

# **Child Under-weight and Agricultural Productivity in India: Implications to Public Provisioning and Women's agency**

**Swarna S. Vepa, Brinda Viswanathan, Rohit Parasar, R.V. havani**

## **Abstract**

India could achieve a reduction in child mortality rates but failed to achieve substantial reduction in child underweight and stunting. This study attempts an empirical explanation of the slow welfare outcome such as fewer underweight children with capitalistic aim of achieving higher land productivity in agriculture and social provisioning aim of better food and public health across 430 districts in India in 2004. The challenges revolve around understanding the role of agricultural productivity in reducing child under-nutrition in the rural and semi urban areas in which the agricultural production, trade and processing exist. The study excludes 100% urban and metropolitan districts. Women's agency aspects of literacy and its interaction with work participation and pregnant women's health status influence child-underweight. A simple Ordinary Least Square equation and quantile regression analysis, alternately using either land productivity or worker productivity in agriculture along with women's agency aspects show stronger influence than the public provisioning of health and water supply. While agricultural land productivity and women's agency impacts are clear at all levels, public provisioning works only in some quantiles, probably due to poor quality of the service or limited coverage of services. Further land inequity can hinder larger welfare gains in agricultural productivity and lacunae in the provisioning of public health and water supply causing Diarrhea hinder child welfare outcomes. Recent improvements may have occurred due to affordability improvements and strong women's agency aspect at higher levels of income. The lower income groups may continue to be malnourished, due to weak public provisioning.

**Key Words:** Agricultural productivity, Child underweight, women's agency, water supply

JEL Code: I1

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## **Introduction**

Agriculture child nutrition linkage is mainly through food consumption and affordability. Droughts and other natural disasters affect agricultural production and affordability of subsistence population. Studies have shown that crop failure leads to higher mortality among children and especially girls (Rose E., 1999). Even after the mortality rates decline, agricultural shocks lead to calorie deprivation and under nutrition. Water sanitation and health along with care giver's education are crucial factors. Calorie deprivation along with other social indicators could explain about 26% of the child underweight between 1975 and 1995 (Smith L. C., and L. Haddad 2000).

According to the Global hunger Index 2014, India falls into the category of seriously hungry country. The index has shown a slight improvement for India and it was due to decline in the proportion of underweight children. The percentage of underweight children in India, according to the Global Hunger Index study fell from 42.5% in 2005-06 to 30.7% in 2009-2014. The underweight figure for the country was based on UNICEF survey of India and the district level health surveys of some states by the government of India (GOI, DLHS-2 and DLHS-4). Complete details of the surveys are not yet available. Limited data available shows that between 2002-04 and 2011-2013 the proportion of underweight children declined in some major states in the country especially southern states, Maharashtra and West Bengal but other better performing northeast states had recorded deterioration and yet others such as Haryana did not show much change.

Overall, child mortality in India declined steadily from 12.6% in 1990 to 5.6% in 2012 (IFPRI 2014). However, the child nutrition indicators of stunting (height for age) and underweight (weight for age) remained fairly high in India at about 48% and 42.5% respectively (IIPS NFH-3 2005-06), far higher than that of Sub Saharan Africa. The skepticism about India's ability to reduce child under-nutrition has given credence to the

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ideas of Asian Enigma (Ramalingaswami, V., et al 1996) and more recently to the idea of Indian Enigma (Headey, D., et.al, 2011). The authors of “Asian Enigma”, pointed out that reason for under-nutrition was the Asian women’s low status of health and education. Low weight-gain of pregnant women and existence of anemia, leads to low birth weight of the child, resulting in underweight in children in subsequent periods. The authors of Indian Enigma point out that despite abundant food production and fairly high growth in GDP, India failed to reduce child undernutrition. Some studies have shown that women’s employment improves child nutrition (Thampi B.V., 2007; Shukla, P., 2011). However there are other studies that doubt the positive impact of women’s work on child nutrition. Additional female wages were found to be too small to change the spending allocation to health (Berman P., et al. 1997). Rural infant mortality risk seems to be fifty percent higher if the mother works in agriculture (Bhalotra, S. 2010). Most of the women workers (79%) in India are engaged in agriculture in the rural areas (NSSO, 2011). The rest (21%) are engaged in non-agricultural work.

