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Crop Insurance, Financial Inclusion and Growth of Rice Production in India

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and
Dr. Debabrata Mukhopadhyay**

Abstract

The study tries to investigate how far the production growth of rice in India, which is a kharif crop, is influenced by fluctuation in rainfall due to climate change and the number of small farmers included in crop insurance schemes over time. The stationarity status of each series of data is examined by applying standard Unit Root Tests of Augmented Dickey Fuller and Phillips- Perron. Then a multiple regression model by Ordinary Least Squares is conducted with Heteroskedasticity and Autocorrelation consistent standard errors and covariance to access the impact of both climate change and crop insurance on production growth of rice. The result shows that both increase in rainfall and inclusion of small farmers in crop insurance schemes positively affects production growth of rice over the period of study. The problem of multicollinearity is checked in terms of Variance Inflation Factor. Johansen Co-integration test is conducted and it is found that there is the existence of long term relationship among growth in production of rice and the number of farmers included in the crop insurance scheme in the nation. To understand the influence of climate change on inclusion of farmers in crop insurance over time, simple Ordinary Least Squares regression technique is used by incorporating Dummy variable, which shows that climate change has significant impact on farmers' inclusion in the crop insurance scheme.

JEL Classification : *C01, C22, H12, Q18*

Key Words : *Risks in farming, Climate change, Rice production, Crop Insurance, Financial inclusion*

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1. Introduction

Rice is not only the staple food of India but also an important source of livelihood for millions of farmers of the nation. India has the largest area under rice cultivation in the world and is second only to China in its production. India accounts for about 20% of all world rice production (International Rice Research Institute, 2007). The use of innovative technology in Indian agriculture during 1960s resulted in 'Green Revolution', which had helped the nation to enhance not only production but also productivity of rice. India's rice production had nearly trebled between 1960 and 2010, with a compound annual growth rate of 2.53% (Indian Council of Agricultural Research, 2011). Despite past achievements, the growth trajectory of this major food crop has to continue for the future to meet the challenge of food and nutritional security of burgeoning population of the nation.

Recently, cultivation of this crop is in crisis all over the world and India is no exception. One can identify the following possible ominous signs of the crisis in Indian context:

Firstly, land under cultivation for rice is going to be scarcer due to rapid pace of urbanization and crop diversification towards cash crops ; Secondly, rice is a kharif crop and thus its production depends upon adequate rainfall due limited spread of irrigation facility throughout the nation. But during the past four decades monsoon in India has changed due to climatic change in two significant ways : (i) it has weakened , i.e., less total rainfall during June to September (Dash,2007 & Goswami,2006) ; (ii) distribution of rainfall within the monsoon season has become more extreme (Dash & Goswami,2009). This uncertainty of rainfall has played havoc with the fortune of the farmers ; Thirdly, the cost of inputs has been escalating but returns from farming are going down ; Fourthly, most of the farmers cultivating this crop are small and marginal in nature, having very little financial ability to withstand risks associated with farming ; Lastly, there is a huge financial exclusion in rural sector. Due to paucity of institutional sources of credit for farming, the poor farmers have to fall back upon the money lenders and input suppliers for their credit needs. They lend money at exorbitantly high rate of interest. The share of non-institutional credit to total agricultural credit in the nation has increased from 33.7% in 1991 to 39% in 2002 and then fell to36% in 2013. The share of moneylenders providing credit rose from 17.5% in 1991 to 29.6% in 2013 (All India Debt and Investment

Survey, relevant issues of NSSO). If there is a crop failure, farmers sink into the burden of debt. About 49% of the farmers in the nation are debt trapped (NSSO Report, 2011). Extreme manifestation of this debt crisis has resulted in unending chain of farmers' suicides in recent times in many states of the nation.

