula or simple Relative Distance Methodology, generally used in the construction of human development index (HDI) but if we try to understand how far and to what extent the states are deprived from the above cited RH, CH or RCH parameters, the Human Poverty Index (HPI) developed by Sen and Anand (1997) is assumed to be much more relevant towards formulation of policy prescription.

It is to be mentioned here that a state with higher achievement generally manifests lower deprivation but it may always not hold good because of the methodological differences. In order to estimate AI, we use relative distance concept whereas DI uses power mean formula. Thus, in order to find out the Deprivation Index (DI) in respect of the RCH parameter, we subtract each parameter from 100, since all are development parameters expressed in terms of percentage.

Thus, following Sen and Anand (1997), we consider the following function:

$$DI(\alpha) = \left[\frac{\sum_j \omega_j P_j^\alpha}{\sum_j \omega_j} \right]^{\frac{1}{\alpha}} \dots\dots\dots (1)$$

Where, $DI(\alpha)$ =deprivation index of order α , ω_j =weight attached to deprivation parameter j , P_j =deprivation parameter of j -th indicator. Following UNDP, we consider $\alpha=3$ and $\omega_1=\omega_2=\dots=\omega_7=1$ for our estimation. Equation (1) does follow some important properties of a good index like convexity, homogeneity, monotonicity and substitutability but it is not sub-group decomposable (Sen and Anand 1997); $DI(\alpha)$ does also suffer from the problem of aggregation, choice of the dimensions, overlapping and multicollinearity (Alkire 2007, Krishnaji 1997, Rippin 2009, Haldar and Roy 2010). Analysis is carried out in a descriptive way; in some cases we use simple correlation in order to justify and strengthen the logic or argument. The direction of causality and causal mechanism is not studied here. The determinants of reproductive health index are not studied here. Moreover, we consider equal weights which is not scientific because variance of the RH parameters is not taken into account in case of identical weights.

Dataset of reproductive health (RH) parameters are drawn from two sources: (a) District Level Household and Facility Survey (DLHS: Round-II: 2003-04(T_3) and Round-III: 2007-08(T_5)) and (b) National Family Health Survey (NFHS: Round I-1992-93(T_1), Round-II: 1997-98(T_2) and Round-III: 2005-06(T_4), Ministry of Health and Family Welfare, Government of India.

Keeping in mind the availability and consistency of data, we have considered only five parameters for measuring deprivation indices (DI) of reproductive health (RH) for five time points (viz. 1992-92, 1997-98, 2003-04, 2005-06 and 2007-08) across 15 major states in India. Following are the deprivation parameters used in DI and the raw data are given in Appendix Table-A1.

PBM= percentage of 2nd and higher order births reported,

NID= percentage of non-institutional delivery,

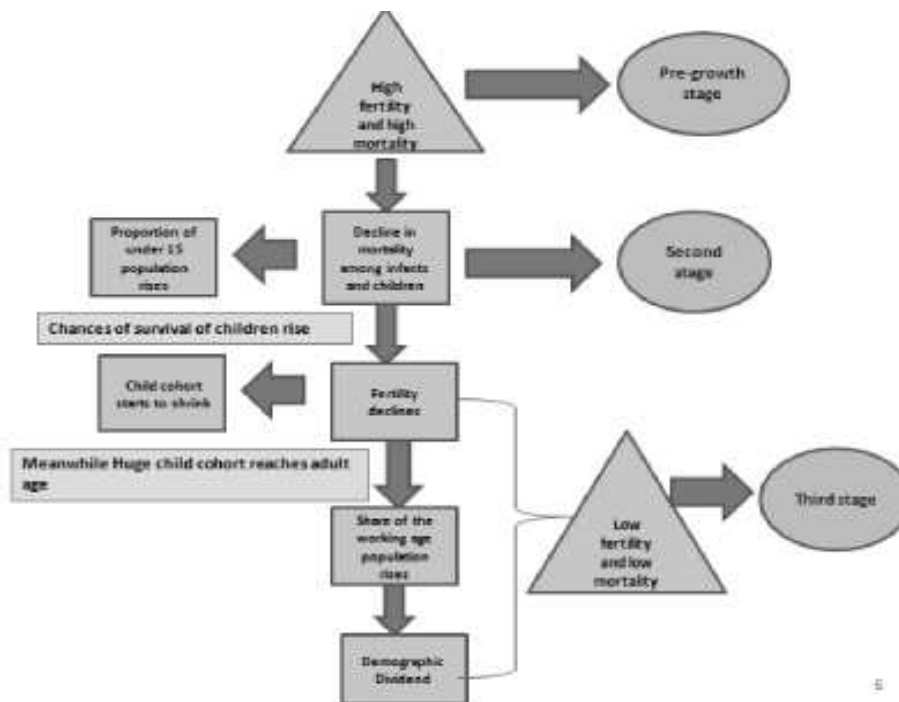
PWNANC3= percentage of pregnant women who had not received 3 antenatal care visits during last pregnancy,

NFPM =percentage of women who are not current users of family planning method, and
SAN=percentage of women who suffer from anemia.

IV. Demographic Transition, Demographic Dividend and Economic Growth: A Simple Theoretical Explanation

Following the flow chart (Figure-1), we can argue that as the economy moves from pre-growth stage to second stage, the beginning of the second stage is marked with the decline in mortality due to improvements in health and innovation of modern medicine.

Figure-1: Flow Chart of Demographic Transition and Demographic Dividend



This fall in mortality is the highest among infants and the children which causes an increase in the share of the population in the childhood ages below 15.

With the children more likely to survive and live longer, couples become less likely to demand more number of children which leads to a decline in the total fertility (Becker et al 1999, Birdsall et al 2001).

Parents use to substitute quantity of children with quality of children and invest their resources in fewer children since child bearing activities are costly in terms of money and opportunity cost of time (Becker and Murphy 1990, Behrman et al 1999). But this decline in fertility following low mortality comes with a time lag; it enters into the third stage of population transition roughly after two decades or one generation; in the meanwhile earlier huge cohorts of children (under age 15 years) reaches their adult age leading to a bulge in the share of working age population (15-59) in total population (Bloom et al 2001, Bloom 2011). As the fertility declines the subsequent child cohorts' starts shrinking which ultimately gives rise to the 'Demographic Dividend'. How does demographic dividend (along with health outcomes) affect economic growth? Following Haldar (2009), Haldar and Mallik (2010), Oketch (2006), we consider a simple aggregate production function as shown by equation (2).

Demographic Dividend, Investment in Physical and Human Capital in the context of Aggregate Economic Growth: A Simple Theoretical Model

Let

$Y_t = Y(K_t, H_t, L_t) \dots (2)$ where Y =aggregate output, K stands for physical capital, H is the human capital (like health status and knowledge base) and L is the labour force.

Differentiating equation (2), with respect to time t , we have:

$\dot{Y} = \frac{\partial Y}{\partial L} \dot{L} + \frac{\partial Y}{\partial K} \dot{K} + \frac{\partial Y}{\partial H} \dot{H}$, dividing throughout by Y and subtracting $r = \frac{\dot{P}}{P}$ (viz. rate of growth of population) from both sides, we have:

$$\frac{\dot{Y}}{Y} - \frac{\dot{P}}{P} = \left(\frac{\partial Y}{\partial L} \right) \cdot \frac{L}{Y} \cdot \frac{\dot{L}}{L} + \left(\frac{\partial Y}{\partial K} \right) \cdot \frac{I_K}{Y} + \left(\frac{\partial Y}{\partial H} \right) \cdot \frac{I_H}{Y} - \frac{\dot{P}}{P}$$

$$\text{Or, } \frac{\dot{y}}{y} = \frac{MP_L}{AP_L} \cdot n + MP_K \cdot \frac{I_K}{Y} + MP_H \cdot \frac{I_H}{Y} - r \dots (3)$$

We assume that gross investment is equal to net investment and it is valid for both physical and human capital. Now, decompose r into the following components:

$$r = \frac{\dot{P}}{P} = \frac{\dot{P}_{0-15} + \dot{P}_{15-59} + \dot{P}_{59+}}{P} = \frac{\dot{P}_{0-15}}{P_{0-15}} \cdot \frac{P_{0-15}}{P} + \frac{\dot{P}_{15-59}}{P_{15-59}} \cdot \frac{P_{15-59}}{P} + \frac{\dot{P}_{59+}}{P_{59+}} \cdot \frac{P_{59+}}{P} = \alpha_1 \cdot r_1 + \alpha_2 \cdot r_2 + \alpha_3 \cdot r_3$$

Where, α_i stands for share of population, $0 < \alpha_i < 1$, $i=1, 2$ and 3 ; r_1 , r_2 and r_3 stand for growth rate of child population, working population and old-age population respectively. Now, insert the value of r in equation (3), we have:

Rate of growth of output per capita:

$$\frac{\dot{y}}{y} = \frac{MP_L}{AP_L} \cdot n + MP_K \cdot \frac{I_K}{Y} + MP_H \cdot \frac{I_H}{Y} - (\alpha_1 \cdot r_1 + \alpha_2 \cdot r_2 + \alpha_3 \cdot r) \quad (4)$$

Now, if we assume that the economy is at full employment, such that the rate of growth of employment (viz. n) is equal to the rate of growth of share of working population (r_2) and average productivity of labour (AP_L) is equal to marginal productivity (MP_L), equation (4) can be written as:

$$\frac{\dot{y}}{y} = n(1 - \alpha_2) + MP_K \cdot \frac{I_K}{Y} + MP_H \cdot \frac{I_H}{Y} - (\alpha_1 \cdot r_1 + \alpha_3 \cdot r) \quad \dots\dots(5)$$

Investment in human capital is basically comprised of health and education expenditure, thus, we can write: $I_H = I_{HE} + I_{EE}$, equation (5) can be written as:

$$\frac{\dot{y}}{y} = n(1 - \alpha_2) + MP_K \cdot \frac{I_K}{Y} + MP_H \cdot \left\{ \frac{I_{HE}}{Y} + \frac{I_{EE}}{Y} \right\} - (\alpha_1 \cdot r_1 + \alpha_3 \cdot r) \quad \dots\dots\dots(6)$$

This simple growth model asserts that the growth of per capita output will increase if (1) rate of growth of employment (n) increases, (2) share of investment of physical capital to total output increases and if the health and education expenditure as a proportion of total output increases. Growth of output per capita is adversely affected if an economy is either characterized by higher proportion of child or old-age population (as well as their corresponding growth rates) because they are not so productive compared to working age group population. Health and educational

outcome depends on $\frac{I_{HE}}{Y}$ and $\frac{I_{EE}}{Y}$. Quality of labour force is expected to improve if an economy spends higher proportion on human capital to total income. Equation (6) and its variants are estimated by many (Aiyar et al 2011, Bhattacharya et al 2015, James 2008, Utsab 2014).

V. Demographic Diversity in India

How does age composition of population vary when demographic transition takes place? The age structure of population changes over time as shown in Table-1. It is observed that India has

been witnessing a falling dependency ratio after 1975- child dependency falls sharply due to rapid decline of fertility whereas old age dependency rises very slowly; this results an increasing share of working age people.

Share of working age group (15-64) starts increasing after 1975 and it will reach a maximum around 2025 which is accompanied by smallest dependency ratio. Therefore, roughly speaking India has started enjoying the benefit of demographic gift at the aggregate level; but there exists wide range of regional disparity in respect of the growth of the share of working age population.

Table-1: Change in Age Composition: Falling Trend of Child Dependency and Rising Trend of Old-Age Dependency Ratio: 1950-2050

Year	Dependency Ratio	Child Dependency Ratio	Old Age Dependency Ratio
1950	73	67	6
1955	74	68	6
1960	76	70	6
1965	78	72	6
1970	79	72	7
1975	77	71	7
1980	74	67	7
1985	72	65	7
1990	69	62	7
1995	68	60	8
2000	64	56	8
2005	60	51	8
2025	48	36	12
2050	50	28	22

Source: United Nations' Population Division, World Population Prospects, 2010. Note: Dependency Ratio is split into two components- child dependency and old age dependency ratio. These are defined as follows:

$$\text{Child Dependency Ratio} = \frac{\text{No. of people aged 0 - 14}}{\text{No. of people aged 15 - 64}} \times 100$$

$$\text{Old Age Dependency Ratio} = \frac{\text{No. of people aged 65 and above}}{\text{No. of people aged 15 - 64}} \times 100$$

The projected percentage share of working age population during 2001-2026 across the 15 major states is estimated by the 'Report of the Technical Group on Population Projections, National Commission on Population, (Registrar General, Govt. of India, May, 2006). It is observed that all most all the states have been witnessing an increase in the share (percentage) of working age population but the rate of increase across states over the decades vary to a great extent, especially during 2001-2011. This is because socio-economically backward states like Uttar Pradesh (UP), Rajasthan, Madhya Pradesh, and Bihar have experienced a high but slow fertility decline during 2001-2011 compared to earlier decades. The percentage share of working age population across 15 major states over the decades 1971-2011 are given in Appendix Table-

A2.

From the projected trend of the share of working age population, we can argue about the existence of North-South dichotomy in respect of demographic gift. Punjab and some Southern states like Tamil Nadu, Kerala, Karnataka, have already started witnessing a decline in the share of working age (15-59) population from 2011 and this trend is likely to be continued till 2026.

But the Northern states like UP, MP, Haryana, Bihar along with Rajasthan and Assam which are slower in terms of population transition are expected to experience a continuous rise in the share of the working age population till 2026. More interestingly, BIMARU states which are still belonging to the second stage of demographic transition are alone expected to contribute to more than sixty percent to the overall increase in the share of working age population of India over twenty five years from 2001 to 2026 (Utsab, 2014). Such a stark demographic diversity has an immense consequence on future economic prosperity of a nation like ours.

Demographic diversity especially in respect of age-cohort across the states is clear; here, we just show population pyramid of two states (viz. West Bengal and Uttar Pradesh) for two time points (viz. 2001 and 2026) which clearly depicts the diversity.

Fig.2

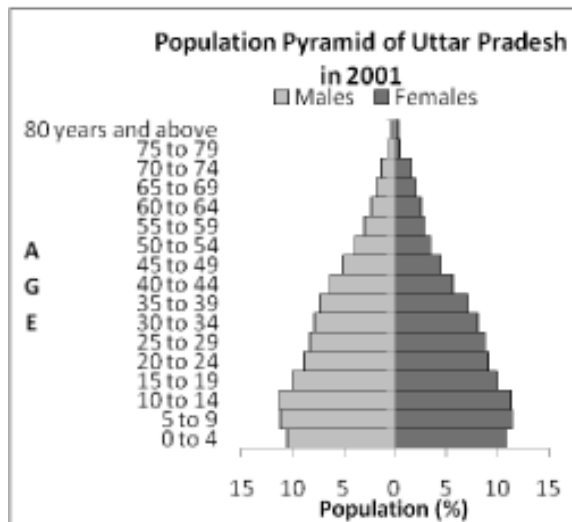


Fig.3

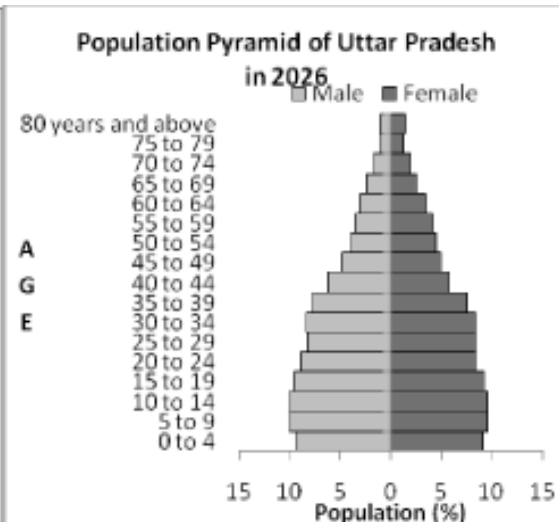


Fig.4

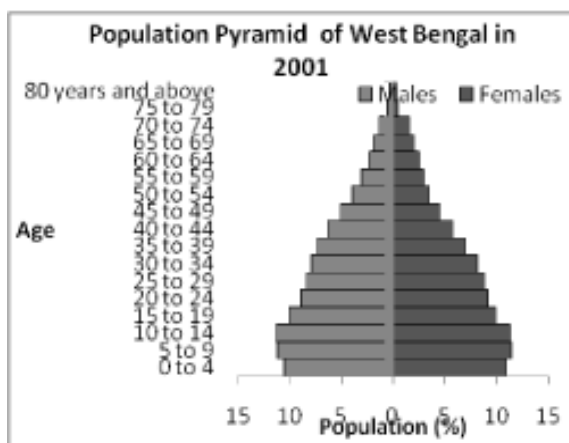
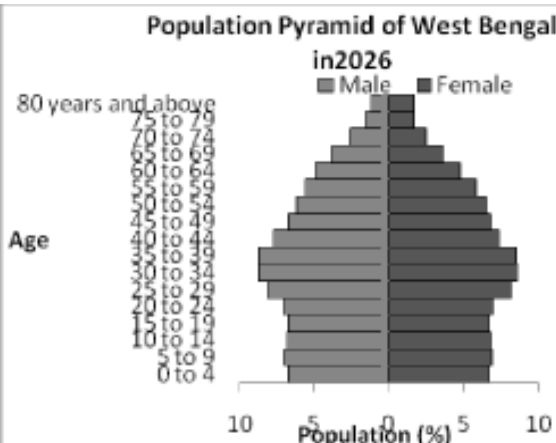


Fig.5



The age sex composition of population in Uttar Pradesh is found to be more or less stable between 2001 and 2026 whereas a dramatic change is noticed in case of West Bengal. Such diversity is caused by the change in fertility of the two states, Uttar Pradesh and West Bengal. West Bengal has been experiencing a rapid decline in fertility as a result the share of working age population is found to be higher in 2026; but till date the fertility in Uttar Pradesh is found to be high and it starts declining at a very slow pace during the last decade 2001-2011.

VI.Reproductive and Child Health in India

Transformation of demographic dividend to economic dividend largely depends on quality of human resources and its proper utilization. Wide spread unemployment, incidence of acute malnutrition of children, poor reproductive health of the mothers, illiteracy, poor enrolment in secondary school etc. are the real barriers to enjoy economic dividend from demographic dividend.

Here, we are mentioning few quality aspect of population in respect of reproductive and child health only; we could not incorporate education human capital in our analysis.

Table 2: Prevalence of chronic under-nutrition (under age 3 years) in fifteen major states in India in 1992-93, 1998-99, 2005-06 and Stunting, Wasting and Under weight of the children below 5 years in few Major States based on NFHS-4 Data (2015-16)

State	1992-93 NFHS-1	1997-98 NFHS-2	2005-06 NFHS-3	NFHS-4 (Children below 5 Yrs.)		
				Stunted	Wasted	Under Weight
Andhra Pradesh	40.8	47.1	38.3	31.4	17.2	31.9
Assam	56.5	53.7	41.4	36.4	17	29.8
Bihar	60.3	57.6	49.5	48.3	20.8	43.9
Gujarat	50.1	51.8	49.1			
Haryana	50.5	55.4	43.2	34	21.2	29.4
Karnataka	47.5	42	42.3	36.2	26.1	35.2
Kerala	32.8	27.8	26.5			
Madhya Pradesh	60	56.4	48	42.2	25.8	42.8
Maharashtra	47	47	43.9	34.4	25.6	36
Orissa	50.8	49.1	43.9			
Punjab	45.2	45.2	34.6			
Rajasthan	45.5	59	40.1			
Tamil Nadu	40.8	35	31.1	27.1	19.7	23.8
Uttar Pradesh	60	60.3	51.9			
West Bengal	56.7	50.1	41.8	32.5	20.3	31.5

Note:: Z–score in each category of malnutrition (stunting, wasting and under-weight) is less than -2SD. Source: Data are based on NFHS I, II , III and IV published by IIPS Mumbai.