Much of the under-nutrition currently prevalent in the children of developing countries is attributable to conditioned malnutrition, arising from infections (Gopalan C., 2013). Sanitation and safe drinking water have been identified as key factors in reducing stunting and underweight (Bhagowalia P., et. al. 2012, Spears D., 2013). Hammer et.al (2013), have shown that approximately 1.3 centimeters height gain is possible in a four-year-old child, with the provision of safe sanitation to children’s immediate environment. Improvement in water and sanitation lowers the incidence of diarrhea by 7-17 percent and reduce the risk of under-five, child mortality by about 50% (Gunther F. G., et.al, 2010). As per the Diarrhea report, of UNICEF (2009), food absorption capacity of the child declines with diarrheal infections. Remedial measures such as administration of oral rehydration salts can substantially prevent survival risks (UNICEF 2009).The frequency, severity and duration of the disease also lead to under-nutrition. It has a direct bearing on the public provisioning of health, water and sanitation related services.

Now the relevant questions are, 1. What has changed between 2005 and 2012 that made it possible for some parts of India to slightly improve child nutrition? 2. What are the likely factors that could have contributed to the improvement in child under weight? In this paper we try to provide probable answers to the questions posed. First, we try to contextualize the neo liberal democratic political economy of India, citing public policy aspects and relevant statistics that could explain the change that has occurred. Second, we look at the association of the proportion of underweight children with the overall agricultural productivity, women’s

agency aspects and available public services, at the district level across 430 districts with the help of linear regressions and quantile regressions. Section II discusses the political economy aspects, Section III elaborates factors that could influence the proportion of underweight children with quantitative methods and concludes.

## **II. Reshaping of the Indian Political economy**

Essentially nothing dramatic or traumatic has happened in India, either in agricultural sector or health sector or in the direction of women's empowerment. There have been slow and steady undercurrents of change in Polity and Society. Indian Political economy has been reshaping and realigning itself, to suit the changes in political ideology. Nexus between big businesses and the polity, raising aspirations of the vocal middle class on one hand and political compulsions, demographic and labour market change on the other appear to reshape the political economy. Countervailing forces appear to be at work making evaluation of public policy more difficult.

The political economy is moving closer to the model of legalizing privatization of public resources and privatizing the public services. On one hand, politically the governments in power, irrespective of their ideology have embraced neo liberal approach. Neo liberal approach promotes capitalistic mode of the economy as opposed to a socialistic one. Trickle down is the only way to reduce poverty and hence slow and ineffective. Some of the outcomes of the neoliberal policies pursued in the past two and half decades have been particularly anti-poor.

There was no attempt by the successive governments at the centre and the states to reduce agricultural land inequality that remained quite high in India. Though land ceiling laws do exist for agricultural land, the neo liberal approach after nineties provided varieties of concessions to the rich to own commercial farms of unlimited size and scale, though land availability may act as a constraint. Mind boggling ownership of thousands of hectares by an individual in the name of a corporation is not uncommon in India where the average size of land in 2010 is just 1.16 hectares (GOI Agricultural Census 2010). Dualism persisted with big farms and commercial farms co-existing along with subsistence farms. Though officially, less than ten percent were land less, many land owners had negligible amount of land most of which was homestead land. Thus 40% of the rural households do not own agricultural land. Ownership of livestock by small farms has declined (Vepa. S. 2009). Most of the

agricultural policies adopted by the Government including support prices, concessional credit, writing off debt, subsidy on nitrogenous fertilizers, and irrigation equipment such as sprinklers and drip irrigation for horticultural crops, subsidies on mechanization in agriculture and so on, mostly benefited the big farmers by the virtue of owning big chunks of land. The spending on public research and extension services in agriculture has been reduced. Public capital investment in agriculture declined and private capital investments increased (Vaidyanathan 2012).

Public sector employment declined. Trade unions were considerably weakened. Another important aspect of employment was 28.4% of all workers were marginal workers who work for six months or less in a year. Women's work participation declined in urban areas (GOI, Census of India 2011).