Farmers are universally risk averse and they wish to avoid risk in farming in terms of various managerial and institutional mechanisms. They may diversify their crops, favour traditional farming techniques by restricting the use of modern costly inputs, enter into share cropping agreements etc. In India for a section of farming community Minimum Support Prices for certain crops provide a means of their income stability. But, for most of the crops and in many states, Minimum Support Prices have not been implemented. Several studies have shown that the policy mostly benefited the farmers of three major states namely Punjab, Haryana and Uttar Pradesh whereas in many other states there have been many problems in implementing the scheme. Recently, mechanisms like contract farming, future trading etc. have been introduced and they are expected to provide some risk cover against price fluctuations. But it is widely believed that crop insurance is the only institutional mechanism available to safeguard against production risk in farming. It provides financial support to the farmers in the event of failure of any of the crops covered under the insurance contract as a result of adverse weather conditions, pests and diseases. It also encourages the farmers to adopt progressive farming practices, high value inputs and advanced technology in agriculture. In this way it helps to stabilize farm income, particularly in disaster years. It spreads the crop losses over space and time and helps in maintaining the dignity of farmers. Moreover, the liability of the Government to bear the cost of relief measures to the farmers following crop failure is reduced to some extent as through crop insurance the farmers themselves contribute to their relief.

Crop Insurance in India has been attempted in embryonic form since independence and there have been many sporadic efforts to ensure protection of farming community against losses suffered through natural calamities. One such important crop insurance programme in India was introduced in the year 1985, named Comprehensive Crop Insurance scheme (CCIS), with active financial responsibility taken by both the Central and the State government and Agricultural Insurance Company was entrusted the role of implementing agency. The National Agricultural Insurance Scheme (NAIS)

replaced CCIS from the Rabi season of 1999-2000. This scheme is still in operation in some modified form. Very recently the Government of India has introduced its new crop insurance scheme named 'Pradhan Mantri Fasal Bima Yojana' to revamp some problems associated with the functioning of NAIS in July 2016.

Financial inclusion, broadly understood as the process in which the marginalized and formal-finance deprived sections of the society get access to the formal financial sector, has increasingly come to the fore-front of the public discourse in recent years. In India, the inclusive growth approach got currency ever since the launching of the 11th Five year plan. Financial inclusion promotes social justice and equal opportunities. But there is a huge financial exclusion in rural areas of India. In August 2014, the Indian Government launched Pradhan Mantri Jan Dhan Yojana scheme for comprehensive financial inclusion with the goal of opening a bank account for every household. By the end of January 2015, it had led to the opening of 125 million new bank accounts. Under the scheme more than 97% of the accounts were opened with public banks (The Hindu, 16.04.2015). But according to the World Bank Report (2015), dormancy rate in India is quite high at 43%. Only 39% of all account holders in India own a debit or ATM card, and using an account might be inconvenient and time consuming if every transaction requires using a bank teller. In India, not only account penetration is comparatively low, at 53%, but so is the use of accounts for payments – mere 15% of adults reported using an account to make or receive payments. About 61% of the people in rural areas of the nation still do not have bank accounts (RBI Bulletien,2015-16). Still today nearly 73% of the farm households in the nation have no access to formal sources of credit. Since most of the farmers in the nation are small and marginal in nature and majority of them are excluded from formal financial system for which they cannot withstand risk associated with farming, the need of the hour is the implementation of a universal crop insurance scheme by the Government to redress the problem of agrarian distress. Moreover, the introduction of crop insurance will necessitate the opening up of bank accounts for the insurance willing farmers as the financial transactions between insurance authority and insured farmers regarding payment of insurance premiums and indemnity should be made by authorized nodal bank branches. This is another dimension of inclusive growth of agricultural production.

There is a large domain of literature that tries to explain the factors which can be considered as important determinants of yield growth of rice in India and the risk