All most all the states have experienced a decline of chronic malnutrition during 1992-92 to 2005-06 but the pace of decline is extremely low. Data on malnutrition for 2015-16 (NFHS-4) are not available for all the major states, it was available only for 9 major states. Moreover, malnutrition for 2015-16 cannot be compared with earlier surveys because of two reasons: earlier surveys consider children aged less than 3 years and children suffer in each of three categories of malnutrition jointly. Bihar and Madhya Pradesh, two major BIMARU states in India in near future will contribute a major share of working population but till date more than 40 percent of the children under age 5 years are found to be stunted and under-weight.

The proportion of malnourished children is disproportionately high among the BIMARU states compared to other states; now if majority of the children do suffer from malnutrition, their future effective human capital formation will be jeopardized. Lots of studies support the view that malnutrition of children is basically caused by poor reproductive health of the mothers, illiteracy and poverty (Smith and Haddad 1999, Som, Pal and Bharati 2007). Healthy and well nourished children perform better in school and better performance in school positively affects their future income. Proper childhood development depends to a large extent on adequate prenatal care for the mother so that child births can take place under adequate medical supervision, and on the suitable and proper preventive and curative medical attention. Current reproductive health status of the mothers significantly affects health status of new born babies. Using NFHS and DLHS survey findings for five time points, we have compiled state level information pertaining to five

key reproductive health deprivation parameters. Using power mean formula developed by Sen and Anand (1997) as mentioned in equation (1), we have estimated reproductive health deprivation indices (RHDI) for 5 time points across 15 major states as shown in Table-3.

Dataset of reproductive health (RH) parameters are drawn from two sources: District Level Household and Facility Survey (DLHS: Round-II: 2003-04(T_3) and Round-III: 2007-08(T_5)) and National Family Health Survey (NFHS: Round I-1992-93(T_1), Round-II: 1997-98(T_2) and Round-III: 2005-06(T_4)), Ministry of Health and Family Welfare, Government of India. Note: Values in parentheses represent rank. PBM= percentage of 2nd and higher order births reported, NID= percentage of non-institutional delivery, PWNANC3= percentage of pregnant women who had not received 3 antenatal care visits during last pregnancy, NFPM=percentage of women who are not current users of any family planning method, SAN=percentage of women who suffer from anemia. Here, lower RHDI means higher ranks.

There is an important linkage between improvement in maternal health and development process as poor maternal health negatively affects child health, reduces women's productive capacity, lowers participation in economic activities, sabotages the poverty alleviation programme and the process of effective human capital formation (Nanda, Switlick and Lule 2005).

Table: 3 Reproductive Health Deprivation Indices (RHDI) based on five key-Reproductive Health Parameters for 5 time points of 15 major states

State	1992-93(T_1)	1997-98(T_2)	2003-04(T_3)	2005-06(T_4)	2007-08(T_5)
AP	48.93(3)	39.19(2)	34.15(4)	36.74(3)	39.59(4)
Assam	71.06(15)	65.13(14)	62.77(13)	63.75(14)	62.28(15)
Bihar	70.62(14)	61.69(13)	67.70(15)	70.31(15)	56.77(13)
Gujrat	49.40(4)	49.00(7)	42.82(6)	44.98(7)	46.09(6)
Hary	59.37(9)	54.58(9)	49.60(9)	51.26(9)	49.24(8)
Karna	50.73(6)	41.65(5)	34.04(3)	40.36(6)	46.13(7)
Kerala	30.0(1)	27.53(1)	25.90(1)	28.51(1)	32.77(1)
MP	68.10(11)	54.78(10)	54.62(11)	52.57(10)	50.89(9)
Maha	46.58(2)	41.63(4)	38.81(5)	38.90(5)	38.79(3)
Orissa	65.36(10)	57.50(11)	50.90(10)	53.17(11)	55.53(12)
Punjab	52.30(7)	44.49(6)	44.61(8)	38.81(4)	33.50(2)
Rajas.	68.53(12)	59.89(12)	55.04(12)	55.02(12)	53.24(11)
TN	49.60(5)	40.69(3)	29.54(2)	35.41(2)	40.55(5)
UP	70.18(13)	68.32(15)	62.99(14)	61.41(13)	59.74(14)
WB	58.44(8)	49.52(8)	43.22(7)	48.87(8)	52.84(10)
Mean	57.28	50.37	46.44	48	47.86
SD	11.85	11.26	12.7	11.75	9.48

Without examining the direction of causality, a simple rank correlation between malnutrition and RHDI ($R_{\text{Mal, RHDI}}$) of 15 major states supports these hypotheses as shown below. Data on malnutrition and RHDI for three time points are drawn from Table-2 and 3 respectively.

Rank Correlation between Malnutrition and Reproductive Health Deprivation (RHDI)

$R_{\text{Malnutrition, RHDI}}$ for 1992-93=0.83 (significant at 1% level)

$R_{\text{Malnutrition, RHDI}}$ for 1997-98=0.88 (significant at 1% level)

$R_{\text{Malnutrition, RHDI}}$ for 2005-06=0.73 (significant at 1% level)

This is inevitable given the fact that the proportion of women in the reproductive age-group is projected to rise to a peak of nearly 55% in 2016 and remain around that level for the next decade (Population Reference Bureau 2007). Realization of demographic dividend can be achieved through promoting and increasing access to health in general and reproductive health in particular, improving child survival, and empowering girls and women through educational and employment opportunities. But, our per capita health (PCHE) and education expenditure (PCEE) is found to be extremely low compared to many less developed economies; moreover, there exists enormous variations of PCHE and PCEE across the states in India for five time points (as shown in Appendix Table-A4 and A5).

Indeed Table-3 shows a bleak future towards accumulation of effective human capital formation among the major states, particularly among the BIMARU states. State level variations around mean RHDI for five time points are presented in Figures 6-10.

Fig.6: Dispersion of RHDI over Mean (1992-93) Fig. 7: Dispersion of RHDI over Mean (1997-98)

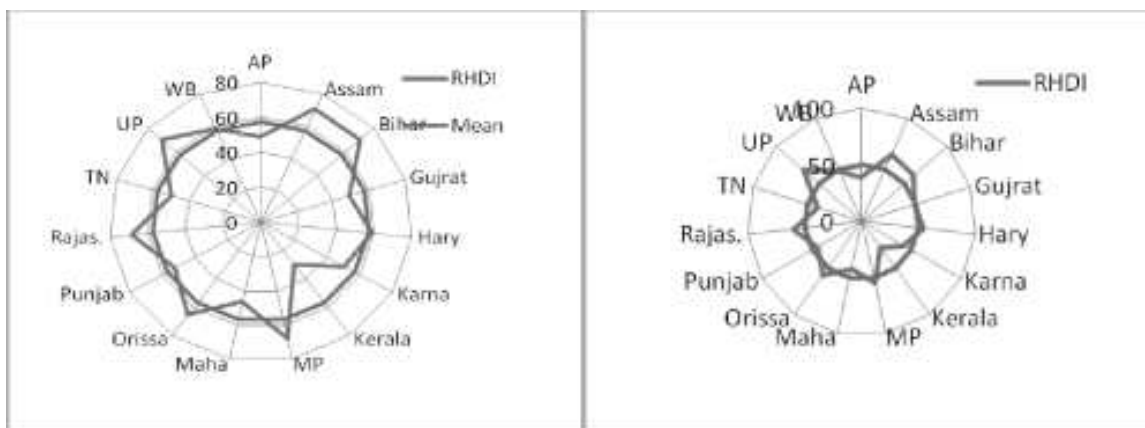


Fig.8 Dispersion of RHDI over Mean (2003-04) Fig.9 Dispersion of RHDI over Mean (2005-06)

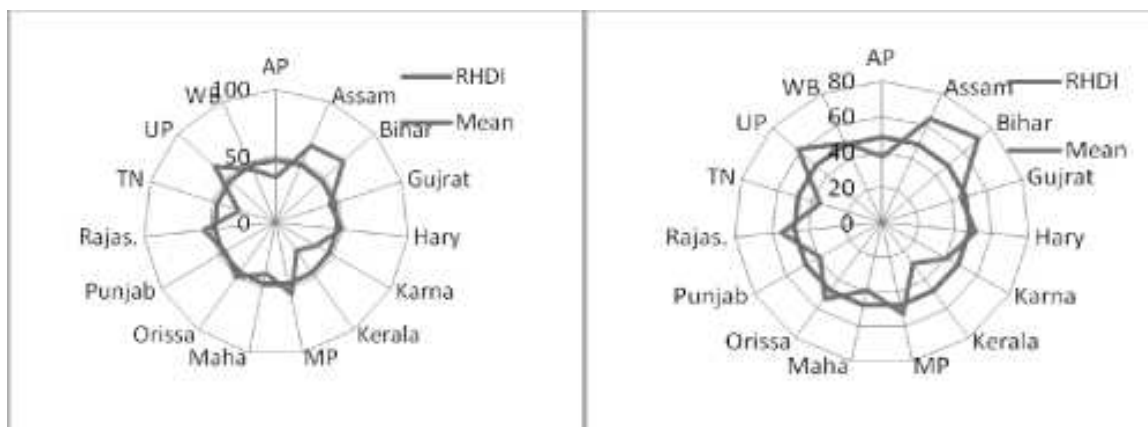
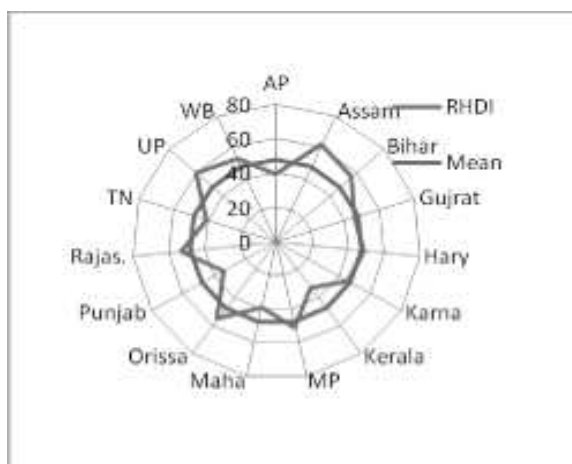


Fig.10 Dispersion of RHDI over Mean (2007-08)



The dispersion of the states in respect of RHDI is quite high; the states like Assam, Bihar, UP, Rajasthan, Orissa and MP lie above the mean RHDI in all the five time points; but these states altogether will contribute about 60 percent of working age population from 2001 to 2026. Since poor reproductive health leads to poor child health, the effective human capital accumulation will be jeopardized.

One can conjecture that such poor health outcomes may be due to poor public expenditure on health and education. One can simply examine this by way of rank correlation coefficient between human capital investment (i.e., PCEE and PCHE) and human development outcomes.

Without examining the direction of causality, a simple rank correlation between RHDI, PCHE, PCEE, PCNSDP of 15 major states for five time points are shown below:

dividend. BIMARU states along with Assam which are still belonging to the second stage of demographic transition are alone expected to contribute to more than sixty percent to the overall increase in the share of working age population of India over twenty five years from 2001 to 2026. But, the health and educational status of these states are found to be extremely poor; many reasons are there but none can deny the extremely low per capita health and education expenditure. India has always had a disproportionately small education and health budget compared to many developing countries in the world. While NDA came in power promising to increase spending on health and education, but the government has actually reduced the proposed spending on both these crucial sectors for the financial year 2015-16; it has reduced spending on education and health by 16 and 15 percent respectively (Tewari, S. 2015). It has serious consequences among the poor living in poorer states. Moreover, various development programmes like Self-Help Groups (SHGs), ICDS, Janani Suraksha Yojana (JSY), Sarba Siksha Abhijan (Education for all), Health for All, NREGA have already been launched but their performances are not satisfactory; in some cases many state governments fail to run all these programmes because of lack of continuous flow of funds. Therefore, we can conclude that India has enormous potential to extract economic returns from demographic dividend if some corrective measures be undertaken immediately at the policy level especially in health sector.

We acknowledge the limitations of the present study because growth of income is not only determined by the quantity of labor (and its productivity) rather quality of labour (viz. human capital) does matter; growth is also determined by physical capital, physical and social infrastructure, good governance, rule of law, corruption, political stability and role of institutions etc. Another limitation of the present study is that causality between economic growth and health is not studied here. Therefore, the present analysis is partial in nature; it just highlights only the role of reproductive and child health in the context of future demographic dividend in India.

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Appendix: Table-A1: Reproductive Health (RH) Parameters of the major States: 1992-93(T₁), 1997-98(T₂), 2003-04(T₃), 2005-06(T₄) and 2007-08(T₅)

States	P ₁ (PBM)					P ₂ (NID)					P ₃ (PWNANC3)					P ₄ (NFPM)					P ₅ (SAN)				
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₁	T ₂	T ₃	T ₄	T ₅	T ₁	T ₂	T ₃	T ₄	T ₅	T ₁	T ₂	T ₃	T ₄	T ₅	T ₁	T ₂	T ₃	T ₄	T ₅
AP	13.2	9.45	5	6	4	65.7	50.2	41	31	22	53	41.1	37	33	29	42.1	31.6	26	21	16	42.6	41.8	40	56	65
Ass	51.1	40.2	38	29	25	88.3	82.4	80	77	65	80.1	73.4	73	73	73	58.2	49.55	45	41	37	64.15	62.3	59	72	79
Bihar	63.7	68.21	65	64	41	88.16	83.7	82	88	72	76.9	46.7	79	77	72	56.4	39.95	53	56	40	57.05	47.4	47	57	36
Guj	24.6	20.67	16	13	10	63.2	52.3	50	45	41	53.1	49.7	45	44	42	42	54.35	39	38	37	48.3	53.6	49	61	67
Harv	27.8	19.75	16	12	8	82.6	77.6	69	61	35	55.6	46.8	44	42	39	47.5	40.35	37	33	30	56.85	55.5	53	70	78
Karn	16.6	13.65	12	11	9	61.5	48.9	41	33	25	52.4	43.5	41	38	35	42.4	35.6	32	29	25	58.15	48.6	30	60	75
Ker	2.7	4.15	5	6	6	11.1	7.1	4	1	0.4	45.6	43.9	43	42	41	26	22.3	20	19	17	27.75	20.3	5	33	47
MP	47.7	15.1	27	21	14	84.1	78	74	70	66	63.5	57.2	52	47	42	49.8	32.35	48	47	46	79.275	49.9	53	56	59
Maha	17.7	13.45	11	9	7	55.5	47.4	41	34	27	47.1	40.1	38	35	33	42.8	34.85	31	27	23	52.75	52.6	52	58	61
Orissa	39	26.05	20	13	7	85.9	77.4	69	61	53	65.3	55.7	56	55	55	48	42.4	40	37	34	68.1	60.5	45	68	80
Pun	12.4	11.75	11	11	11	75.2	62.5	55	48	37	48.7	46.2	45	44	43	42.7	35.7	32	29	25	45.75	37.1	54	42	35
Raj	67.2	46.15	36	25	15	88	78.5	73	68	55	69	61.9	59	56	52	50.7	49.45	49	48	48	55.15	51.4	44	61	70
TN	5.8	3.6	3	1	1	35.7	20.7	15	10	4	54.8	49.7	45	40	35	32.3	26.9	24	22	19	71.6	57.1	28	53	66
UP	55.6	51.8	38	34	30	88.8	84.8	80	78	76	80.2	79.2	74	71	68	57.5	63.45	56	56	55	53.5	45.8	49	50	51
WB	24.6	16.35	12	8	4	68	59.9	58	57	51	62.4	52.7	51	50	49	46.2	38.75	35	31	28	69	56.9	33	63	78

Source: Dataset of reproductive health (RH) parameters are drawn from two sources: District Level Household and Facility Survey (DLHS: Round-II: 2003-04(T₃) and Round-III: 2007-08(T₅)) and National Family Health Survey (NFHS: Round I-1992-93(T₁), Round-II: 1997-98(T₂) and Round-III: 2005-06(T₄)) conducted by Ministry of Health and Family Welfare, Government of India. Note: PBM= percentage of 2nd and higher order births reported, NID= percentage of non-institutional delivery, PWNANC3= percentage of pregnant women who had not received 3 antenatal care visits during last pregnancy, NFPM =percentage of women who are not current users of any family planning method, SAN=percentage of women who suffer from anemia.

Appendix: Table-A2: Percentage share of working population (SWP) between age (15-59 yrs.) of 15 Major States

State	1971	1981	1991	2001	2011
Andhra Pradesh	56.13	57.8	60.09	63.45	67.32
Assam	50.31	53.27	56.24	59.35	62.92
Bihar	54.16	54.59	54.61	54.73	55.02
Gujarat	54	57.73	59.9	62.85	65.76
Haryana	50.54	54.48	55.09	59.26	64.85
Himachal Pradesh	54.51	55.72	58.91	62.27	67.11
karnataka	55.17	56.49	59.28	63.37	67.58
Kerala	55.76	60.16	64.21	66.07	68.13
Madhya Pradesh	53.05	54.95	56.14	57.35	61.29
Maharashtra	55.37	58.29	59.79	62.37	66.37
Orissa	54.4	56.58	59.46	61.77	64.96
Punjab	54.14	58.15	59.82	61.85	67.57
Rajasthan	53.11	54.18	55.3	56.15	60.12
Tamil Nadu	59.04	61.09	64.42	67.11	69.78
Uttar Pradesh	54.36	54.33	54.9	55.23	58.62
West Bengal	53.91	56.43	58.16	61.92	67.3

Note: Census was not conducted in Assam in 1981, values of SWP is estimated using suitable interpolation method. Source: Data are drawn from various Census Reports, RG, Govt. of India

Appendix: Table-A3: Per Capita Net State Domestic Product (PCNSDP) measured in Rupees of 15 Major States at constant price.

Year	AP	Assam	Bihar	Guj.	Haryana	Karnat.	Kerala	MP	Maharas.	Orissa	Punjab	Rajas.	TN	UP	WB
1992-93	2039	1557	1017	3091	3421	2278	1932	1618	3837	1476	3931	1975	2363	1615	2295
1997-98	8191	5796	3100	13018	12389	9416	9265	7301	13925	5382	13812	8601	11260	5518	8408
2003-04	18819	13675	6117	22387	28805	18236	23159	11870	24859	11900	27075	15579	20707	10120	18374
2005-06	27179	17050	7588	36102	40627	29295	34837	15927	40671	18194	34096	19445	34126	13445	23808
2007-08	33217	18089	9070	42498	47046	35574	40288	17572	50138	21640	39567	21922	41314	14875	27094

Note: Base years of PCNSDP for the year 1992-93 and 1997-98 were 1980-81 and 1993-94 respectively; base year of PCNSDP for 2003-4, 2005-06 and 2007-08 was 2004-05). Source: CSO and RBI website; data are compiled by indiastat.com

Appendix: Table-A4: Per Capita Health Expenditure (PCHE) measured in Rupees of 15 Major States at constant price.