There was neither an expansion of free public health services, nor specific improvement in the delivery, except an innovative attempt to involve the services of women from the rural community, to spread maternal and child health education and nutrition education, under national rural health mission. ASHA (Accredited Social Health Activist), Anganwadi worker (Village courtyard Worker) for Integrated Child Development Services (the lowest paid temporary employees of the government without any job security) are deployed for spreading the health and nutrition knowledge. Limited attempts were made to provide insurance cover to the poor for small amounts rather than providing public health services free. These are cost cutting exercises in line with the neo liberal approach. Private public partnership in health, education (except primary education) and infrastructure has become the norm.

On the other hand, the vote bank politics of appeasing sections of population lead to some populist measures. The political question is about the acceptability of aiming public policy toward particular deprived groups. There seems to be a consensus on this, across the political parties in India on targeting deprived sections, and claiming credit for the benefits. As pointed out by Sen, A.K, (1992), as deprivations of particular groups get politicized, they acquire a level of support far beyond what was obtained before. It happened in the case of Food security ACT, unanimously passed by the Indian parliament, albeit the voices of the middle class and occasional political decent against subsidies are getting louder now than ever before. No government in India can afford to face the electorate without supporting the low priced food for the poor. Dreze J, et.al., (1991) alludes to this as the reason for the non

occurrence of famine in independent India. Governments in the states especially the southern states competed with each other since 2007 (the start of high food inflation) to reduce the price of food grains in the public distribution system. States with opposing political ideology such as West Bengal and Chhattisgarh also followed suit to reduce the price of food-grains supplied to the poor through public distribution system. High support price of food grain to farmers ensured sufficient production and supply of food grains in the country. Mid-day meal program in schools may have also supplemented the food availability of the deprived sections at least in the states where scheme was implemented well. Further, as and when implemented effectively, old age pensions, cash transfer program for safe mother hood (Janani Suraksha) conditional on regular health checkups, (Lim, Stephen S., et al. 2010) National rural employment guarantee scheme of 100 days of employment (Nair *et al.* 2012) may have benefited the deprived sections. As pointed out by Sen, A. K (1992) in the context of targeting, a gap exists between the availability of public services and their actual use by deprived groups. Lack of education according to him is the main constraint. Education helps to close the information gap. Private sector facilities are used when public services are not available.

Demographic changes reshaped the labour markets. Tight labour markets push up wages and help alleviate poverty to some extent. There were periods of no growth in employment (2004-05 and 2009-10). There were periods of a spurt in employment (2009-10 and 2011-12). These uneven changes appear to be a combination of demographic structure of falling birth rates in the previous periods, progressively reducing the new entrants into the labour force. The shift of people from agriculture to non-agriculture by about 9% occurred as investments in construction sector created jobs during this period (Mehrotra S et al. 2014). Real per capita average monthly expenditure increased by 22.2% in the rural areas and by 26.5% in urban areas between 2004-05 and 2011-12 (NSSO 2013). While calorie consumption per consumer unit declined in all expenditure classes, dietary diversity into healthy foods such as vegetables, milk and eggs increased at the average level (NSSO 2014). Fewer children coupled with improved affordability and women's literacy at 65% may have improved the food quality and care given to children in not so poor families.

Finally deterioration of the child nutrition status in some of the north eastern states could be explained with political instability, insurgency, and political infighting. Such events lead to pre-occupation of the political party in power with divisive politics on caste lines or religious lines or on lines of ethnicity. They may lead to disruption of normal life for the

citizens leading to deterioration of health and nutrition service delivery and availing of the same by the deprived groups.

### **III. Factors influencing Child nutrition at the District level**

**Data sources:** In the absence of more recent data, we rely on the earlier data sets, to examine the factors that influence reduction in child underweight. A district level data analysis has the advantage of enabling us to combine the data sets from different sources at the district level for the purpose of analysis. All hundred percent urban districts have been excluded from this study to capture the agricultural linkage to child nutrition. Only, 427 districts could be included in the study due to data limitations. Data for variables on proportion of underweight children, proportion of pregnant women with anemia, proportion of population with access to any government health facility, proportion of under three children reporting diarrhea, proportion of children vaccinated, proportion of children who received oral rehydration salts, proportion of women with education above secondary level have all been taken from the District level health survey -2 for 2002-04. Data on proportion of households with access to shared toilets, proportion of population with access to manmade sources of water such as piped water and well water were also available from the District Level Health Surveys. While own toilets are better than public toilet shared, public toilet facility represents the public provisioning to the deprived sections. Normally toilet ownership captures, literacy and income levels, while access to public shared toilets reflects the public provisioning to the deprived.

In India, officially the term “safe water supply” only means piped water or well water mostly supplied by the public authorities. The definitions vary from state to state. Sometimes, they include wells and sometimes, they do not. To make the variable uniform, all wells both public and private, piped water from the government, and private sources have been included under the name of non natural sources of water,

Data on agricultural aspects were triennium averages and taken from the ministry of agriculture and cooperation. District GDP for agriculture, including production of crops, milk, meat, poultry and fisheries is from a private company called “Indicus analytics”, which compiles government data as time series. Land productivity is the per hectare three-year average GDP from agriculture at constant prices (Ag GDP/cultivable area of the district).

**Methodology:** The study's focus is on proportion of children, underweight for age, who are below two standard deviations by WHO standards. Linear regression models and the quantile regression models test the association of two sets of independent variables with the proportion of children who are healthy and not underweight at the district level. Quantile regression helps us to understand the influence of the variables at various levels of severity of the problem of underweight. The quantile method estimates several regression models, each based on various quantiles or percentage point of the distribution of child underweight rates (Koenker, 2005). This approach helps us in understanding the differences in the causal relationship across the entire distribution of the child underweight rates. Since lower quantiles would encompass districts with high levels of underweight rates and they are of interest from a public policy perspective for intervening, such an analytical tool is of relevance in the current context. .

To ensure that one would not miss-out on the lowest deciles, the under-weight percentage is reversed to non-underweight percentage. Now the dependent variable captures the proportion of normal children in the district and not that of underweight children. Consequently, coefficient in the estimated model reverses the signs, compared to the results estimated with underweight children. For uniform interpretation of results of ordinary least squares estimates and the quantile regression estimates, the dependent variable is the proportion of normal children, which is nothing but 1 minus the proportion of underweight children. In the lower quantiles (20<sup>th</sup>) there are fewer normal children and more underweight children. In the upper quantile (80<sup>th</sup>) there are more normal children.

There are two separate equations either with vaccination variable or with the women's work education interaction variable. We find a very high correlation between proportion of children fully vaccinated and the interaction term of women's education and work participation. The result consists of two ordinary least square equations as detailed below and two quantile regressions that correspond to these equations. Statistical tests did not show any endogenous variables in the equations estimated.

$$1. \text{ Normal Children} = \alpha + \beta_1 \ln \text{ Ag. Ldpr} + \beta_2 \text{ Int Wmwk.WmSec edu} + \beta_3 \text{ Anemia Wm} + \beta_4 \text{ Dia under3} + \beta_5 \text{ Ors} + \beta_6 \text{ Any govt. facility} + \beta_7 \text{ Toilets sh} + \beta_8 \text{ Water Pipe well} + e$$

$$2. \text{ Normal Children} = \alpha + \beta_1 \ln \text{ Ag. Ldpr} + \beta_2 \text{ Anemia Wm} + \beta_3 \text{ Dia under3} + \beta_4 \text{ Vac full} + \beta_5 \text{ Ors} + \beta_6 \text{ Any govt. facility} + \beta_7 \text{ Toilets sh} + \beta_8 \text{ Water Pipe well} + e$$



Abbreviations used for Variable:

Normal children = 1- Proportion of underweight children

ln Ag. Ldpr = Natural log of agricultural Land productivity

Int Wmwk.WmSec edu = Interaction of women's work participation rate with proportion of women