Year	AP	Assam	Bihar	Guj.	Hary.	Karnat.	Kerala	MP	Maha	Orissa	Punjab	Rajas.	TN	UP	WB
1993	60.82	57.83	42.4	72.8	62.46	77.18	76.53	48.57	74.52	51.87	94.21	71.71	85.57	50.86	60.37
1998	91.98	85.8	41.99	112.05	97.03	100.41	132.04	64.76	109.17	66.59	149.98	97.89	122.52	67.02	86.6
2004	151.76	109.28	60.84	141.81	135.9	142.91	217.63	104	159.11	101.1	217.95	133.59	155.06	77.85	141.4
2006	157.75	113.55	83.31	166.1	164.28	177.77	250.94	123.9	188.64	96.39	240.64	156.32	169.64	116.79	154.3
2008	247.11	217.88	105.9	193.62	192.66	220.14	321.51	141.4	220.7	154.6	254.74	181.57	217.64	136.64	177.4

Note: Base years of PCHE for the year 1992-93 and 1997-98 were 1980-81 and 1993-94 respectively; base year of PCHE for 2003-4, 2005-06 and 2007-08 was 2004-05). Source: RBI website; data are compiled by indiastat.com

Appendix: Table-A5: Per Capita Education Expenditure (PCEE) measured in Rupees of 15 Major States at constant price.

Year	AP	Assam	Bihar	Gujarat	Haryana	Karna.	Kerala	MP	Maha	Orissa	Punjab	Rajas.	TN	UP	WB
1993	195.18	273.94	146.62	262.66	248.1	235.21	303.07	159.51	286.03	187.56	286.74	227.76	273.54	172.82	193.93
1998	302.4	453.21	258.56	486.12	442.18	431.7	554.13	256.74	545.49	342.32	563.7	412.82	474.6	255.79	327.55
2004	589.9	897.18	399.93	686.34	682.21	682.1	931.33	362.4	923.83	489.94	815.06	599.79	648.4	349.75	536.52
2006	658.94	873.56	481.51	753.14	839.62	856.48	1036.32	435.05	1021.64	592.39	874.6	742.4	767.54	476.54	649.42
2008	799.12	1187.28	583.97	954.834	1132.35	1179.1	1336.35	545.02	1257.22	819.52	996.5	835.43	1033.07	609.9	808.3

Note: Base years of PCEE for the year 1992-93 and 1997-98 were 1980-81 and 1993-94 respectively; base year of PCEE for 2003-4, 2005-06 and 2007-08 was 2004-05). Source: RBI website; data are compiled by indiastat.com .

HEALTH CARE EXPENDITURE AND ECONOMIC GROWTH NEXUS - A PANEL DATA ANALYSIS OF SOME DEVELOPING COUNTRIES

SOVIK MUKHERJEE*

Abstract

One of the essential issues in health systems across the world is that what factors control the resources a country allocates to medical care. The share of health expenditures of GDP in the developing countries is often less as compared to the developed countries. Consequently, as the country progresses through the various stages of development, health expenditures increase too. The purpose of this paper is to take a closer look at the liaison between the two focus variables viz. growth and public healthcare expenditure. Initially, a theoretical model has been proposed which brings out the link between the focus variables. Panel cointegration and causality are the techniques applied in a Vector Error Correction Mechanism (VECM) set-up using panel data from 1980-2015. The findings corroborate the existence of a cointegrated relationship between health expenditure and economic growth coupled with a bidirectional causality linking the focus variables in this model. Also, this paper attempts to verify the health-led growth hypothesis for the developing countries used in this context i.e. the list includes the top performers in terms of growth in 2015 among all developing countries in the world — China, Philippines, Kenya, India, Indonesia, Thailand, Singapore, Nigeria, Malaysia, Peru, Thailand, U.A.E, Peru, Kazakhstan, Saudi Arabia, Colombia, Taiwan, Turkey, South Korea and Mexico. Finally, the paper ends with a conclusion by highlighting the possible implications of the results.

KEY WORDS : Economic Growth, Public Health Expenditure, Difference Equations, Panel Data, Cointegration, Granger Causality

JEL CLASSIFICATION CODES : I10, I15, I18

I. Introduction

One of the essential issues in health systems across the world is that what factors control the resources a country allocates to medical care. The share of health expenditures of GDP in the developing countries is often less as compared to the developed countries. The role of health care spending on stimulating economic growth was first suggested by Mushkin (1962). This is known as the “health-led growth” hypothesis. According to this particular hypothesis, health is a capital, thus investment on health can increase income, hence lead to overall economic growth. In fact, health can affect growth through its impact on human and physical capital accumulation.

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Also, given that healthier people are more productive, they have a strong incentive to develop their knowledge and skills because they expect to relish the benefit over a longer period of time (Bloom and Canning, 2000). In contrast, poor health has an unfavourable impact on productivity, thus it emerges to be a key factor in explaining the under-development in many regions throughout the world. Alternatively, economic growth can also liven up the health-state of population in two aspects: Firstly, economic growth implies rising per-capita income and part of this increased income goes into the consumption of a higher quantity of nourishing food. Accordingly, health improves. Secondly, economic growth is fuelled by the technological health care expenditure and part of this progress is reflected in improvements in medical science. From the microeconomic perspective, when individual's income is low, demand for medical care also tends to be low. As a result, the marginal rate of return to invest in health through medical care investment is very high. Hence, a small percentage increase of income will strongly improve the health state. When an individual reaches a very healthy state, an additional income will not make this individual healthier, but stagnant. Therefore, the effect of economic growth on health status of a nation is concave and depends on the level of development (Preston, 1975).

Even though, studies about the interaction between health and per-capita economic growth have been flourishing but panel data studies for the developing countries is a rare phenomenon. The rest of the paper has been organized as follows. To start with, a brief evaluation of the select literature on the liaison between healthcare expenditure and economic growth has been carried out in Section II. In Section III, a theoretical construct has been developed to bring out the liaison between the focus variables. Section IV illustrates the methodology employed. Section V puts forward the empirical results and the discussions thereof. The paper ends with a conclusion.

II. Review of Select Literature

One of the essential issues in healthcare systems across the world is that what factors control the resources a country allocates to medical care. The share of health expenditures of GDP in the developing countries is often less as compared to the developed countries. The role of health care spending on stimulating economic growth was first suggested by Mushkin (1962). This is known as the "health-led growth hypothesis". According to Mushkin's hypothesis, "health is a capital, thus investment on health can increase income, hence lead to overall economic growth." In fact, health affects the growth prospects of a nation through its impact on human and physical capital accumulation. Since healthier people are much more productive, they have a strong incentive to develop their knowledge and skills because they want to savour the benefit over a longer period of time (Bloom & Canning, 2000). In contrast, poor health status has an unfavourable impact on productivity, thus it transpires to be a significant factor in explaining the under-development in many regions throughout the world.

On the other hand, economic growth can also liven up the health status of the population in two aspects :- Firstly, economic growth implies rising per-capita income and a part of this increased income goes into the consumption of a higher quantity of nourishing food. As a result, health

improves. Secondly, economic growth is fuelled by the technological health care expenditure and part of this progress is reflected in improvements in medical science. From the microeconomic perspective, when individual's income is low, demand for medical care also tends to be low. As a result, the marginal rate of return to invest in health through medical care investment is very high. Hence, a small percentage increase of income will strongly improve the health state. When an individual attains a very healthy condition, an additional income will not make this individual healthier, but stagnant. As a result, the effect of economic growth on the health status of a nation is concave and depends on the level of development (Preston, 1975).

Shifting the focus, a variety of empirical studies, based on time-series or cross-country data, have estimated the extent of the contribution of public expenditures to economic growth. Some studies try to associate levels of public expenditures to growth while others focus have focused on the relationship between certain expenditure components, such as public investment which includes education or health expenditures. Some studies (Devarajan, Swaroop & Zou 1996; De & Endow, 2008) have predicted a positive unidirectional relation between the focus variables while others (Baltagi & Moscone, 2010; Erdil & Yetkiner, 2009) have hit upon a positive bidirectional impact between health expenditure and income. The authors of Baltagi and Moscone (2010) examined the long run relationship between health expenditure and income growth in 20 OECD countries during 1971-2004. The study by Erdil and Yetkiner (2009) shows that the bidirectional causality between health expenditure and GDP growth depends on the type of countries *viz.* high, low and middle income countries. Their analysis brings to light that one-way causality runs from GDP to healthcare expenditure in the low and the middle income countries, whereas the reverse holds for high income countries. Initially, health expenditure acts as an investment in human capital, and given that human capital accumulation is an elemental source of economic growth, an increase in healthcare expenditure in due course leads to a higher level of GDP. Additionally, an increase in the healthcare expenditures associated with effective health intervention increases labour supply and productivity. This in turn increases the earnings of an individual which ultimately leads to a rise in GDP. Thus, all kinds of expenditure on health make a positive contribution to economic growth by developing the quality of human capital.

Taking a walk down the memory lane, the study by Sorkin (1978) can be regarded as one of the earliest studies of its kind to examine the impact of health on economic growth. Sorkin (1978) argues that a decline in the birth rate positively affects economic growth. Similar research papers such as Arora (2001) scrutinized the effect of health on economic growth for 10 industrialized countries. With an increase in the rate of growth, health parameters have significantly improved. Bhargava et al. (2001) have studied the impact of health indicators for the period 1965-90 for developed and developing countries. The extent of increase in economic growth performance with the improvement in public health in developing countries is much more as compared to the developed countries. Going by Bloom et al. (2001), an annual improvement of 1 year in the life expectancy component increases growth to the tune of 4 per cent. Howitt (2005) highlighted the channels that influence the health of the country in the light of Schumpeterian

growth theory. Some time series studies like Halder (2008), McCoskey and Selden (1998) have tried to focus on the direction of causality and issue of cointegration between health expenditure and growth. The empirical literature however brings in controversial results as research papers have come up with bidirectional, unidirectional or no causality results (Devlin & Hansen, 2001). In the context of developing countries, studies concerning the bivariate analysis of economic growth and health expenditure in the post globalization era are very few.

III. An Illustrative Model

In this framework, the author has considered a three-equation model (at the individualistic level) comprising of health status, health expenditure and income earned by a person in a given period. To expand the concept of the inter-relationship between health expenditure and economic growth and how the dynamics have evolved, a framework of difference equations have been used. The difference of this model with the one proposed by Hurd & Kapteyn (2003) lies in the fact that it was developed in the context of a discrete time variable that is the time variable is only permitted to take integer values, as against a continuous time variable. The pattern of change of variables over a period of time must be described by the expected differences rather than by the derivatives or differentials. This structure is very much applicable given the fact that all the major variables in this framework can be considered at discrete time points. Before moving onto the structure of the model, the set of assumptions following Hurd & Kapteyn (2003) have been discussed below.

- i) Healthcare spending depends on income but it varies across the population;
- ii) Health and its evolution depend on the amount of spending on healthcare facilities;
- iii) Healthcare spending includes spending on nutrition, housing, medical insurance and several other attributes that affect health;
- iv) Income growth at the current period depends on the current health status.

Let y_t be the earnings, h_t be the health status and s_t be the spending on healthcare at age t and be y_{t+1} the earnings, h_{t+1} be the health status and s_{t+1} be the spending on health at age $(t + 1)$. Then, consider this simple system of difference equations :

$$1) y_{t+1} = a + bh_t$$

Substituting equation (3) in (2), we get

$$\text{or, } h_{t+1} = [c + de] + dfy_t$$

$$\text{or, } h_{t+1} = g + ky_t \text{ where, } g = c + de \text{ and } k = df.$$

This is a system of simultaneous difference equations consisting of equation (1) and equation (4).

The generic solution of this system of difference equations is given by the 'particular solution' together with the complementary function.

In matrix notations, equation 6 shows,

$$6) \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} y_{t+1} \\ h_{t+1} \end{pmatrix} + \begin{pmatrix} 0 & -b \\ -k & 0 \end{pmatrix} \begin{pmatrix} y_t \\ h_t \end{pmatrix} = \begin{pmatrix} a \\ g \end{pmatrix}$$

If stationary equilibrium exists, the particular solution can be expressed as $y_{t+1} = y_t = \bar{y}$ and $h_{t+1} = h_t = \bar{h}$. Substituting these values in the matrix form,

$$7) \bar{y} - b\bar{h} = a$$

$$8) \bar{h} - k\bar{y} = g$$

Solving (7) and (8) simultaneously, the particular solution is

$$\bar{h} = \frac{ak + g}{1 - bk} \text{ and } \bar{y} = \frac{a + bg}{1 - bk}$$

The search for the complementary function, based on the trial solutions mr^t and nr^t , involves the reduced form of the matrix since $r^t \neq 0$

$$9) \begin{pmatrix} r & -b \\ -k & r \end{pmatrix} \begin{pmatrix} m \\ n \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

In order to avoid the trivial solutions, set

$$\begin{vmatrix} r & -b \\ -k & r \end{vmatrix} = 0$$

$$\text{or, } r^2 - bk = 0$$

$$\text{or, } r^2 = bk$$

$$\text{or, } r = \pm\sqrt{bk}$$

Assuming only positive values of r (given both b and k to be positive), the solution is,

$$10) y_t = m(\sqrt{bk})^t + \left(\frac{a + bg}{1 - bk} \right)$$

$$11) h_t = n \left(\sqrt{bk} \right)^t + \left(\frac{ak + g}{1 - bk} \right)$$

Given the values at the initial level, one can definitize the value of m and n. The values of m and n are basically functions of the initial health and the income variables and the final solution of the model is :

$$12) y_t = \left[y_0 - \left(\frac{a + bg}{1 - bk} \right) \right] \left(\sqrt{bk} \right)^t + \left(\frac{a + bg}{1 - bk} \right)$$

$$13) h_t = \left[h_0 - \left(\frac{ak + g}{1 - bk} \right) \right] \left(\sqrt{bk} \right)^t + \left(\frac{ak + g}{1 - bk} \right)$$

Consequently, equation (13) has to be substituted in equation (3) to derive the time path of health expenditure. For convergence of the time paths in case of equations (12) and (13), $\sqrt{bk}$ has to be less than 1 but the empirical dynamics of the convergence issue has been left for further research. The time paths demonstrate that an individual's income and health status will act in an analogous manner depending on the initial health status and income levels.

IV. The Empirical Framework

The theoretical structure developed in the preceding section will motivate the empirical structure used in this segment. The idea is to generalize this micro model to a macro model empirically. Ideally, one should consider a simultaneous equation framework which enables the measurement of feedback effects and establishes the interdependence between economic growth and health expenditure. This paper has evaluated the causality and long-run relationship existing between economic growth (GDP) and health care expenditures (HE) in 20 developing countries¹ using Panel Cointegration approach. I have extracted yearly data on the required components from the World Bank and the Human Development Reports for the period 1990-2015. The data on health expenditure does not include private health expenditure due to data unavailability. To avoid the scale effect, here I have considered public health expenditure (in PPP\$) as a percentage of GDP coupled with the per-capita GDP growth rate (aggregates based on constant 2005 US\$).

IV.1 Econometric Methodology

Before starting off with the panel unit root tests, the heteroskedasticity needs to be looked at. The Chi-Square value of 7.22 in Table 1 is low and lies within the confidence limits and the results undeniably confirm the absence of heteroskedasticity as the null hypothesis of "constant

¹This list includes the top performers in terms of growth in 2015 among all the developing countries in the world — : China, Philippines, Kenya, India, Indonesia, Thailand, Singapore, Nigeria, Malaysia, Peru, Thailand, U.A.E, Peru, Kazakhstan, Saudi Arabia, Colombia, Taiwan, Turkey, South Korea, and Mexico.

variance in the model” gets accepted. The foremost difference lies in the fact that in case of a panel data study, it is required to take into account the asymptotic behaviour of the time-series dimension T and cross-sectional dimension N .

Table 1. Heteroskedasticity Results

H_0 : Constant variance	Likelihood-ratio test	
	LR Chi-Square value (Z^2)	Probability > Chi-Square (Z^2)
	7.22	0.98*

Notes : * denotes significance at 95 per cent level and calculation has been done by the author in Stata 12

Levin, Lin and Chu (LLC) unit root tests have been used in this study. The test is based on their model given below :

$$\Delta y_{it} = \alpha_i y_{it-1} + \sum_{j=1}^{p_j} \beta_{ij} \Delta y_{it-j} + x_{it}' \delta + \varepsilon_{it}$$

Here, α_i is the error correction term and consequently, the null hypothesis of non-stationarity is as follows :

Test hypotheses :

H_0 : $\alpha_i = 0$ for all the cross section units, so the series is non-stationary and has a unit root.

H_1 : $\alpha_i < 0$ for at least one cross section unit, so the series is trend stationary.

When the probability value obtained from the test results is smaller than 0.05, H_0 is rejected and the stationarity of the series gets determined. LLC panel unit root test results that I have got are reported in table 2. As Levin, Lin and Chu (2002) have pointed out; this test-statistic performs well when N lies between 10 and 250 and when T lies between 5 and 250. To determine whether a cointegrating relationship exists or not, the methodology proposed by Pedroni (1999) has been employed. Fundamentally, it employs four panel statistics and three group panel statistics to test the null hypothesis of no cointegration against the alternative hypothesis of cointegration. The first set is the within-dimension approach comprising of four statistics that are - panel v -statistic, panel $\tilde{t}$ -statistic, panel PP-statistic and the panel ADF-statistic (Pedroni, 1999). This set pools the autoregressive coefficients across various members for the unit root tests to be carried out on the estimated residuals. The second set of statistics, centered on the between-

dimensional approach, includes three statistics that are respectively the group $\tilde{n}$ -statistic, group PP-statistic and group ADF-statistic. If the variables are not cointegrated it implies that the residuals are not $I(0)$. These estimators are based on Monte Carlo simulations and the details for these calculations are given in the original paper (Refer to Pedroni, 1999). If the null hypothesis is rejected in the panel case, then the variables in question are cointegrated for all the 20 countries considered. On the other hand, if the null is rejected in the group panel case, then cointegration among relevant variables exists for at least one of the countries. The VECM framework used has been given below.

$$\Delta GDP_{i,t} = \alpha_{1,i} + \phi_{1,i} ECT_{i,t} + \sum_{j=1}^k \beta_{1,j,i} \Delta HE_{i,t-j} + \sum_{j=1}^k \nu_{1,j,i} \Delta GDP_{i,t-j} + \varepsilon_{1,i,t}$$

$$\Delta HE_{i,t} = \alpha_{2,i} + \phi_{2,i} ECT_{i,t} + \sum_{j=1}^k \beta_{2,j,i} \Delta HE_{i,t-j} + \sum_{j=1}^k \nu_{2,j,i} \Delta GDP_{i,t-j} + \varepsilon_{2,i,t}$$

Where i ($i = 1, \dots, N$) denotes the state, t ($t = 1, \dots, T$) the period, j is the optimum lag considering the Akaike Information Criteria (AIC). ECT is the lagged error correction term derived from the long-run co-integrating relationship; the j_1 and j_2 are the adjustment coefficients and $\varepsilon_{1,i,t}$ and $\varepsilon_{2,i,t}$ are disturbance terms assumed to be white-noises and uncorrelated. The coefficients on the ECT s represent how fast the deviations from the long-run equilibrium are eliminated following a change in each of the variables. If the ECT s coefficients are zero ($j_{1,i} = 0$, or $j_{2,i} = 0$) for all i , then there is no error correction and thus there exists no cointegration. But if ($j_{1,i} < 0$, or $j_{2,i} < 0$) then there exists error correction and consequently, we have cointegration. This paper examines the health expenditure and per-capita GDP growth rate relationship by taking advantage of the heterogeneous panel cointegration framework developed by Pedroni (1999) across the 20 major developing countries considered. It needs to be noted that the first four statistics comply with the 'within dimension' based terminology of panel data and the rest are 'between dimension' based statistics. Now, I move on to the causality issue in case of panel data. Given that, this analysis is being carried out across the 20 developing countries (as already mentioned), the assumption that coefficients are different across cross-sections follows from Dumitrescu and Hurlin (2012), i.e.

$$\alpha_{0,i} \neq \alpha_{0,j}, \alpha_{1,i} \neq \alpha_{1,j}, \dots, \alpha_{p,i} \neq \alpha_{p,j}, \mu_{0,i} \neq \mu_{0,j}, \mu_{1,i} \neq \mu_{1,j}, \dots, \mu_{p,i} \neq \mu_{p,j} \text{ and}$$

$$\beta_{1,i} \neq \beta_{1,j}, \dots, \beta_{p,i} \neq \beta_{p,j} \text{ \& } \eta_{1,i} \neq \eta_{1,j}, \dots, \eta_{p,i} \neq \eta_{p,j} \text{ for all } i \text{ and } j.$$

Bivariate regressions in Dumitrescu and Hurlin (2012) take the form,

$$y_{i,t} = \alpha_{0,i} + \sum_{p=1}^k \alpha_{p,i} y_{i,t-p} + \sum_{p=1}^k \beta_{p,i} x_{i,t-p} + \varepsilon_{i,t}$$

$$x_{i,t} = \mu_{0,i} + \sum_{p=1}^k \mu_{p,i} x_{i,t-p} + \sum_{p=1}^k \eta_{p,i} y_{i,t-p} + e_{i,t} \text{ where,}$$

t denotes the time period dimension of the panel, and i denotes the cross-sectional dimension and k is the number of lags. This assumption is applicable in this context contrary to the assumption where the panel is treated as one large stacked set of data points. The intention is to perform Granger causality regressions for each and every individual cross-sectional unit. Subsequently, take the average of the Wald statistics derived from each cross section to get the W-bar statistic.