Anemia Wm = Proportion of pregnant women with anemia

Dia under3 = Proportion of children under three with diarrhea

Vac full = Proportion of children fully vaccinated

Ors = Proportion of children administered with Oral rehydration salts

Any govt. facility = Proportion of population with access to any government health facility

Toilets sh = Proportion of population with access to public shared toilets

Water Pipe well = Proportion of population with access to piped water or water from wells  
(Other than natural water sources such as ponds, tanks, rivers, and streams and springs)

**Results and interpretation:** The descriptive statistics show the average levels of the independent variables. Since the units in which they are expressed, the standard deviations are not comparable. Some of the variables chosen such as public toilets are not common, with only few people having access to them, yet they may prove to be effective, in the district that have them, where as almost all the districts have public water supply without being particularly effective. Coefficient of variation shows that access to water has the lowest value and access to shared toilets has the highest value.

All the models estimated had a good fit, explaining about 33 to 35 percent of the variations in the proportion of normal children across the districts ( Appendix 1 tables). Agricultural land productivity appears to have a significant positive association with proportion of normal children, indicating underweight rates could come down with agricultural prosperity. In combination with the same set of variables, the quantile regressions show that Land productivity has positive significant association with the proportion of normal children in all the quantiles. The interaction of women's work participation and above secondary level education has significant positive association with proportion of normal children at the overall context and also in all the quantiles, in the district context.

The view that women's agricultural work is not good for children arises out of the perceived trade-off between additional income earned and reduced care time given to the child. The income and education effect may not lead to loss of care hours if proper care from other family members is forthcoming. Analysis using only the rural sample from the data

using the same data set for another study supported the view that women's work participation reduces the proportion of underweight children. Some confusion seems to arise about the income effect of women's paid work outside the house and unpaid work in family enterprise. Even the unpaid work of women on family enterprise contributes to income of the family and results in welfare outcomes. Anemia among pregnant women has a significant negative influence on proportion of normal children in OLS estimation and in the regressions estimated for all quantiles. Thus women's agency aspect through work, education and health seem to go a long way in promoting child nutrition.

The set of variable used, to reflect the public provisioning of health services had varying association with proportion of normal children. Proportion of vaccinated children has positive association in all the quantiles except in the highest quantile.( results not presented as they are similar to the earlier results). Presence or absence of the government facility seems to make a difference only in the lowest quantile. Diarrhoea among three year olds has a significant negative association with the proportion of normal children in OLS estimations. In quantile regressions it tends to turn significant only in higher quantiles. Administration or oral rehydration salts show negative significant association with normal children in almost all the regressions both OLS and quantiles. Use of oral rehydration and full immunization through vaccination prevents the underweight in children.

Public toilets also seem to help improve the proportion of normal children in the districts. In all OLS estimations significant positive association is apparent with proportion of normal children. In the quantile regressions they had no association in the lowest quantiles but association improved in the higher quantiles. It may mean that in more urbanized areas, where fewer underweight children exist, the public toilets for the slums may prove effective.

Of all the variables considered, water supply is the only variable that has shown either an insignificant association or a significant adverse negative association with the proportion of normal children. The association tended to turn significantly adverse in the higher quantile. Without doubt public water supply should improve.

**Conclusion:** In the light of the empirical analysis, the question posed in the beginning of the study may be answered. Empirical analysis clearly shows that agricultural productivity that directly or indirectly increases the affordability along with women's agency aspects help reduce child underweight. While public provisioning of health sanitation and water supply services help reduce underweight in children, either the public services are of negligible coverage as in the case of public toilets, or faulty as in the case of water supply. Vaccination

and oral rehydration practices seem to be helpful, though it is not clear how much of it is provided by the public health services. Thus there is a strong case for strengthening women's agency aspect and improving public service delivery in India for further reduction in child nutrition.

## Appendix I

**Table 1: Association of proportion of normal children with agricultural (land) productivity and women's agency, health and sanitation**

Normal Children (%) (100 – proportion of underweight children)	Coefft.	<i>p</i> -value
<b>Ln of Land productivity in agriculture</b>	4.66***	0.000
<b>Female work participation (%) * female education above secondary level (%) (interaction term)</b>	0.01***	0.000
<b>Women with anemia (%)</b>	-0.09*	0.014
<b>Children under age 3 with prevalence of diarrhea (%)</b>	-0.24**	0.007
<b>Children Administered with Oral Rehydration Salt (%)</b>	0.20***	0.000
<b>Households with access to any Govt. Facility (%)</b>	0.06	0.101
<b>Households with access to Shared Toilets (%)</b>	0.56*	0.015
<b>Households using Non-natural water (Piped water + Well water) (%)</b>	-0.12	0.102
<b>Constant</b>	43.53***	0.000
<b>R-sq=0.3512; Prob&gt;F=0.000; No. of Obs: 427</b>		

Source: DLHS-2 (2002-04), Indicus Analytics & Department of Agriculture

Note: #p-value< 0.10; \*p-value<0.05; \*\* p-value <0.01; \*\*\* p-value <0.001

**Table 2: Association of proportion of normal children with agricultural (land) productivity, immunization, health and sanitation**

Normal Weight Children (%)	Coefft.	<i>p</i> -value
<b>Ln of Land productivity in agriculture</b>	4.47***	0.000
<b>Children fully Immunized (%)</b>	0.07**	0.006
<b>Women with anaemia (%)</b>	-0.08*	0.026
<b>Children under age 3 with prevalence of diarrhea (%)</b>	-0.25**	0.009
<b>Children Administered with Oral Rehydration Salt (%)</b>	0.22***	0.000
<b>Households with access to any Govt. Facility (%)</b>	0.08*	0.045
<b>Households with access to Shared Toilets (%)</b>	0.57*	0.019
<b>Households using Non-natural water (Piped water + Well water) (%)</b>	-0.24**	0.002
<b>Constant</b>	54.94***	0.000
<b>R-sq=0.3377; Prob&gt;F=0.000; No. of Obs: 427</b>		

Source: DLHS-2 (2002-04), Indicus Analytics & Department of Agriculture

Note: #p-value< 0.10; \*p-value<0.05; \*\* p-value <0.01; \*\*\* p-value <0.001

**Table 3: Association of proportion of normal children with agricultural (land) productivity and women's agency, health and sanitation (Quantile Analysis)**

Normal Weight Children (%)	Quantile (0.20)		Quantile (0.40)		Quantile (0.60)		Quantile (0.80)	
	Coefft.	<i>p-value</i>	Coefft.	<i>p-value</i>	Coefft.	<i>p-value</i>	Coefft.	<i>p-value</i>
<b>Ln of Land productivity in agriculture</b>	5.35**	0.002	6.09***	0.000	5.58***	0.000	4.89***	0.000
<b>Children fully Immunized (%)</b>	0.16***	0.000	0.12***	0.000	0.08*	0.021	0.06	0.215
<b>Women with anaemia (%)</b>	-0.07	0.154	-0.07#	0.058	-0.08#	0.059	-0.12*	0.025
<b>Children under age 3 with prevalence of diarrhea (%)</b>	-0.26	0.101	-0.09	0.397	-0.21*	0.047	-0.23*	0.026
<b>Children Administered with Oral Rehydration Salt (%)</b>	0.04	0.444	0.10*	0.014	0.20**	0.005	0.31***	0.000
<b>Households with access to any Govt. Facility (%)</b>	0.14*	0.011	0.10*	0.017	0.05	0.281	-0.01	0.818
<b>Households with access to Shared Toilets (%)</b>	0.51	0.260	0.96*	0.013	0.82*	0.013	0.74*	0.033
<b>Households using Non-natural water (Piped water + Well water) (%)</b>	0.07	0.658	-0.37*	0.020	-0.33**	0.002	-0.40***	0.009
<b>Constant</b>	12.47	0.372	56.34***	0.000	63.51***	0.000	81.93***	0.000
<b>R- Sq</b>	0.167		0.2074		0.2224		0.2551	
<b>No. of Obs</b>	427							

Source: DLHS-2 (2002-04), Indicus Analytics & Department of Agriculture

Note: #p-value< 0.10; \*p-value<0.05; \*\* p-value <0.01; \*\*\* p-value <0.001

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