V. Results and Discussion

Table 2 presents the results of the Levin, Lin, Chu (LLC) unit root tests. The results indicate that both variables are stationary after first differencing. In other word, both variables are integrated of order (1). Hence, we can apply the procedure of Pedroni (1999) to look into the cointegration possibility between the focus variables. The results in table 3 clearly indicate that there exists a cointegrated relationship between health spending and per-capita economic growth in long run.

Table 2. LLC Unit Root Test Results

Variables	Level	Probability	1 st Difference	Probability	Result
GDP	0.37	0.61	-3.40	0.00*	I(1)
HE	-0.63	0.27	-4.62	0.00*	I(1)

*Source : Results obtained in Eviews 7 are significant at 5 per cent level

Table 3. Panel Cointegration Test

Test procedure	Test statistic	Probability value	Result
Panel v-statistic	3.19	0.00*	Cointegration
Panel rho-statistic	-2.35	0.00*	Cointegration
Panel PP-statistic	-3.08	0.00*	Cointegration
Panel ADF-statistic	-2.90	0.00*	Cointegration
Group rho-statistic	-4.72	0.00*	Cointegration
Group PP-statistic	-2.77	0.00*	Cointegration
Group ADF-statistic	-8.11	0.00*	Cointegration

*Source : Results obtained in Eviews 7 are significant at 5 per cent level

However, the presence of a cointegration relationship does not give any idea on the causality relationship between the variables. The results of the Wald test for causality are reported in Table 4.

Table 4. Results of Panel Causality Test

Null Hypothesis	Wald Statistic	Probability
HE does not Granger Cause GDP	2.23	0.04*
GDP does not Granger Cause HE	4.59	0.00*

*Source : Results obtained in Eviews 7 are significant at 5 per cent level

Therefore, there is a bilateral causality running between GDP and HE which are consistent with the results in Hurd and Kapteyn (2003). The higher is the health care expenditure, better are the infrastructural facilities and as people are able to avail these facilities, the burden of disease falls. Thus, labourers become much more productive and are able to bring in more income. A rise in income in the subsequent periods eventually leads to economic growth. On the other hand, if economic growth rises it means the citizens are much better off. This in turn means that the citizens will be capable enough to demand high quality health infrastructure which in turn will pressurize the Government to increase health care expenditures. The arguments can be seen from a negative perspective also that is suppose if health care expenditure is low, health infrastructure will be poor and labour productivity will fall so eventually economic growth peters out. When economic growth is low this means people are not capable of earning more so demand for quality health care services will be less so health care expenditure will also be less. So, the bi-directional causal relation is justified in this context.

VI. Concluding Remarks

This article explored the economic liaison between health care expenditure and per-capita GDP in the developing countries over an interval of twenty five years. I have studied the stationarity and cointegration properties of health care expenditure and per-capita GDP growth. The analysis illustrates that the focus variables are non-stationary, and that they are linked in the long run. For the panel test, our result clearly rejects the null hypothesis of no cointegration. In other words, the findings indicated income as an important factor across countries in the growth of health care expenditure. The health-led growth hypothesis in the developing countries gets validated in my study. Due to time limitations, this model could not be extended for the developed countries. Also, in the future, this model can be extended to include education expenditure as a percentage of GDP which would put in another dimension to this subject. The significant impact of health spending on growth validates the necessity of governments' intervention by implementing the policies to encourage health spending required to develop a healthier and a productive society to support economic growth and development in these developing countries.

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PATTERN AND EFFECT OF CHILD NUTRITIONAL INDICATORS ON CHILD SURVIVAL STATUS IN INDIA

BASUDHA MUKHOPADHYAY*

Abstract

Background: There is a noticeable inconsistency of income growth and prevalence of undernutrition among children in India. There are evidences that suggest that there is varied magnitude of the existence child undernutrition in different states of India. Again the long cherished goal of reducing the infant mortality rate has not yet reached its target. The present paper is an attempt to examine the pattern and influence of child nutritional status on infant mortality and under five mortality across India.

Methods: The present paper attempted to investigate this question using Unit- level data from NFHS-1, NFHS-2 and NFHS-3 and factsheet data from NFHS-4 (2015-16) for all the states in India. The dependent variables were infant mortality and under five mortality rates. The independent variables are the child nutritional status. In this paper, bar graphs are used to depict the pattern of child nutrition and child survival status in India. Further, Normality test was performed to determine whether the dataset is distributed and thereafter Correlation to quantify the strength of the linear relationship between the variables.

Main Findings: The result shows that the pattern of child nutritional indicators and child survival status varies across states and in all the four rounds of NFHS. It is observed that the data follows a normal distribution and there is a significant association between stunting and underweight with child survival status. The result also shows that all the nutritional status do not affect the child survival status equally in all the rounds of NFHS.

Conclusion: Thus in spite of the declining trend of infant mortality rate and childhood nutritional status, there is still a need for developing a strong information, education and communication programme with respect child survival and nutritional status to achieve the Sustainable Development goal of ending all forms of malnutrition by 2030. This paper calls for a detailed study on the other factors that may be responsible for determining the status of child survival in different states of our country.

Key words: Infant Mortality, Under five Mortality, Stunting, Wasting, Underweight, Normality, Correlation and Regression.

JEL Classification Code: H51; I 15, J13; O53

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I. Introduction

In the context of development, undernutrition among children is a disturbing feature that exists in developing countries. This is important because undernutrition of children not only affects the health and well-being of the population but also affects the future human capital formation which is essential to augment the growth of the economy. Under nutrition is the biggest challenge facing the global community today. At least 12 of the 17 Sustainable Development Goals contain indicators that are highly relevant for nutrition, reflecting nutrition's central role in sustainable development. Improved nutrition is the platform for progress in health, education, employment, female empowerment, and poverty and inequality reduction. Every child has the right to a fair chance in life. (India Health Report: Nutrition 2015) Leaving no child behind is both a moral imperative and a strategic priority for the development of inclusive, sustainable and stable societies everywhere. (Unicef, 2015).

But health care has been one of the most neglected aspects of development in India. Despite stirring statements in planning documents on the centrality of health and health care, the field has suffered from persistent neglect in public policy in general and development planning in particular (Dreze and Sen **2002**). In the past two decades, India have seen significant improvements in Household incomes, agricultural productivity and child survival. (India Health Report: Nutrition 2015)

There is various literatures to demonstrate the fact that India continues to be the single largest contributor to the global prevalence of undernutrition. The noticeable incongruity of the considerable income growth realized in India not leading to equivalent decreases in the prevalence of undernourishment, and similarly of not relocating into proportionate reductions in anthropometric measures of undernutrition (stunting, for example) has been the subject of several papers, the most frequently cited among them being Deaton and Dreze (2009) and the literature to which it gave rise.

Again, the Infant mortality Rate (IMR)-probability of dying before one year of age expressed per 1000 live-births and under-five mortality (U5MR)-probability of dying between birth and age 5 expressed per 100 live births have been used as measures of children's well-being for many years. Infant and child mortality rates are considered as sensitive indicators of living and socio-economic conditions of a country. This recognition has made the international organizations as well as National Governments to intensify their efforts to reduce infant and improve child survival.

But the situation in states in India show a different picture. In India, according to SRS 2012, the percentage of infant deaths to total deaths varies across the states. The percentage of under-five deaths to total deaths ranges from 2.7 percent in Kerala, 5.1 percent in Tamil Nadu to 23.4 percent in Bihar, 23.2 percent in Uttar Pradesh, 22.7 percent in Rajasthan, while other states figures between these states.

Against this backdrop, by using the information from all the four rounds of NFHS, the present

paper attempts to show the pattern of child nutritional indicators and child survival status in different states in India. Further, this paper attempted to examine whether the child nutritional indicators have significant influence on child survival status in India. For that purpose regression analysis is used to estimate the effect of nutritional indicators on child survival status in India. Linear regression requires all the variables to be multivariate normal. Hence normality test is used to determine whether the data set are normally distributed. Thereafter correlation is performed to quantify the strength of the linear relationship between the variables.

The following definitions are required for the study

Definitions:

Under-nutrition: This is condition where the body does not have adequate amounts of one or more nutrients and usually reflects in anthropometric indicators such as stunting (height-for-age), underweight (weight-for-age) and wasting (weight-for-height).

Stunting: This reflects short stature-for-age. A child who has height-for-age z-scores less than -2 standard deviations of the reference population of well-nourished children is considered chronically malnourished (stunted).

Underweight: Reflects too light for age. Children whose weight-for-age z-score is less than -2 standard deviation of the reference population of well-nourished or healthy children is considered to be underweight.

Wasting: Reflects too thin for height and is due to recent and severe shortage of food and/ or disease. A child who has a weight-for-height z-score less than -2 standard deviations of the reference population is considered acutely malnourished.

Infant Mortality Rate: IMR is the number of deaths of infants under one year old per 1000 live births. This rate is often used as an indicator of the level of health in a country.

Under-five mortality rate: Probability of dying between birth and exactly 5 years of age, expressed per 1000 live-births.

II. Data and Methodology

The data in this study is based on NFHS surveys conducted in India during the year 1992-93, 1998-99, 2005-06 and 2014-15.

NFHS-1 was conducted during April 1992 to September 1993, with a nationally representative sample of 88,562 households and 89,777 ever-married women in the age group 13-49 from 24 states and then National Capital of Delhi (which later attained statehood) using uniform questionnaire, sample design and field procedures.

NFHS-2 conducted during 1998-99, covered a representative sample of about 91,000 ever-married women age 15-49 from 26 states. The survey provides state-level estimates of demographic and health parameters as well as data on various socio-economic dimensions.

NFHS-3 was conducted from December 2005 to August 2006 with interviews with more than 230,000 women age 15-49 and men age 15-54 throughout India.

NFHS-4 is the latest health survey conducted in 2014-15 with a sample size of 568,200 households. In these households information about 265,653 children below the age 5, 93,065 men and 625,014 women were interviewed.

The main objective of the surveys was to collect reliable information on all health related issues.

In the present paper we used Bar graphs to show the pattern of Child Undernutrition and Child survival status for different states in India. Further, this paper attempted to examine whether the child nutritional indicators have significant influence on child survival status in India. For that purpose regression analysis is used to estimate the effect of nutritional indicators on child survival status in India. Linear regression requires all the variables to be multivariate normal. Hence normality test is used to determine whether the data set are normally distributed. Thereafter correlation is performed to quantify the strength of the linear relationship between the variables.

III. Analysis

One of the indicators of undernutrition among young children (under five years) is the prevalence of stunting, which refers to compromised age-specific growth in height and is considered an indicator of long term deprivation. Another is underweight, which refers to low weights (relative to age), and captures short-term loss in weight due to illness or inadequate food intake. Another indicator is wasting which refers to reflects too thin for height and is due to recent and severe shortage of food and/ or disease. A child who has a weight-for-height z-score less than -2 standard deviations of the reference population is considered acutely malnourished and is due to short-term undernutrition. A third indicator is underweight which reflects too light for age. Children whose weight-for-age z-score is less than -2 standard deviation of the reference population of well-nourished or healthy children is considered to be underweight.

These measures of undernutrition pertain to young children, they have long-term economic and health consequences into adulthood, and also for the inter-generational transmission of malnutrition. Undernourished young girls often grow up to be undernourished mothers, who in turn tend to give birth to babies with low birth weights.

In order to understand the pattern of child nutritional status and the child survival status, tables 1, 2, 3 and 4 are used to represent the percentages of stunting, wasting and underweight, and infant and under-5 mortality parameters for different states in India for the four rounds of NFHS i.e., NFHS1, NFHS2, NFHS3 and NFHS4 respectively.

It can be observed from the following tables that the proportion of stunting and underweight reduced in Indian states during the last two rounds of NFHS, but a rising trend is observed in the prevalence of wasting among children below 5 years. The data from NFHS-4 indicates that all the 29 states have witnessed a decline in the proportion of stunting among children below 5 years between NFHS-3 and NFHS-4.

During 2015-16, the prevalence of stunting among children below 5 years has been the highest in Bihar (48.2 percent), followed by Uttar Pradesh (46.3 percent), Jharkhand (45.3 percent), Meghalaya (43.8 percent) and Madhya Pradesh (42.0 percent). The proportion of stunting children has been lowest in Kerala (19.7 percent), followed by Goa (20.1 percent), Tripura (24.3 percent), Punjab (25.7 percent), and Himachal Pradesh (26.3 percent) during the same year.

According to UNICEF, stunting, or low height for age, is caused by insufficient nutrient intake and frequent infections. Stunting generally happens below two years of age, and the effects are largely irreversible. These includes delayed motor development, impaired cognitive function and poor school performance. The percentage of stunting is presented in Table:1

Table:1 Percentage of stunting in the four NFHS rounds across all the states in India

States	Stunting(%)			
	NFHS1	NFHS2	NFHS3	NFHS4
Andhra Pradesh		38.6	38.4	31.4
Arunachal Pradesh	53.9	26.5	37	29.4
Assam	52.2	50.2	41.1	36.4
Bihar	60.9	53.7	50.1	48.3
Chhattisgarh			52.6	37.6
Delhi	43.2	36.8	43.2	32.3
Goa	32.5	18.1	25.9	20.1
Gujarat	48.2	43.6	49.2	38.5
Haryana	46.7	50	43.3	34
Himachal Pradesh		41.3	34.3	26.3
Jammu and Kashmir	40.8	38.8	33.1	27.4
Jharkhand			47.2	45.3
Karnataka	47.6	36.6	42.4	36.2
Kerala	27.4	21.9	26.5	19.7
Madhya Pradesh		51	46.5	42
Maharashtra	48.5	39.9	44	34.4
Manipur	33.6	31.3	29	28.9
Meghalaya	50.8	44.9	47.7	43.8
Mizoram	41.3	34.6	35.1	28
Nagaland	32.4	33	34.1	28.6
Orissa	48.8	44	43.9	34.1
Punjab	40	39.2	34.7	25.7
Rajasthan	43.1	52	40.1	39.1
Sikkim		31.7	31.8	29.6

Tamil Nadu		29.4	31.1	27.1
Tripura	46		34.1	24.3
Uttar Pradesh	59.5	55.5	52.4	46.3
Uttarakhand			39.6	33.5
West Bengal		41.5	41.8	32.5
Andaman and Nicobar				23.3
Chandigarh				28.7
Daman and Diu				23.4
Dadra & Nagar Haveli				41.7
Lakshadweep				
Puducherry				23.7
Telangana				28.1

Sources: 1992/93, 1998/99 and 2005/06 data are computed from the unit-record data of the first, second and third rounds of National Family Health Survey, respectively; and factsheet data are taken for 2005/06 from the fourth round of National Family Health Survey.

During 2015-16, the prevalence of wasting among children below 5 years has been the highest in Jharkhand (29.0 percent), followed by Gujarat (26.4 percent), Karnataka (26.1 percent), Madhya Pradesh (25.8 percent), and Maharashtra (25.6 percent). The proportion of wasted children has been lowest in Mizoram (6.1 percent), followed by Manipur (6.8 percent), Nagaland (11.2 percent), Jammu and Kashmir (12.1 percent), and Himachal Pradesh (13.7 percent).

According to UNICEF, wasting, or low weight for height, is a strong predictor of mortality among children under five years of age. Wasting occurs due to recent food deprivation or serious illness. The percentage of wasting is presented in Table:2

Table:2 Percentage of wasting in the four NFHS rounds across all the states in India

States	Wasting(%)			
	NFHS1	NFHS2	NFHS3	NFHS4
Andhra Pradesh		9.1	14.9	17.2
Arunachal Pradesh	11.2	7.9	17	17.3
Assam	10.8	13.3	16.7	17
Bihar	21.8	21	32.6	20.8
Chhattisgarh			24.1	23.1
Delhi	11.9	12.5	17.2	17.1
Goa	15.3	13.1	12.8	21.9
Gujarat	18.9	16.2	19.7	26.4
Haryana	5.9	5.3	22.4	21.2

Himachal Pradesh		16.9	19.9	13.7
Jammu and Kashmir	14.8	11.8	18.1	12.1
Jharkhand			35.8	29
Karnataka	17.4	20	18.9	26.1
Kerala	11.6	11.1	15.6	15.7
Madhya Pradesh		19.8	39.5	25.8
Maharashtra	20.2	21.2	17.2	25.6
Manipur	8.8	8.2	10.8	6.8
Meghalaya	18.9	13.3	31.8	15.3
Mizoram	2.2	10.2	9.7	6.1
Nagaland	12.7	10.4	15.8	11.2
Orissa	21.3	24.3	23.7	20.4
Punjab	19.9	7.1	10.2	15.6
Rajasthan	19.5	11.7	22.5	23
Sikkim		4.8	12.8	14.2
Tamil Nadu		19.9	22.9	19.7
Tripura	17.5		24	16.8
Uttar Pradesh	16.1	11.1	19.5	17.9
Uttarakhand			18.2	19.5
West Bengal		13.6	19.2	20.3
Andaman and Nicobar				18.9
Chandigarh				10.9
Daman and Diu				24.1
Dadra & Nagar Haveli				27.6
Lakshadweep				
Puducherry				23.6
Telangana				18

Sources: 1992/93, 1998/99 and 2005/06 data are computed from the unit-record data of the first, second and third rounds of National Family Health Survey, respectively; and factsheet data are taken for 2005/06 from the fourth round of National Family Health Survey.

During 2015-16, the proportion of underweight children below 5 years has been the highest in Jharkhand (47.8 percent), followed by Bihar (43.9 percent), Madhya Pradesh (42.8 percent), Uttar Pradesh (39.5 percent), and Gujarat (39.3 percent). The proportion of underweight children below 5 year age has been the lowest in Mizoram (11.9 percent), followed by Manipur (13.8 percent), Sikkim (14.2 percent), Kerala (16.1 percent), and Jammu and Kashmir (16.6 percent). The percentage of wasting is presented in Table 2

Table:3 Percentage of underweight in the four NFHS rounds across all the states in India

States	Underweight(%)			
	NFHS1	NFHS2	NFHS3	NFHS4
Andhra Pradesh	49.1	37.7	29.8	31.9
Arunachal Pradesh	39.7	24.3	29.7	19.5
Assam	50.4	36	35.8	29.8
Bihar	62.6	54.4	54.9	43.9
Chhattisgarh			47.8	37.7
Delhi	41.6	34.7	24.9	27
Goa	35	28.6	21.3	23.8
Gujarat	50.1	45.1	41.1	39.3
Haryana	37.9	34.6	38.2	29.4
Himachal Pradesh	47	43.6	31.1	21.2
Jammu and Kashmir	44.5	34.5	24	16.6
Jharkhand			54.6	47.8
Karnataka	54.3	43.9	33.3	35.2
Kerala	28.5	26.9	21.2	16.1
Madhya Pradesh	57.4	55.1	57.9	42.8
Maharashtra	54.2	49.6	32.7	36
Manipur	30.1	27.5	19.5	13.8
Meghalaya	45.5	37.9	42.9	29
Mizoram	28.1	27.7	14.2	11.9
Nagaland	28.7	24.1	23.7	16.8
Orissa	53.3	54.4	39.5	34.4
Punjab	45.9	28.7	23.6	21.6
Rajasthan	41.6	50.6	36.8	36.7
Sikkim		20.6	17.3	14.2
Tamil Nadu	48.2	36.7	25.9	23.8
Tripura	48.8		35.2	24.1
Uttar Pradesh	59	51.7	41.6	39.5
Uttarakhand			31.7	26.6
West Bengal	56.8	48.7	37.6	31.5
Andaman and Nicobar				21.6
Chandigarh				24.5
Daman and Diu				26.7
Dadra & Nagar Haveli				38.9
Lakshadweep				
Puducherry				22
Telangana				28.5

Sources: 1992/93,1998/99 and 2005/06 data are computed from the unit-record data of the first, second and third rounds of National Family Health Survey, respectively; and factsheet data are taken for 2005/06 from the fourth round of National Family Health Survey.

Infant Mortality Rate (IMR) declined from 57 to 41 per 1000 live-births between NFHS-3(2005-06) and NFHS-4(2014-15). IMR declined substantially in almost all the states during the last decade. It dropped by more than 20 percentage points in Tripura, West Bengal, Jharkhand, Arunachal Pradesh, Rajasthan and Odisha. IMR substantially declined over the period from 79 per 1000 live births in NFHS-1 (1992-93) to 41 per 1000 live-births in NFHS-4. The IMR and under five MR are shown in Table 4.

Table:4 Percentage of infant mortality and under-five mortality in the four NFHS rounds across all the states in India

	NFHS2		NFHS1		NFHS3		NFHS4	
	Infant Mortality	under 5 mortality rate	Infant Mortality	under 5 mortality rate	Infant Mortality	under 5 mortality rate	Infant Mortality	under 5 mortality rate
India	67.6	94.9	78.5	109.3	57	74.3		
Delhi	46.8	55.4	65.4	83.1	39.8	46.7	35	47
Haryana	56.8	76.8	73.3	98.7	41.7	52.3	33	41
Himachal Pradesh	34.4	42.4	55.8	69.1	36.1	41.5	34	38
Jammu & Kashmir	65	80.1	45.4	59.1	44.7	51.2	32	38
Punjab	57.1	72.1	53.7	68	41.7	52	29	33
Rajasthan	80.4	114.9	72.6	102.6	65.3	85.4	41	51
Madhya Pradesh	86.1	137.6	85.2	130.3	69.5	94.2	51	65
Uttar Pradesh	86.7	122.5	99.9	141.3	72.7	96.4	64	78
Bihar	72.9	105.1	89.2	127.5	61.7	84.8	48	58
Orissa	81	104.4	112.1	131	64.7	90.6	40	49
West Bengal	48.7	67.6	75.3	99.3	48	59.6	27	32
Arunachal Pradesh	63.1	98.1	40	72	60.7	87.7	23	33
Assam	69.5	89.5	88.7	142.2	66.1	85	48	56
Manipur	37	56.1	42.4	61.7	29.7	41.9	22	26
Meghalaya	89	122	64.2	86.9	44.6	70.5	30	40
Mizoram	37	54.7	14.6	29.3	34.1	52.9	40	46
Nagaland	42.1	63.8	17.2	20.7	38.3	64.7	29	37
Sikkim	43.9	71	75.8	104.6	33.7	40.1	29	32
Goa	36.7	46.8	31.9	38.9	15.3	20.3	13	13
Gujarat	62.6	85.1	68.7	104	49.7	60.9	34	43

Maharashtra	43.7	58.1	50.5	70.3	37.5	46.7	24	29
Andhra Pradesh	65.8	85.5	70.4	91.2	53.5	63.2	35	41
Karnataka	51.5	69.8	65.4	87.3	43.2	54.7	28	32
Kerala	16.3	18.8	23.8	32	15.2	16.3	6	7
Tamil Nadu	48.2	63.3	67.7	86.5	30.4	35.5	21	27
Uttaranchal					41.9	56.8	40	47
Chattisgarh					70.8	90.3	54	64
Jharkhand					68.7	93	44	54
Tripura					51.5	59.2	27	33
Anadaman and Nicobar							10	13

Sources: 1992/93, 1998/99 and 2005/06 data are computed from the unit-record data of the first, second and third rounds of National Family Health Survey, respectively; and factsheet data are taken for 2005/06 from the fourth round of National Family Health Survey.

The bar graphs are drawn to pictorially depict the relative position of these variables in different rounds of NFHS for all the states of India.

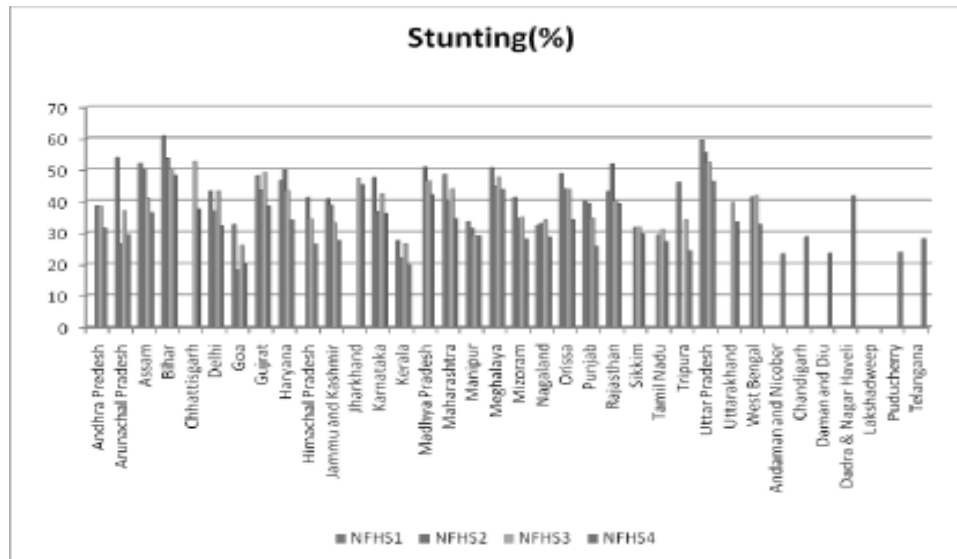
It can be observed from the Figure 1 that the level of stunting reduced in almost all the states of India. But there is a noticeable inter-state variations. Among the Northern states, it can be seen that in Punjab there is a sharp decline in stunting from 40% in NFHS-1 to 39.2 % in NFHS-2 to 34.7 % in NFHS-3 to 25.75 in NFHS-4. While in Rajasthan, it was 43.1 in NFHS-1, which increased to 52% in NFHS-2, got reduced to 40.1% in NFHS-3 and further to 39.1% in NFHS-4.

Among the states situated in the central part of the country, in Madhya Pradesh the rate of stunting reduced from 52% in NFHS-2 to 42% in NFHS-4, while in Uttar Pradesh the rate declined from 59.5% in NFHS-1 to 46.3% in NFHS-4.

In the state of West Bengal in the east, there is around 9% decline in the rate of stunting from 41.5 % in NFHS-2 to 32.5 % in NFHS-4. Among the north eastern states, a sharp decline is observed in the state of Assam from 52.2% in NFHS-1 to 50.2% in NFHS-2 to 41.1% in NFHS-3 to 36.4 % in NFHS-4, while in Manipur it declined from 33.6% in NFHS-1 to 28.9% in NFHS-4.

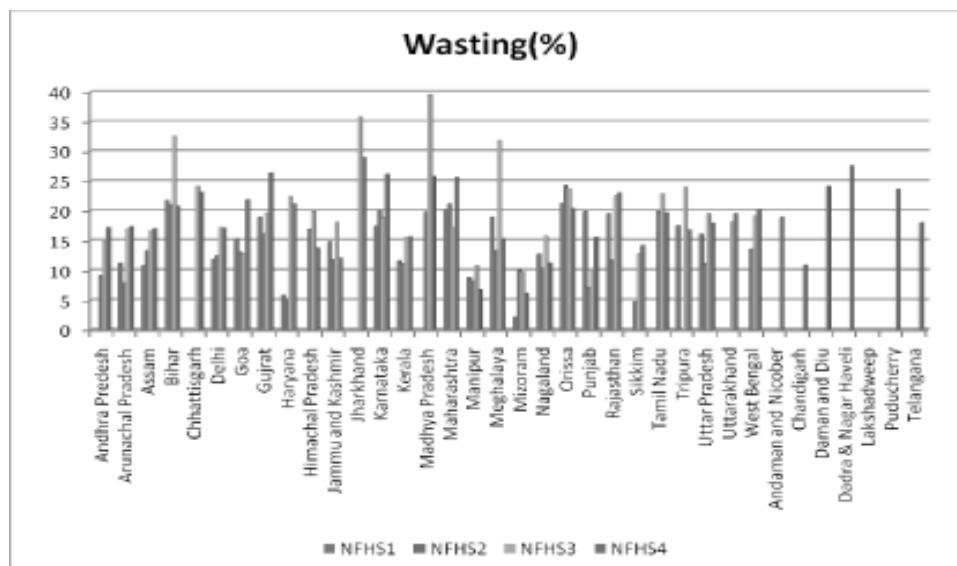
In the west, the state of Gujarat shows a 10% decline in the rate of stunting from 48.2% in NFHS-1 to 36.2 % in NFHS-4 while in Maharashtra there is a remarkable decline from 48.5% in NFHS-1 to 36.2 % in NFHS-4.

The southern states shows a slight decrease in the rate of stunting from 38.6% in NFHS-2 to 31.4% in NFHS-4 in Andhra Pradesh and 29.4% to 27.1 % in the state of Tamil Nadu.

Figure1: Pattern of Stunting in different states in India

Sources: Authors compilation from NFHS-1, 2 and 3 unit data and NFHS-4 factsheet data

It can be observed from Table:2 and Figure:2 that the rate of wasting has increased slightly in certain states like Andhra Pradesh, Arunachal Pradesh, Assam, Karnataka, Maharashtra, Rajasthan and West Bengal from NFHS-1 to NFHS-4. While certain states like Bihar, Jharkhand, Madhya Pradesh, Meghalaya, Tamil Nadu and Tripura had higher rate of wasting in NFHS-3, which got slightly reduced in NFHS-4.

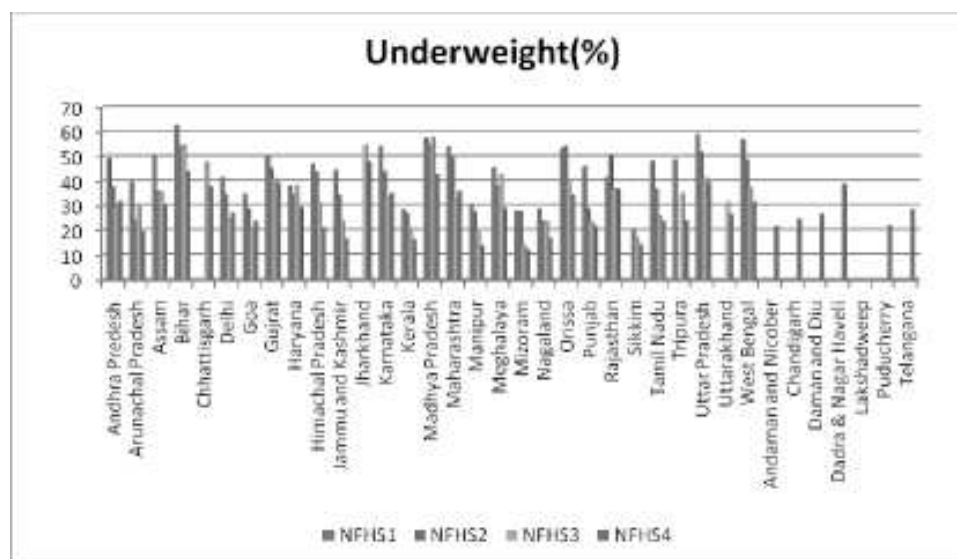
Figure 2: Pattern of wasting in different states in India

Sources: Authors compilation from NFHS-1, 2 and 3 unit data and NFHS-4 factsheet data

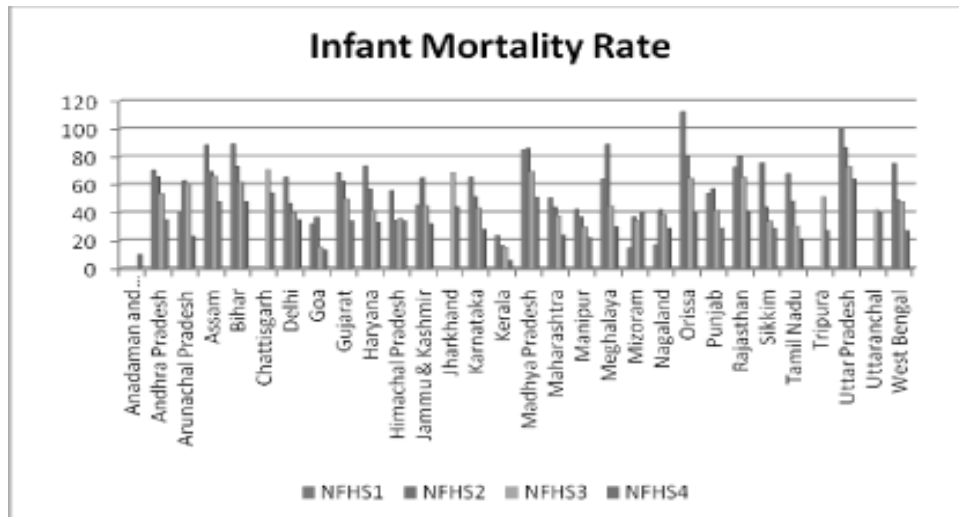
In terms of Underweight, it can be observed from Table 3 and Figure 3 that there had been a reduction in the rate in almost all the states of the country when compared from NFHS-1 to NFHS-4. Among the northern states, Delhi has shown a sharp reduction in the rate of Underweight from 41.6% in NFHS-1 to 34.7% in NFHS-2 to 29.9% in NFHS-3 to 27% in NFHS-4. But a reduction reduction can be seen in case of Himachal Pradesh where the rate has decreased from 47% in NFHS-1 to 21.2% in NFHS-4.

Among the states situated in the central part of the country, Uttar Pradesh has shown around 20% decline in Underweight from 59% in NFHS-1 to 39.5% in NFHS-4. A sharp decline can also be observed in Orissa in the eastern part of the country. Here, underweight percentage declined from 53.3% in NFHS-1 to 34.4% in NFHS-4. In the north eastern part of the country, the state of Arunachal Pradesh shows a 20% decline in Underweight percentage from 39.7% in NFHS-1 to 19.5% in NFHS-4. Among the western states, Gujarat has shown a decline in the rate from 50.1% in NFHS-1 to 41.1% in NFHS-3 to 39.3% in NFHS-4. Again, in Kerala, a state in the south, has shown a dip in the rate from 28.5% in NFHS-1 to 16.1% in NFHS-4.

Figure 3: Pattern of underweight in different states in India

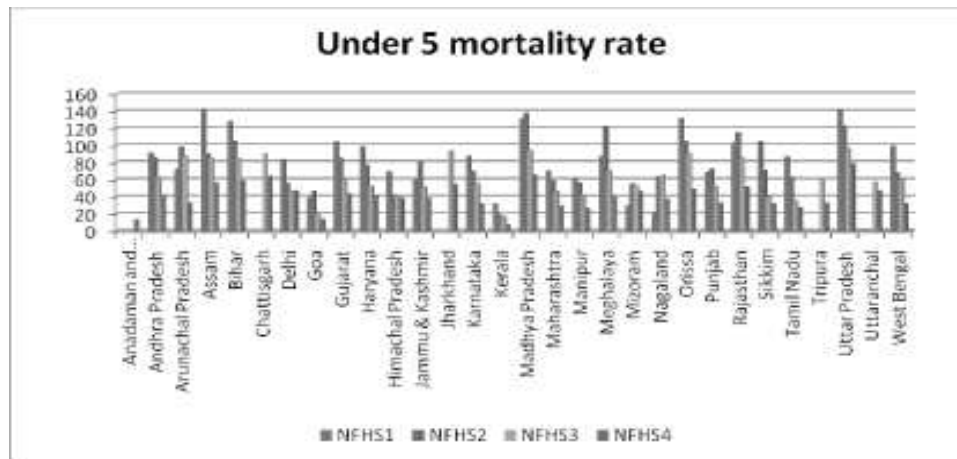


Sources: Authors compilation from NFHS-1, 2 and 3 unit data and NFHS-4 factsheet data

Figure 5 :Pattern of infant mortality rate in different states in India

Sources: Authors compilation from NFHS-1, 2 and 3 unit data and NFHS-4 factsheet data

It can be perceived from Table 4 and Figure 3 and Figure 4 that both the Infant Mortality and Child Mortality rates have declined for almost all the states of India when compared from NFHS-1 to NFHS-4.

Figure 6: Pattern of under five mortality rate in different states in India

Sources: Authors compilation from NFHS-1, 2 and 3 unit data and NFHS-4 factsheet data For the purpose of understanding the effect of child nutritional status on child survival status in India, regression analysis is used. Multiple regression assumes that the variables are normally distributed. Hence the Shapiro-Wilk test is performed to determine whether the data set is well-modelled by the normal distribution. The null hypothesis of this test is that the population is normally distributed. Thus, if the p-value is less than 0,05, then the null hypothesis is rejected and there is evidence that the data tested are not from a normally distributed population, in other

words the data is not normal. On the contrary, if the p-value is greater than 0.05 then the null hypothesis that the data came from a normally distributed population cannot be rejected. Table:5 shows the Test of Normality. **Table:5 Tests of Normality**

NFHS		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Stunting(%)	1	0.109	19	0.200	0.972	19	0.819
	2	0.102	25	0.200	0.976	25	0.802
	3	0.108	29	0.200	0.973	29	0.636
	4	0.098	30	0.200	0.975	30	0.670
Wasting(%)	1	0.148	19	0.200	0.940	19	0.268
	2	0.161	25	0.092	0.954	25	0.305
	3	0.167	29	0.037	0.911	29	0.018
	4	0.078	30	0.200	0.977	30	0.741
Underweight(%)	1	0.112	19	0.200	0.955	19	0.472
	2	0.134	25	0.200	0.937	25	0.129
	3	0.090	29	0.200	0.965	29	0.435
	4	0.092	30	0.200	0.972	30	0.603
Infant Mortality	1	0.103	19	0.200	0.977	19	0.895
	2	0.106	25	0.200	0.965	25	0.531
	3	0.116	29	0.200	0.952	29	0.211
	4	0.106	30	0.200	0.984	30	0.925
Under 5 mortality rate	1	0.099	19	0.200	0.958	19	0.534
	2	0.109	25	0.200	0.978	25	0.854
	3	0.158	29	0.061	0.943	29	0.123
	4	0.103	30	0.200	0.981	30	0.839

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction **Sources: Authors compilation from NFHS-1, 2 and 3 unit data and NFHS-4 factsheet data**

From the above table it can be seen that the data on stunting, wasting, underweight, infant mortality and child mortality rate follows a normal distribution checked by Shapiro Wilk test, the p-value being higher than .05 in all the cases, except wasting in NFHS-3 which is .018. Hence we can apply Pearson's correlation coefficient to understand the association between the variables and multiple linear regression method to understand the dependency of infant mortality rate and under-five mortality rate on stunting, wasting and underweight.

The goal of correlation analysis is to see whether the measurement variables covary, and to quantify the strength of the relationship between the variables. To quantify the strength of the linear relationship, we calculate the Pearson's Product Moment Correlation Coefficient. Its numerical value ranges from +1.0 to -1.0. On the other hand, regression expresses the relationship in the form of an equation. Hence, in order to quantify the strength of the linear relationship between the child nutritional indicators and child survival status, correlation excise is performed.

Let the null hypothesis be H_0 , which implies that there is no correlation.

It can be observed from Table:6 ,that in case of NFHS-1, there is a significant positive correlation between infant mortality rate and under-five mortality rate with the three parameters of malnutrition i.e., stunting, wasting and underweight, the p-values being less than .05 in all the cases. Hence the null hypothesis is rejected in all the cases except wasting, with under-five mortality rate where the p-value is > than 0.05.

In case of NFHS-2, the correlation coefficient between stunting and Infant Mortality Rate is 0.749 and with Underfive Mortality rate is 0.717. Correlation Coefficient between underweight and Infant Mortality Rate is 0.587, while with Under-five Mortality rate it is 0.548. In both the cases we have significant p-values and hence the null hypothesis is rejected. But with regard to wasting there is little correlation as the p-vau is > .05.

In NFHS-3, there is a significant correlation between the three antropometric measures on child undernutrition and child survival status. Hence, in all the cases the null hypothesis is rejected.

Again, as observed from Table 6, in NFHS-4 a sifnificant correlation is witnessed between stunting and undernutrition with Infant and Under five Mortality status. So null hypothesis is rejected in these two cases. But, with regards to wasting, there is no significant correlation , as the p-values are .299 and .240 respectively which are > .05.

Table 6: Results of correlation

Correlations				
NFHS			Infant Mortality	Under5 mortality rate
1	Stunting(%)	Pearson Correlation	0.730	0.810
		p Value	0.000	0.000
	Wasting(%)	Pearson Correlation	0.494	0.408
		p Value	0.032	0.083

	Underweight(%)	Pearson Correlation	0.812	0.804
		p Value	0.000	0.000
2	Stunting(%)	Pearson Correlation	0.749	0.717
		p Value	0.000	0.000
	Wasting(%)	Pearson Correlation	0.224	0.181
		p Value	0.281	0.388
	Underweight(%)	Pearson Correlation	0.587	0.548
		p Value	0.002	0.005
3	Stunting(%)	Pearson Correlation	0.765	0.754
		p Value	0.000	0.000
	Wasting(%)	Pearson Correlation	0.573	0.581
		p Value	0.001	0.001
	Underweight(%)	Pearson Correlation	0.767	0.747
		p Value	0.000	0.000
4	Stunting(%)	Pearson Correlation	0.771	0.804
		p Value	0.000	0.000
	Wasting(%)	Pearson Correlation	0.196	0.221
		p Value	0.299	0.240
	Underweight(%)	Pearson Correlation	0.599	0.623
		p Value	0.000	0.000

Sources: Authors compilation from NFHS-1, 2 and 3 unit data and NFHS-4 factsheet data

Therefore for Regression analysis, only stunting and underweight are considered as independent variables for the analyzing the child survival status for all the four rounds of NHFS. As wasting was found to be insignificant in few cases, hence it is not considered as a variable for determining the child survival status. The goal of the regression analysis is to create a mathematical model that can be used to predict the values of a dependent variable based on the values of the independent variables.

Here, in this paper, the two dependent variables are Infant Mortality Rate and Under-five Mortality Rate. Stunting and underweight are the two parameters which are independent. We want to

examine the effect of stunting and underweight on Infant and Under-five Mortality in India.

The first regression equation is

$$\text{IMR} = a + bs + cu$$

The second Regression equation is

$$\text{U5MR} = p + qs + ru$$

Where s and u are the percentages of stunting and underweight respectively.

It can be concluded from Table 7 and Table 8 that for NFHS-1 the two equations will be

$$\text{IMR} = 32 + 2.08u$$

$$\text{U5MR} = 66.975 + 3.32s$$

Here underweight is found to be significantly affecting IMR and stunting U5MR.

Correspondingly in NFHS-2, it can be seen that the two equations will be

$$\text{IMR} = 0.619 + 1.46s$$

$$\text{U5MR} = 3.28 + 2.07s$$

This explains the fact that in NFHS-2, stunting was the most significant factor affecting the child survival status.

In NFHS-3 the corresponding two equations will be

$$\text{IMR} = 11.36 + 1.076u$$

$$\text{U5MR} = 27.06 + 2.24s$$

Here it is observed that while stunting is a significant cause for U5MR, but underweight is responsible for IMR.

In NFHS-4, the relevant equations boils down to

$$\text{IMR} = 10.139 + 1.316s$$

$$\text{U5MR} = 14.97 + 1.67s$$

In NFHS-4 stunting is found to be the significant factor affecting both the child survival status.

Table 7: Regression analysis of stunting and underweight on Infant Mortality Rate**Model Summary**

NFHS	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.805 ^a	.648	.627	16.7256975
2	.749 ^b	.561	.542	12.9020191
3	.767 ^a	.589	.573	10.3787947
4	.771 ^b	.595	.580	8.3159211

a. Predictors: (Constant), Underweight(%)

b. Predictors: (Constant), Stunting(%)

ANOVA^a

NFHS		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8737.017	1	8737.017	31.232	.000 ^b
	Residual	4755.732	17	279.749		
	Total	13492.749	18			
2	Regression	4897.130	1	4897.130	29.419	.000 ^c
	Residual	3828.628	23	166.462		
	Total	8725.758	24			
3	Regression	4159.659	1	4159.659	38.616	.000 ^b
	Residual	2908.423	27	107.719		
	Total	7068.082	28			
4	Regression	2840.639	1	2840.639	41.077	.000 ^c
	Residual	1936.327	28	69.155		
	Total	4776.967	29			

a. Dependent Variable: Infant Mortality

b. Predictors: (Constant), Underweight(%)

c. Predictors: (Constant), Stunting(%)

Coefficients^a

NFHS		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	32.086	16.726		-1.918	.072
	Underweight(%)	2.080	.372	.805	5.589	.000
2	(Constant)	.619	10.913		-.057	.955
	Stunting(%)	1.461	.269	.749	5.424	.000
3	(Constant)	11.362	6.091		1.865	.073
	Underweight(%)	1.076	.173	.767	6.214	.000
4	(Constant)	10.139	6.905		-1.468	.153
	Stunting(%)	1.316	.205	.771	6.409	.000

a. Dependent Variable: Infant Mortality*Sources: Authors compilation from NFHS-1, 2 and 3 unit data and NFHS-4 factsheet data*

Table:8 Regression of stunting and underweight on Under five Mortality Rate**Model Summary**

NFHS	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.810 ^a	.656	.636	22.5503647
2	.717 ^a	.514	.493	20.1776725
3	.754 ^a	.568	.552	14.9240852
4	.804 ^a	.646	.633	9.5139120

a. Predictors: (Constant), Stunting(%)

ANOVA^a

NFHS		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16469.395	1	16469.395	32.387	.000 ^b
	Residual	8644.822	17	508.519		
	Total	25114.217	18			
2	Regression	9892.335	1	9892.335	24.297	.000 ^b
	Residual	9364.185	23	407.138		
	Total	19256.520	24			
3	Regression	7914.169	1	7914.169	35.533	.000 ^b
	Residual	6013.665	27	222.728		
	Total	13927.833	28			
4	Regression	4622.293	1	4622.293	51.067	.000 ^b
	Residual	2534.407	28	90.515		
	Total	7156.700	29			

a. Dependent Variable: Under 5 mortality rate

b. Predictors: (Constant), Stunting(%)

Coefficients^a

NFHS		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	66.975	26.671		-2.511	.022
	Stunting(%)	3.323	.584	.810	5.691	.000
2	(Constant)	3.280	17.067		-.192	.849
	Stunting(%)	2.077	.421	.717	4.929	.000
3	(Constant)	27.064	15.176		-1.783	.086
	Stunting(%)	2.242	.376	.754	5.961	.000
4	(Constant)	14.971	7.900		-1.895	.068
	Stunting(%)	1.679	.235	.804	7.146	.000

a. Dependent Variable: Under 5 mortality rate

Sources: Authors compilation from NFHS-1, 2 and 3 unit data and NFHS-4 factsheet data

IV. Conclusion

An attempt is made in this paper to understand the pattern of child nutritional status and child survival states for all the states of India. It is found that though the rates of the three parameters, namely, stunting, wasting and underweight has declined, yet there are interstate variations with respect to the rate of sinking. All the independent variables have shown significant association with the dependent variables. The result of regression analysis shows that all the child nutritional determinants do not equally affect all the child survival status indicators. An attempt is also made to understand the most significant nutritional factor affecting the child survival for all the four rounds of NFHS. Here, it is witnessed that there is a dissimilitude in the nutritional factors affecting the IMR and U5MR, in the four rounds. The data for the analysis are taken from four rounds of NFHS. While unit level data is utilized for the first three rounds of NFHS, factsheet data is used for NFHS-4.

It is also evident from the inter-state variations of the study that the burden of malnutrition needs to be refocused and requires greater policy intervention to achieve the Sustainable Development goal of ending all forms of malnutrition by 2030. This paper calls for a detailed study on the other factors that may be responsible for determining the status of child survival in different states of our country.

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MATERNAL AND CHILD HEALTH IN INDIA IN THE POST-REFORM PERIOD

MOU ROY*

Abstract

Maternal and Child health play pivotal role in shaping the health status of a country. A longer and healthier life of woman gifts the nation a healthy and productive work force. Thus maternal and child health attainments at micro level are crucial for achieving a decent and respectable level of human development at the macro level. Although right to health is not a constitutional right in India, improvement of maternal health was assigned top priority in the country since inception of the planning era. The Government of India in its endeavour to ensure accessible, affordable and reliable health services for all, especially poor and vulnerable, has introduced several schemes and programmes over the years, notable among them being the National Rural Health Mission (NRHM) and Janani Suraksha Yojana (JSY) in the recent years. The paper aims to assess the state of maternal and child health in India in the post reform period in terms of both outcome indicators and process indicators. The paper presents an inter-state analysis and brings out stark inter-state disparities in maternal and child health attainments and utilization of health care services. The discussion attempts to explore the causes and determinants of maternal and child mortality in India and observes the influence of a host of socio-economic factors apart from maternal health care services.

Key Words: Maternal Mortality Ratio, Infant Mortality Rate, Under Five Mortality Rate

JEL Classification Codes: I 14, J11, J16.

I. Introduction

Maternal and Child health play pivotal role in shaping the health status of a country. Mother's health has an important bearing on child's health. A longer and healthier life of woman gifts the nation a healthy and productive work force. Thus maternal and child health attainment at micro level are crucial for achieving a decent and respectable level of human development at the macro level.

Although right to health is not a constitutional right in India, improvement of maternal health was assigned priority in the country since inception of the planning era. The National Family Planning Programme adopted in 1952, which later in 1977 came to be known as Family Welfare Programme focused on delivering adequate health care to women, specially pregnant women, their newborn and children. The Government of India in its endeavour to ensure accessible,

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affordable and reliable health services for all, especially poor and vulnerable, has introduced several schemes and programmes over the years, notable among them being Reproductive & Child Health Programme (RCH) in 1996 and Integrated Child Development Scheme (ICDS), in 2001. Realising the importance of synergy and convergence between different health, nutrition and family welfare programmes as well as disease control measures, the National Rural Health Mission (NRHM) launched in April, 2005 integrated all erstwhile nationally funded programmes including RCH. Janani Suraksha Yojana (JSY), which is an intervention in the purview of National Rural Health Mission (NHRM, April 2005, attached importance on safe motherhood programmes including institutional deliveries in rural and BPL households.

The paper aims to assess the state of maternal and child health in India in the post reform period in terms of both outcome indicators and process indicators. The outcome indicators chosen are Maternal Mortality Rate (MMR), Infant Mortality Rate (IMR) and Under five Mortality Rate (U5MR). The process indicators include the maternal and child health care services like coverage of antenatal care, institutional delivery and immunisation of children. The paper presents an inter-state analysis to suggest appropriate policy interventions. In the discussion attempt is made to explore the determinants of maternal and child health.

The study is based on secondary data as provided by India Development Reports, India Public Policy Report, National Family Health Survey Reports, Family Welfare Statistics in India and Census Reports.

This paper is organized into four sections. Section II examines the achievement in the field of maternal and child health in the country during 1991–2011. Section III explores the determinants of maternal and child health outcome indicators, viz, MMR, IMR and U5MR. Section IV makes concluding observations.

II. Maternal and Child Health

We begin with a discussion of the vital rate related to maternal health, followed by an analysis of the safe motherhood programmes.

Maternal Health: Outcome Indicator

Maternal Mortality Ratio (MMR) is a very sensitive index that reflects the quality of reproductive care received by a pregnant woman. MMR is the number of women aged 15–49 years who die as a result of complications of pregnancy or child bearing in a given year per one lakh live births in that year.

Committing to Millennium Development Goals, India in her National Population Policy (2000) targeted to reduce MMR to 109 by 2015.

Table 1: Maternal Mortality Ratio (per 1, 00,000 live births)

Null Hypothesis	Wald Statistic	Probability
HE does not Granger Cause GDP	2.23	0.04*
GDP does not Granger Cause HE	4.59	0.00*

Source: Registrar General of India, Ministry of Home Affairs

Maternal Mortality Ratio had more than two-fold decline in the country from 398 in 1997-98 to 167 in 2011-13.

Data on MMR is available for only 15 states and they are ranked on the basis of MMR in Table A.1. The states of Assam, Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh underperformed in terms of national average in all the three points of time, 1997-98, 2004-06 and 2011-12. Odisha joined them since 2004-06. The states which improved their achievement index and rank are Maharashtra, Andhra Pradesh, West Bengal and Bihar. The ranks of Gujarat and Haryana deteriorated. The remaining states maintained almost the same position during these years. Three states namely Kerala, Tamil Nadu and Maharashtra have realized the MDG target. Andhra Pradesh is in close proximity to achieving the goal. There is wide disparity among the states, though it has narrowed overtime.

Maternal Health: Process Indicators

According to Ministry of Health and Family Welfare guideline (1997) and recommendations of Reproductive and Child Health Programme (RCH), as part of antenatal care, women should receive three antenatal check-ups, two doses of tetanus toxoid vaccine and adequate amount of iron and folic acid tablets. Safe motherhood programmes also attach importance to institutional deliveries (ID).

Though Universal Immunisation Programme (UIP) in 1985-86 which merged with RCH programme in 1996 recommended that all pregnant women should be vaccinated against tetanus by 1990, full coverage of tetanus toxoid vaccine has still not been possible. In India the coverage is around 76 percent in 2005-06. Antenatal care (three antenatal check-ups) is an important factor in ensuring safe motherhood. However data on coverage of antenatal care (ANC) to pregnant women provided by NFHS 1 and 2 had no reference on the number of check-ups. According to NFHS in India, 34 percent of the pregnant women were deprived of any antenatal check-up in 1998-99 which reduced to 23 percent in 2005-06. But if we consider at least three antenatal check-ups, the figure rises to 48 percent in 2005-06 according to NFHS 3. In 2005-06, only 65 percent of the pregnant women received iron/folic acid tablets causing as well as resulting in high incidence of severe anaemia among women in India.

Table 2: Maternal Care (percentage)

	Antenatal Care (at least one visit)			Antenatal Care (at least three visits)	TT Vaccine (two doses)			Iron/Folic Acid Tablets		
	1993	1998	2005	2005-06	1993	1998	2005	1993	1998	2005
	-	-	-		-	-	-	-	-	-
	94	99	06		94	99	06	94	99	06
India	64.6	65.8	76.8	52.0	53.8	66.8	76.3	50.5	57.6	65.1

Source: National Family Health Survey 1998-99, 2005-06.

Note: The data includes proportion who received antenatal care on the last birth to ever married woman in the three years preceeding the survey.

NFHS 1 and 2 provide data on at least 1 ANC visit. NFHS 3 provides data on 3 ANC visits for 2005-06 only. Hence for interstate comparison overtime we consider at least 1 ANC visit. Over these years the percentage of at least 1 ANC visit has improved remarkably in Chhattisgarh and in Madhya Pradesh but has declined in the states of Bihar and Mizoram. In 2005-06 only in three states of Tamil Nadu, Goa and Kerala, more than 90 percent of women received antenatal care. Andhra Pradesh was in close proximity. To the contrary Bihar has only 17 percent of women receiving ANC (at least 3 ANC visits).

The inter-state disparity in the provision of antenatal care has reduced marginally in the nineties but more in the last decade. The disparity is more severe with respect to 3 ANC visits compared to at least 1 ANC visit.

Table A.3 ranks the states with respect to coverage of tetanus toxoid vaccine. Data is available for 29 states in 2005-06, of which, only in top 3 states more than 90 percent of women received tetanus toxoid vaccine. Only 40 percent of women were under this coverage in Arunachal Pradesh in 2005-06. Overtime the percentage has improved remarkably in Rajasthan, Bihar and Haryana, though the former two states were below national average still in 2005-06. In Rajasthan from a meager 28 percent (rank: 26) in 1993-94, it rose to 65.2 percent (rank: 24) in 2005-06. The disparity in the states in the coverage of tetanus toxoid vaccine has reduced considerably over the years.

It is evident from Table A.4 that in 2005-06, only in top 2 states more than 90 percent of women received iron/folic acid tablets. Kerala has been consistently in the topmost position during these years followed by Goa and Tamil Nadu who interchanged their positions in 2005-06. Less than 30 percent of women were under this coverage in Nagaland and Bihar in 2005-06. Overtime the percentage has improved remarkably in Odisha, Rajasthan, Uttar Pradesh and Manipur, though barring the first, all others were still below national average in 2005-06. Mizoram and Haryana recorded deterioration in the percentage of recipients of iron/folic acid tablets

followed by a drop in their ranks over these years. The inter-state disparity in the percentage of recipients of iron/folic acid tablets has reduced in the nineties but more in the last decade.

Thus it is observed that in terms of utilization of maternal health care services, the north eastern hilly states are laggards, more severely Arunachal Pradesh and Nagaland along with Bihar-Jharkhand, Uttar Pradesh-Uttarkhand and Rajasthan. All the southern states are better performers. Kerala, Tamil Nadu, Goa and Andhra Pradesh are among the best performing states with respect to maternal health attainment and utilization of maternal health care services.

Table 3: Maternal Health Indicators: State Profile (High and Low)

	Top five states	Bottom five states
MMR 2010-12	Kerala, Maharashtra, Tamil Nadu, Andhra Pradesh, West Bengal	Bihar, Uttar Pradesh, Rajasthan, Odisha, Madhya Pradesh
ANC $\geq$ 3 2005-06	Tamil Nadu, Goa, Kerala, Andhra Pradesh, Karnataka	Bihar, Uttar Pradesh, Odisha, Nagaland, Arunachal Pradesh
TT Vaccine 2005-06	Tamil Nadu, West Bengal, Delhi, Kerala, Goa,	Arunachal Pradesh, Nagaland, Mizoram, Meghalaya, Uttar Pradesh
Iron/Folic acid tablets 2005-06	Kerala, Tamil Nadu, Goa, Sikkim, Himachal Pradesh	Nagaland, Bihar, Arunachal Pradesh, Jharkhand, Uttar Pradesh
Institutional Delivery 2012	Goa, Kerala, Tamil Nadu, Mizoram, Andhra Pradesh	Nagaland, Chattisgarh, Jharkhand, Uttar Pradesh, Arunachal Pradesh

Source: Table A1, A2, A3, A4.

Child Health: Outcome Indicators

Infant Mortality Rate (IMR) refers to the number of deaths per thousand live births in the first year of a child's birth. It reflects the probability of a child dying before his first birthday. IMR is likely to be more sensitive to changes that have a bearing on the quality of life, particularly to the health and longevity of the people. IMR is thus more useful from the point of view of policy targeting

Table 4: Infant Mortality Rate (Male, Female) (per thousand)

	1991			2001			2012		
	Male	Female	Person	Male	Female	Person	Male	Female	Person
India	81	80	80	64	68	66	41	44	42

Source: Indian Public Policy Report 2014, SRS Bulletin, 2013

Table 5: Infant Mortality Rate (Rural, Urban) (per thousand)

	1991			2001			2010		
	Male	Female	Person	Male	Female	Person	Male	Female	Person
Rural	87	87	87	70	74	72	50	53	51
India									
Urban	53	52	53	41	44	42	30	33	31

Source: Indian Public Policy Report 2014.

In 2012, IMR in India is 42 per thousand live births, much behind the target of 28 per thousand live births by 2015 under MDG. IMR for females is higher than that of male in both rural and urban in 2001 and 2010. The gender gap was against the male in 1991 in urban India and in the country as a whole. The rural-urban disparity is very much pronounced. The rural IMR has always been greater than the urban for both male and female. Over the years the rural-urban disparity has declined. IMR declines by 28.8 percent (combined for male and female) in the last decade compared to 17.5 percent in the decade of the 90s. The decline in female IMR in the last decade is quite close to that of male. The decline is sharper in rural India than in urban in the last decade.

Table 6: Annual Rate of Decline of Infant Mortality Rate

Year	Male	Female	Person	Rural	Urban
1991 2001	2.1	1.5	1.75	1.72	2.08
2001 2011	2.81	2.79	2.88	2.92	2.62

Source: Indian Public Policy Report 2014 and own computation.

There is wide variation in IMR across states; the coefficient of variation was higher in 2001 than of 1991 which declined sharply in 2010.

It follows from Table A.5 that in terms of child survival the states of, Assam, Madhya Pradesh, Odisha and Uttar Pradesh have underperformed compared to the national average throughout the period 1991 – 2011. Rajasthan joined this status from 2001. With the inclusion of Bihar, Chhattisgarh, Haryana and Meghalaya the number of underperformer states compared to national average inflated to 9 in 2011. The consistently good performers are Kerala, Goa, Manipur and Puducherry. Of the 35 states and union territories, 9 reached the target under MDG in 2011.

Under 5 Mortality Rate (U5MR) refers to the probability of children born in a specific period dying before reaching the age of five years and is expressed as number of deaths per '000 live births. The MDG target for U5 MR is 42 per '000 live births by 2015. According to SRS data

U5 MR in 2012 was 52 in India. It has fallen from 74 in 2005-06. The male female differential has also fallen over the period.

Table 7: Under 5 Mortality Rate (Male, Female) (per thousand)

	1998-99			2005-06			2012		
	Male	Female	Person	Male	Female	Person	Male	Female	Person
India	97.9	105.2	94.9	69.7	79.2	74.3	49	56	52

Source: NFHS Report, SRS Bulletin, 2013

Our U5 MR data for 1998-99 and 2005-06 are from NFHS Reports and that of 2012 is from SRS Bulletin. Data from the two sources may not be comparable. Again SRS Bulletin provides data for fewer states. However the trend and the pattern observed in the performances of the states are more or less the same. The rankings are the same. The states underperforming compared to the all India average in all the time periods were Bihar, Odisha and Rajasthan.

Child Health: Process Indicators

One of the crucial indicators of the child care system is the vaccination of children against six diseases namely tuberculosis, diphtheria, pertusis, tetanus, poliomyelitis and measles. In National Family Health Survey, children who have received BCG, measles and 3 doses each of DPT and polio are considered to be fully vaccinated. The National Population Policy (2000) envisaged universal immunization of children against vaccine preventable diseases. However immunization coverage of children is far from universal in the country still today.

Table 8: Children aged 12 – 23 months fully vaccinated (Male, Female) (percentage)

	1992-93			1998-99			2005-06		
	Male	Female	Person	Male	Female	Person	Male	Female	Person
India	36.7	34.1	35.4	43.1	40.9	42.0	45.3	41.5	43.5

Source: National Family Health Survey 1993-94, 1998-99, 2005-06.

Table 9: Children aged 12 – 23 months fully vaccinated (Rural, Urban) (percentage)

	1992-93			1998-99			2005-06		
	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total
India	30.9	50.7	35.4	36.6	60.5	42.0	38.6	57.6	43.5

Source: National Family Health Survey 1993-94, 1998-99, 2005-06.

Table 10: Children aged 12 – 23 months not vaccinated (Male, Female) (percentage)

	1992-93			1998-99			2005-06		
	Male	Female	Person	Male	Female	Person	Male	Female	Person
India	27.8	32.3	30.0	13.5	15.3	14.4	4.3	6.0	5.1

Source: National Family Health Survey 1993-94, 1998-99, 2005-06

Table 11: Children aged 12 – 23 months not vaccinated (Rural, Urban) (percentage)

	1992-93			1998-99			2005-06		
	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total
India	34.0	16.4	30.0	16.7	6.4	14.4	5.7	3.3	5.1

Source: National Family Health Survey 1993-94, 1998-99, 2005-06.

At the all India level in 2005-06, not even half of the children of age 12 and 23 months received full vaccination while 5 percent did not receive any vaccination. During 1998-99 – 2005-06 there has been marginal increase by only 1.5 percent in full immunization coverage of children. A strong urban bias and gender bias are evident in immunization coverage.

The disparity among the states is very high with respect to full immunization coverage, more so with respect to no immunization coverage. In fact, the coefficient of variation in 2005-06 with respect to no immunization coverage was larger than that in 1992-93.

The states are ranked based on full immunization coverage of children aged 12 – 23 months in Table A.6. Overtime the percentage of children fully vaccinated and thus the state's rank declined in Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Mizoram and Punjab. Though the percentage also declined in the states of Goa, Himachal Pradesh and Kerala, there was not much deterioration in their ranks in 2005-06 as they reached high percentage of immunization coverage in 1998-99. Sikkim, Tamil Nadu, Tripura and West Bengal improved their rank considerably.

Table 12: Child Health Indicators: State Profile (High and Low)

	Top five states	Bottom five states
IMR 2011	Goa, Kerala, Manipur, Puducherry, Mizoram	Madhya Pradesh, Odisha, Uttar Pradesh, Assam, Rajasthan
U5MR 2005 – 06	Kerala, Goa, Tamil Nadu, Sikkim, Arunachal Pradesh	Uttar Pradesh, Madhya Pradesh, Jharkhand, Odisha, Chattisgarh
Full Vaccination of Children 2005-06	Tamil Nadu, Goa, Kerala, Himachal Pradesh, Sikkim	Nagaland, Uttar Pradesh, Rajasthan, Arunachal Pradesh, Assam

Source: Table A5, A6, A7.

It is observed that several states have made commendable progress in improving their performance on child health in the last decade. But the national average is still far away from

MDG goals. Goa, Kerala and Tamil Nadu, joining the former two in the recent years are among the best performers in child health as well as in maternal health. Manipur and Sikkim also score well in child health. On the other hand the states of Madhya Pradesh, Odisha, Uttar Pradesh, Assam and Rajasthan comprising almost half of the country's population lag in child health. These states were underperformers in major maternal health indicators. Thus a close association between maternal and child health is implicit.

III. Factors Affecting Maternal and Child Health

There is a vast literature exploring the determinants of maternal, infant and child survival. Besides pointing to the medico-clinical causes, research papers indicate several socio-economic and demographic factors to explain the variation in child health indicators. In fact, often a two way causal relationship is found between these factors and the maternal and child health parameters. Using state level cross section data of our country from secondary sources for the time period 2005 – 2012, our study chooses few parameters to examine their influence on MMR, IMR and U5MR. They can be classified into the following broad dimensions:

Economic development: We consider Per capita Net State Domestic Product (PNSDP), Per capita real monthly consumption expenditure and Percent of households below poverty line (BPL) in this category as indicators of economic growth and an individual's command over economic resources.

Health sector development: This includes Maternal and Child health care indicators and Health infrastructure. Maternal and Child health care indicators include Percent of women receiving Antenatal Care, at least 3 visits (ANCe'3), TT Vaccine(2 doses), Iron/Folic acid tablets, Percent of Institutional Delivery (ID) and delivery by skilled health personnel (HP). To reflect the public health care infrastructure, physical as well as human, we select availability of beds in government hospitals and health personnel in rural health centers. We consider Rural Health Personnel Index as constructed in the Indian Public Policy Report considering health staff per rural health centre adjusted by the ratio of doctors serving per health centre. Health staff includes health workers, health assistants, nursing staff, radiographer, pharmacist and laboratory technician while doctors include General Duty Medical Officers and Specialists of Community Health Centers.

Physical infrastructure: This relates to basic amenities and living environment and includes proportion of household with electricity, safe drinking water and sanitation facilities and proportion of surfaced road to total.

Status of women: We focus on female literacy rate, sex ratio and female work participation rate to represent the status of women.

Table 13 shows the correlation matrix of maternal and child healthcare variables. All of the maternal healthcare indicators have strong and significant negative correlation with child mortality indicators. This implies the better the maternal health care services and its utilisation, more is the child's survival prospects.

Table 13: Correlation coefficient matrix of maternal and child health indicators

	ANC = 3	ID	Delivery by HP	TT Vaccine	Immunisation	IMR	U5MR	MMR
ANC = 3	1							
ID	0.884	1						
Delivery by HP	0.771	0.835	1					
TT Vaccine	0.745	0.753	0.712	1				
Immunisation	0.768	0.734	0.599	0.742	1			
IMR	-0.803	-0.781	-0.659	-0.702	-0.504	1		
U5MR	-0.851	-0.792	-0.611	-0.748	-0.773	0.981	1	
MMR	-0.852	-0.825	-0.763	-0.878	-0.824	0.868	0.909	1

Source: Own computation

Note: All values of correlation coefficient are significant at 1 percent level

The correlation coefficient between ANC and U5 mortality is the highest, - 0.851, with infant mortality it is -0.803. The correlations of institutional deliveries with infant mortality and with U5 mortality are more or less the same. Correlation coefficients between infant and U5 mortality rate and other maternal healthcare indicators like delivery by skilled health personnel and coverage of TT vaccine are also moderately strong and negative. Thus it can be concluded that institutional delivery by skilled health professionals and 3 full antenatal care ensure better health for mothers as well as their children. The correlations between MMR and measures of child mortality viz, IMR and U5MR are high and significant reinforcing strong influence of maternal health on child health. Immunisation of children aged 12–23 months are more associated with U5MR rather than IMR, quite obvious from the definitions of the two child mortality indicators.

Table 14: Correlation coefficient matrix of Maternal and Child Health Indicators and Health Infrastructure

	Hospital beds	Health personnel	ID	ANC = 3	IMR	U5MR	MMR
Hospital beds	1						
Health personnel	-0.1*	1					
ID	0.626	0.159*	1				
ANC = 3	0.543	0.221*	0.884	1			
IMR	-0.591	-0.169*	-0.781	-0.803	1		
U5MR	-0.46	-0.012*	-0.792	-0.851	0.981	1	
MMR	-0.591	0.1*	-0.825	-0.852	0.868	0.909	1

Source: Own computation

Note: * Values not significant

Except *, all other values are significant at 1 percent level

Achieving good health, especially for the poor and the underprivileged depends crucially on the availability of health infrastructure, both physical and human. Health infrastructure is found to have very low impact on maternal and child health indicators. The correlation coefficient between number of hospital beds per '0000 population and IMR and MMR are the same, as low as – 0.59. However Rural Health Personnel Index is found to have no impact on either IMR or MMR. This may be because of the limitation of the data. Our data on health infrastructure pertains to health care from government sector only. Empirical evidences reveal that except for a few northeastern and northern states, the majority of households in the rest of the states seek medical care from private sector. Kerala, a leading state in health care attainment has equal share of public and private health care provision.

Table 15: Correlation coefficient matrix of Maternal and Child Health Indicators with Physical Infrastructure

	Proportion of Households with sanitation facilities safe drinking water electricity			Proportion of surfaced road IMR U5MR MMR			
Sanitation facilities	1						
Safe drinking water	0.19*	1					
Electricity	0.583	0.082*	1				
Surfaced road	0.069*	0.363**	0.568	1			
IMR	-0.606	-0.15*	-0.534	-0.284*	1		
U5MR	-0.608	0.095*	-0.675		0.981	1	
MMR	-0.599	0.065	-0.752	-0.421*	0.868	0.909	1

Source: Own computation

Note: * Values not significant, ** values significant at 10 percent level

Except * and **, all other values are significant at 1 percent level

It is expected that basic amenities and hygienic living conditions in the form of access to safe drinking water sources, sanitation facilities, electricity and road coverage generate positive externalities leading to better health conditions in general and maternal and child health in particular. However our results in Table 15 show that among the infrastructural indicators only provision of electricity and sanitation facilities within household premises have moderately high association with maternal and child health indicators. Provision of safe drinking water and road coverage have, rather insignificant impact on IMR or MMR. This may be because states like Jharkhand, Rajasthan with high IMR have much higher proportion of surfaced road compared to Kerala with low IMR as well as low coverage of surfaced road. Also proportion of surfaced road to

total, that we have considered in this study, may not be a good proxy of road connectivity indicator. The correlation coefficient we obtained with respect to access to safe drinking water and child mortality is also puzzling. We can cite the example of Kerala as a cause of such puzzle. Kerala with low IMR has only 33.5 percent households with safe drinking water. This low coverage is mostly on account of water being accessed from covered wells in Kerala, which are not considered 'safe' in the definition of safe drinking water adopted.

Table 16: Correlation coefficient matrix of Maternal and Child Health Indictors with indicators of the state of the economy

	PNSDP	Per capita monthly expenditure	BPL population (in percent)	IMR	U5MR	MMR
PNSDP	1					
Per capita monthly expenditure	0.651	1				
BPL population (in percent)	-0.546	-0.759	1			
IMR	-0.686	-0.627	0.683	1		
U5MR	-0.737	-0.701	0.662	0.981	1	
MMR	-0.825	-0.619	-0.683	0.868	0.909	1

Source: Own computation

Note: All values of correlation coefficient are significant at 1 percent level

Table 16, shows the coefficient of correlation among Per capita Net State Domestic product, Per capita real monthly expenditure, Percentage of BPL population and outcome indicators of maternal and child health. It is evident from the table that correlation coefficient between all economic variables and maternal and child health indicators are significant, but the values are slightly lower, when compared with the correlation value of maternal health process indicators. The correlation between PNSDP and MMR is the highest, -0.825, attributing less maternal deaths to the richer states. The economically poorer states in India comprising a large proportion of marginalized sections of the society remain beyond the outreach of development programmes. The correlation between poverty and MMR and IMR are almost equal, around 0.68. Both PNSDP and monthly per capita real consumption expenditure have moderately high correlation with U5 MR suggesting improved income and consumption level contributing to better outcomes of child survival.

Table 17: Correlation coefficient matrix of maternal and child health indicator and women empowerment indicators

	Female Literacy Rate	Sex ratio	Female Work Participation Rate	IMR	U5MR	MMR
FLR	1					
Sex ratio	0.52	1				
FWPR	0.15*	0.336*	1			
IMR	-0.727	-0.363*	0.173*	1		
U5MR	-0.69	-0.376	0.153	0.981	1	
MMR	-0.653	-0.37*	-0.076*	0.868	0.909	1

Source: Own computation

Note: * Values not significant

Except * and **, all other values are significant at 1 percent level

The impact of women's education on maternal and child health is well researched. Literate and educated women have a better knowledge of health and family planning, are aware of the importance of antenatal and post natal care and are more likely to choose institutional deliveries and adopt preventive child health care measures like immunization. Education enhances the status of women and enables them to exercise their choices and decisions.

The state level data in India in 2011-12 shows moderately high correlation between female literacy rate and maternal mortality and child mortality (Table 17). The association between female literacy rate and maternal mortality rate is significant, but the value of correlation is lower as compared to the value between female literacy and infant and U5 mortality rate. However other variables concerning status of women like sex ratio and female work participation rate do not indicate any significant linear association with child and maternal mortality indicators.

IV. Conclusion

The scope of the study is limited within the analysis of data from secondary sources since 1990 and any comparative analysis of the functioning of the government and private institutions is not attempted at. This study also fails to capture the view of the consumers on the quality of services provided by the health care delivery system in the country.

We rather attempt at assessing the maternal and child health scenario in India in terms of some achievement indicators in the last two decades. This leaves us with a mixed feeling. Maternal and

child health outcomes have improved appreciably overtime. Yet the mortality related MDGs could not be achieved. There are wide variations across states, within rural and urban areas and across gender. The states of Bihar-Jharkhand, Madhya Pradesh-Chattisgarh, Uttar Pradesh-Uttarkhand, Odisha, Rajasthan and north eastern states of Nagaland, Arunachal Pradesh and Assam, comprising almost half of the country's population and large proportion of socially disadvantaged groups, viz, Scheduled Caste (SC), Scheduled Tribe (ST), minorities (Muslim) lag in major maternal and child health indicators. However, in the last decade most of these backward states have made faster progress than the national average resulting in convergence of the indicators to the national average.

Better maternal and child mortality outcomes require sufficient progress of process indicators. Our results show strong and significant association between maternal health outcome and process indicators and child health outcome indicators. It is therefore necessary to further improve maternal health process indicators for a sustained decline in maternal as well as child mortality. In this context the public health care system should continue to be subsidized and become more widespread.

We obtained moderately high correlation of provision of electricity and sanitation facilities within household premises with maternal and child health indicators. Our results do not reveal any association of safe drinking water and road coverage on maternal and child health. But one cannot deny the role of improved drinking water sources for a hygienic and healthy life. Though more people are having access to safe drinking water within their households and the number of beneficiaries in Sanitation Campaign has increased over the last decade, more attention in this field is deemed necessary. Community participation in the true sense can expand the outreach and also improve the quality of services delivered. There is also a scope for improvement in coordination and convergence of different health related schemes like Integrated Child Development Scheme, Swachh Bharat Abhiyan etc at grass root level.

Our study reveals strong influence of economic growth, poverty and standard of living on maternal and child survival. A mother and child's survival depends on the health care offered to them, which in turn depends on a household's command over resources. Again, the poorer states comprising a large proportion of excluded social groups remain beyond the outreach of different health programmes.

Finally, women's education is found to have a strong and significant correlation with maternal and child survival. Thus a child's health is crucially linked with mother's literacy. In fact, the two human development outcomes, education and health are mutually interrelated. These outcomes are again linked in a synergistic manner with economic growth and poverty reduction measures.

Therefore the achievement of lower maternal and child mortality in India is dependent on a strong and qualitative health care system and utilization of its services which in turn calls for policies aimed at achieving higher levels of human capital and direct action to reduce poverty, in addition to rapid economic growth.

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Table A.1: State wise Maternal Mortality Ratio in India, 1997-98 – 2010-12

	1997-98		2004-06		2010-12	
	Maternal Mortality Ratio	Rank	Maternal Mortality Ratio	Rank	Maternal Mortality Ratio	Rank
Andhra Pradesh	197	6	154	5	110	4
Arunachal Pradesh	-	-	-	-	-	-
Assam	568	14	480	15	328	15
Bihar	531	13	312	11	219	10
Chhatisgarh	-	-	-	-	-	-
Goa	-	-	-	-	-	-
Gujarat	46	1	160	6	122	6
Haryana	136	3	186	7	146	8
Himachal Pradesh	-	-	-	-	-	-
Jammu & Kashmir	-	-	-	-	-	-
Jharkhand	-	-	-	-	-	-
Karnataka	245	7	213	9	144	7
Kerala	150	4	95	1	66	1
Madhya Pradesh	441	11	335	12	230	11
Maharashtra	166	5	130	3	87	2
Manipur	-	-	-	-	-	-
Meghalaya	-	-	-	-	-	-
Mizoram	-	-	-	-	-	-
Nagaland	-	-	-	-	-	-
Odisha	346	10	303	10	235	12
Punjab	280	8	192	8	155	9
Rajasthan	508	12	388	13	255	13
Sikkim	-	-	-	-	-	-
Tamil Nadu	131	2	111	2	90	3
Tripura	-	-	-	-	-	-
Uttar Pradesh	606	15	440	14	292	14
Uttarakhand	-	-	-	-	-	-
West Bengal	303	9	141	4	117	5
Andaman & Nicobar Island	-	-	-	-	-	-
Chandigarh	-	-	-	-	-	-
Dadra & Nagar Haveli	-	-	-	-	-	-
Daman & Diu	-	-	-	-	-	-
Delhi	-	-	-	-	-	-
Lakshadweep	-	-	-	-	-	-
Puducherry	-	-	-	-	-	-
All India	398		254		178	

Source: Registrar General of India, Ministry of Home Affairs

Note: Bihar includes Jharkhand, Madhya Pradesh includes Chhattisgarh and Uttar Pradesh includes Uttarakhand

Table A.2: State wise Recipients of Antenatal Care in India, 1993-94 – 2005-06

	1993-94		1998-99		2005-06		2005-06	
	ANC ≥ 1	Rank	ANC ≥ 1	Rank	ANC ≥ 1	Rank	ANC ≥ 3	Rank
Andhra Pradesh	89.1	5	92.6	4	95.8	4	85.4	4
Arunachal Pradesh	50.0	21	61.0	19	59.0	27	35.5	24
Assam	52.6	19	60.6	20	70.8	23	39.3	22
Bihar	36.8	24	34.4	29	33.9	29	17.0	28
Chhatisgarh	-	-	56.6	23	89.0	13	54.2	17
Goa	96.6	2	99.0	2	98.1	3	94.9	2
Gujarat	77.0	12	87.2	8	87.0	16	67.5	11
Haryana	76.0	14	58.3	22	89.1	12	59.2	16
Himachal Pradesh	76.1	13	86.4	10	90.1	11	62.6	12
Jammu & Kashmir	79.5	10	83.8	12	84.8	17	73.5	8
Jharkhand	-	-	42.0	27	60.7	26	35.9	23
Karnataka	86.5	7	87.0	9	90.7	8	79.5	5
Kerala	98.2	1	99.2	1	99.8	1	93.6	3
Madhya Pradesh	52.1	20	63.3	18	80.5	18	40.7	21
Maharashtra	85.1	8	90.7	6	93.0	6	75.1	6
Manipur	64.3	17	79.9	14	87.7	14	68.6	10
Meghalaya	55.4	18	53.6	23	67.9	24	54.0	18
Mizoram	90.1	4	92.0	5	75.0	21	59.3	15
Nagaland	39.3	23	59.9	21	56.9	28	32.7	25
Odisha	64.4	16	80.5	13	87.4	15	27.0	26
Punjab	87.6	6	74.5	15	90.6	9	74.8	7
Rajasthan	32.7	25	48.9	25	75.6	20	41.2	20
Sikkim	-	-	71.6	16	90.4	10	70.1	9
Tamil Nadu	95.6	3	98.3	3	99.1	2	95.9	1
Tripura	65.8	15	70.4	17	79.1	19	60.0	14
Uttar Pradesh	44.7	22	34.7	28	67.3	25	26.6	27
Uttarakhand	-	-	45.5	26	74.8	22	44.9	19
West Bengal	78.2	11	90.6	7	93.2	5	62.0	13
Andaman & Nicobar Island	-	-	-	-	-	-	-	-
Chandigarh	-	-	-	-	-	-	-	-
Dadra & Nagar Haveli	-	-	-	-	-	-	-	-
Daman & Diu	-	-	-	-	-	-	-	-
Delhi	-	-	-	-	-	-	-	-
Lakshadweep	84.6	9	84.6	11	91.8	7	75.1	6
Puducherry	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
All India	64.6		65.8		76.9		52.0	

Source: National Family Health Survey 1, 2, 3

Table A.3: State wise Recipients of Two Doses of TT Vaccine in India, 1993-94 – 2005-06

	1993-94		1998-99		2005-06	
	Recipients (in percent)	Rank	Recipients (in percent)	Rank	Recipients (in percent)	Rank
Andhra Pradesh	89.1	5	92.6	4	95.8	4
Arunachal Pradesh	50.0	21	61.0	19	59.0	27
Assam	52.6	19	60.6	20	70.8	23
Bihar	36.8	24	34.4	29	33.9	29
Chhatisgarh	-	-	56.6	23	89.0	13
Goa	96.6	2	99.0	2	98.1	3
Gujarat	77.0	12	87.2	8	87.0	16
Haryana	76.0	14	58.3	22	89.1	12
Himachal Pradesh	76.1	13	86.4	10	90.1	11
Jammu & Kashmir	79.5	10	83.8	12	84.8	17
Jharkhand	-	-	42.0	27	60.7	26
Karnataka	86.5	7	87.0	9	90.7	8
Kerala	98.2	1	99.2	1	99.8	1
Madhya Pradesh	52.1	20	63.3	18	80.5	18
Maharashtra	85.1	8	90.7	6	93.0	6
Manipur	64.3	17	79.9	14	87.7	14
Meghalaya	55.4	18	53.6	23	67.9	24
Mizoram	90.1	4	92.0	5	75.0	21
Nagaland	39.3	23	59.9	21	56.9	28
Odisha	64.4	16	80.5	13	87.4	15
Punjab	87.6	6	74.5	15	90.6	9
Rajasthan	32.7	25	48.9	25	75.6	20
Sikkim	-	-	71.6	16	90.4	10
Tamil Nadu	95.6	3	98.3	3	99.1	2
Tripura	65.8	15	70.4	17	79.1	19
Uttar Pradesh	44.7	22	34.7	28	67.3	25
Uttarakhand	-	-	45.5	26	74.8	22
West Bengal	78.2	11	90.6	7	93.2	5
Andaman & Nicobar Island	-	-	-	-	-	-
Chandigarh	-	-	-	-	-	-
Dadra & Nagar Haveli	-	-	-	-	-	-
Daman & Diu	-	-	-	-	-	-
Delhi	84.6	9	84.6	11	91.8	7
Lakshadweep	-	-	-	-	-	-
Puducherry	-	-	-	-	-	-
All India	64.6		65.8		76.9	

Source: National Family Health Survey 1998-99, 2005-06

Table A.4: State wise Recipients of Iron/Folic Acid tablets in India, 1993-94 – 2005-06

	1993-94		1998-99		2005-06	
	Recipients (in percent)	Rank	Recipients (in percent)	Rank	Recipients (in percent)	Rank
Andhra Pradesh	76.4	4	81.2	6	76.6	11
Arunachal Pradesh	44.7	17	56.3	16	47.7	27
Assam	39.4	19	55.0	17	62.1	20
Bihar	21.4	24	24.1	27	29.7	28
Chhatisgarh	-	-	54.9	18	74.6	12
Goa	89.3	2	94.7	2	87.4	3
Gujarat	69.3	10	78.0	8	82.4	7
Haryana	59.9	12	67.0	14	61.3	22
Himachal Pradesh	71.7	7	85.6	4	84.2	5
Jammu & Kashmir	70.7	8	70.8	12	67.6	15
Jharkhand	-	-	32.7	25	49.5	26
Karnataka	74.9	5	78.0	8	74.3	13
Kerala	91.2	1	95.2	1	96.4	1
Madhya Pradesh	44.3	18	48.9	21	62.8	18
Maharashtra	70.6	9	84.8	5	80.9	9
Manipur	35.5	20	50.0	19	65.2	17
Meghalaya	49.6	16	49.5	20	54.7	24
Mizoram	63.7	11	72.7	10	61.9	21
Nagaland	23.9	23	42.5	22	25.6	29
Odisha	49.9	15	67.6	13	83.1	6
Punjab	73.6	6	79.6	7	65.5	16
Rajasthan	29.2	22	39.3	23	57.7	23
Sikkim	-	-	-	-	86.4	4
Tamil Nadu	84.1	3	93.2	3	91.9	2
Tripura	53.2	14	63.0	15	68.8	4
Uttar Pradesh	29.5	21	32.4	26	53.2	25
Uttarakhand	-	-	38.5	24	62.6	19
West Bengal	56.3	13	71.6	11	81.9	8
Andaman & Nicobar Island	-	-	-	-	-	-
Chandigarh	-	-	-	-	-	-
Dadra & Nagar Haveli	-	-	-	-	-	-
Daman & Diu	-	-	-	-	-	-
Delhi	74.9	5	77.8	9	77.6	10
Lakshadweep	-	-	-	-	-	-
Puducherry	-	-	-	-	-	-
All India	50.5		57.6		65.1	

Source: National Family Health Survey 1998-99, 2005-06

Table A.5: State wise Infant Mortality Rate (IMR) in India, 1991–2010

	1991		2001		2011	
	IMR	Rank (Inv IMR)	IMR	Rank (Inv IMR)	IMR	Rank (Inv IMR)
Andhra Pradesh	73.0	20	66.0	25	46.0	25
Arunachal Pradesh	64.5	16	32.8	10	30.6	12
Assam	81.0	24	74.0	26	58.0	30
Bihar	69.0	18	62.0	24	48.0	26
Chhatisgarh	-	-	-	-	51.0	27
Goa	20.8	3	14.0	4	10.0	1
Gujarat	69.0	18	60.0	22	44.0	24
Haryana	68.0	17	66.0	25	48.0	26
Himachal Pradesh	74.6	21	42.8	14	40.0	20
Jammu & Kashmir	-	-	40.0	13	43.0	23
Jharkhand	-	-	-	-	42.0	22
Karnataka	77.0	22	58.0	21	38.0	18
Kerala	16.0	2	11.0	3	13.0	2
Madhya Pradesh	117.0	26	86.0	29	62.0	32
Maharashtra	60.0	15	45.0	16	28.0	9
Manipur	21.7	5	9.9	2	14.9	3
Meghalaya	57.0	14	51.2	19	51.9	28
Mizoram	-	-	17.9	6	19.2	5
Nagaland	6.6	1	-	-	19.5	6
Odisha	124.0	27	91.0	30	61.0	31
Punjab	53.0	12	52.0	20	34.0	15
Rajasthan	79.0	23	80.0	27	55.0	29
Sikkim	51.0	10	29.2	9	30.0	11
Tamil Nadu	57.0	14	49.0	17	24.0	7
Tripura	56.2	13	35.1	11	40.6	21
Uttar Pradesh	97.0	25	83.0	28	61.0	31
Uttarakhand	-	-	-	-	38.0	18
West Bengal	71.0	19	51.0	18	31.0	14
Andaman & Nicobar Island	30.0	6	6.6	1	30.9	13
Chandigarh	35.0	7	15.8	5	35.2	16
Dadra & Nagar Haveli	-	-	60.7	23	29.3	10
Daman & Diu	51.6	11	42.9	15	27.6	8
Delhi	42.7	8	25.1	8	36.0	17
Lakshadweep	43.8	9	37.8	12	38.4	19
Puducherry	21.2	4	21.9	7	16.1	4
All India	80.0		66.0		47.0	

Source: India Public Policy Report 2014 .

Table A.6: State wise Under Five Mortality Rate (U5MR) in India, 1991–2010

	1998-99		2005-06		2012	
	U5MR	Rank (Inv U5MR)	U5MR	Rank (Inv U5MR)	U5MR	Rank (Inv U5MR)
Andhra Pradesh	85.5	17	63.2	17	43	7
Arunachal Pradesh	42.4	2	41.5	5	-	-
Assam	89.5	18	85.0	21	75	15
Bihar	105.1	20	84.8	20	57	11
Chhatisgarh	-	-	90.3	23	55	10
Goa	46.8	3	20.3	2	-	-
Gujarat	85.1	16	60.9	16	48	8
Haryana	76.8	14	52.3	10	48	8
Himachal Pradesh	42.4	2	41.5	5	43	7
Jammu & Kashmir	80.1	15	51.2	8	43	7
Jharkhand	-	-	93	25	50	9
Karnataka	69.8	11	54.7	12	37	5
Kerala	18.8	1	16.3	1	13	1
Madhya Pradesh	137.6	24	94.2	26	73	14
Maharashtra	58.1	7	46.7	7	28	3
Manipur	56.1	6	41.9	6	-	-
Meghalaya	122.0	22	70.5	19	-	-
Mizoram	54.7	4	52.9	11	-	-
Nagaland	63.8	9	64.7	18	-	-
Odisha	104.4	19	90.6	24	68	13
Punjab	72.1	13	52.0	9	34	4
Rajasthan	114.9	21	85.4	22	59	12
Sikkim	71.0	12	40.1	4	-	-
Tamil Nadu	63.3	8	35.5	3	24	2
Tripura	-	-	59.2	14	-	-
Uttar Pradesh	122.5	23	96.4	27	68	13
Uttarakhand	-	-	56.8	13	-	-
West Bengal	67.6	10	59.6	15	38	6
Andaman & Nicobar Island	-	-	-	-	-	-
Chandigarh	-	-	-	-	-	-
Dadra & Nagar Haveli	-	-	-	-	-	-
Daman & Diu	-	-	-	-	-	-
Delhi	55.4	5	46.7	7	28	3
Lakshadweep	-	-	-	-	-	-
Puducherry	-	-	-	-	-	-
All India	94.9		74.3		52.0	

Source: NFHS 2, 3, SRS 2012

Table A.7: State wise Children aged 12- 23 months fully vaccinated in India, 1992-93 – 2005-06

	1992-93		1998-99		2005-06	
	Children fully vaccinated (in percent)	Rank	Children fully vaccinated (in percent)	Rank	Children fully vaccinated (in percent)	Rank
Andhra Pradesh	45.0	13	58.7	10	46.0	19
Arunachal Pradesh	22.5	18	-	-	28.4	26
Assam	19.4	21	17.0	16	31.4	25
Bihar	10.7	23	10.6	22	32.8	24
Chhatisgarh	-	-	-	-	48.7	16
Goa	74.9	1	82.6	2	78.6	2
Gujarat	49.8	12	48.3	12	45.2	20
Haryana	53.5	10	62.7	7	65.3	7
Himachal Pradesh	63.5	5	83.4	1	74.2	4
Jammu & Kashmir	65.7	2	56.7	11	66.7	6
Jharkhand	-	-	-	-	34.2	22
Karnataka	52.2	11	60.0	8	55.0	13
Kerala	54.4	9	79.2	3	75.3	3
Madhya Pradesh	29.2	16	22.4	17	40.3	21
Maharashtra	64.1	4	78.2	4	58.8	12
Manipur	29.1	17	42.3	16	46.8	17
Meghalaya	9.7	24	14.3	21	32.9	23
Mizoram	56.4	8	59.6	9	46.5	18
Nagaland	3.8	25	-	-	21.0	29
Odisha	36.8	14	43.7	14	51.8	14
Punjab	61.9	6	72.1	5	60.1	10
Rajasthan	21.1	19	16.0	20	26.5	27
Sikkim	-	-	43.9	13	69.6	5
Tamil Nadu	64.9	3	78.2	4	80.9	1
Tripura	19.0	22	-	-	49.7	15
Uttar Pradesh	19.8	20	21.2	18	23.0	28
Uttarakhand	-	-	-	-	60.0	11
West Bengal	34.2	15	43.1	15	64.3	8
Andaman & Nicobar Island	-	-	-	-	-	-
Chandigarh	-	-	-	-	-	-
Dadra & Nagar Haveli	-	-	-	-	-	-
Daman & Diu	57.8	-	69.8	6	63.2	-
Delhi	-	7	-	-	-	9
Lakshadweep	-	-	-	-	-	-
Puducherry	-	-	-	-	-	-
All India	35.4	-	42.0	-	43.5	-

Source: India Public Policy Report 2014

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The 38th Annual Conference of the Parishad will be held in *Bijoy Krishna Girls' College, Howrah*, on 17th & 18th February, 2018.

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The conference will have the following Topics :

TOPIC I : Macroeconomics for Developing Country

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Papers on any topic of the Conference are invited. Contributed papers along with an Abstract,keywords, and JEL Classification Codes , in MS Word be sent to the President ,Bangiya Arthaniti Parishad at bchatterjee.presidentbea@gmail.com within January 10, 2018.For registration and other details, please contact Dr.Ruma Bhattacharyya,Principal , Bijoy Krishna Girls' College, Howrah at rumabhattacharyya61@gmail.com.

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