associated with its farming due to weather vulnerability, like the effect of global warming or fluctuations in rainfall etc. Battese and Coelli (1992) studied production function of rice farmers in India and found that labour and land cost as well as the ratio of irrigated land to total land were significant determinants of yield growth of rice and they affected productivity positively. The study of Reddy (1996) showed that proper irrigation, scheduled commercial banks' credit flow to farmers and provision of fertilizer subsidy are key determinants for yield growth of rice for small and marginal farmers in India. Kumar and Parikh (2001) showed that climate change has led to a significant reduction of yield growth of rice in few states of the nation over the years since 1980s. Farming of this crop is risky due to uncertainty of monsoon as a consequence of climate change. The study of S.K.Dash , R.K. Jenemani, R.S.Kalsi, S.K.Panda (2007) as well as the study of B.N.Goswami, V.Venugopal, D.Sengupta, M.S.Madhusudan, K.Price (2006) has shown that monsoon rainfall in India has not only weakened (i.e., less total rainfall during June to September) in recent time but also the distribution of rainfall within the monsoon season has become more extreme. Both of these have serious implication for production of rice. The rainfall data collected from the Meteorological Department, the Government of India also confirms this fact. The studies of L.S.Rathore, S.D.Attri and A.K.Jaswal have identified that in India, the state average monsoon season rainfall has increased in Bihar, Gujarat, Jharkhand, Karnataka, Lakshadweep, Meghalaya, Mizoram and West Bengal during 1951 to 2010. The decreasing trend in monsoon rainfall has been observed in Andaman and Nicobar Island, Andhra Pradesh, Arunachal Pradesh, Assam, Chattisgarh, Delhi, Goa, Haryana, Himachal Pradesh, Jammu and Kashmir, Kerala, Madhya Pradesh, Maharashtra, Manipur, Nagaland, Orrisa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and Uttarakhand.

In their paper Kannan and Sundaram analyzed the trend in India's agricultural growth in between 1967-68 to 2007-08. They concluded that enhanced capital formation, better irrigation facilities, normal rainfall and improved fertilizer consumption can help to improve output of crop production in India and production of rice in particular. According to the report of the Central Rice Research Institute (2011), the rice production in India is going to come under additional pressure in the days to come due to land and water constraint and more difficult growing environment because of climate change, high price of energy and fertilizer. The report mentions that depletion of soil heaith (nutrient and humus) is another problem associated with cultivation of this crop.

But very little work has been done to access how the spread of crop insurance scheme can promote the production growth of rice, which is a risky crop to cultivate due to weather vulnerability and climate change and at the same time ensures financial inclusion of small and marginal farmers who found themselves excluded from formal financial system. The present study tries to fill this research gap.

The present study, in its limited domain, tries to investigate

(a) how far the production growth of rice, which is a kharif crop, is influenced by fluctuation in rainfall over time due to climate change and the number of small farmers included in crop insurance schemes over time;

(b) The influence of climate change on inclusion of farmers in crop insurance schemes;

(c) Whether there exists any long term time invariant relationship between production growth of rice and the number of small farmers included in crop insurance schemes.

The plan of the paper is as follows – Section I introduces the paper by highlighting the motivation of the study, a brief review of literature and objectives of the study. Section II provides the sources of data and research methodology used in the study. Section III makes an empirical analysis of data, while Section IV concludes.

I. Data & Methodology

The study is based on secondary data. In this time series analysis the data regarding production of rice in India has been collected from the Centre for Monitoring Indian Economy (CMIE) for the time period between 1985-86 and 2003-04. The data regarding Net irrigated area as a percentage of net sown area in the nation has also been collected from CMIE and the data regarding the number of small farmers benefited by crop insurance schemes is collected from AIC report. The rainfall data of the nation during kharif season (i.e. from the month of July to September) has been collected from the Meteorological Department of Government of India.

The period of time has been so chosen as all the relevant data regarding the chosen variables are available for this period of time.

This study assumes that the growth rate of rice production in the nation over time depends on :- (i) Net irrigated area as a percentage of net sown area in the nation ;

(ii) Number of small farmers benefited by crop insurance during the kharif seasons ; and (iii) Rainfall during the kharif seasons.

The cereal rice has been chosen for the study as it is a staple food in India, which is a kharif crop and thus its production is associated with the risk of weather vulnerability, particularly due to fluctuations in rainfall.

The stationarity status of each series of data is examined by applying the standard Unit Root Tests of Augmented Dickey Fuller (ADF) and Phillips- Perron (PP). Then a multiple regression model by Ordinary Least Square (OLS) has been conducted with Heteroskedasticity and Autocorrelation consistent standard errors and covariance to access the impact of both climate change and crop insurance on production growth of rice. The study tries to estimate the coefficients of the following regression equation by Ordinary Least Square techniques :-

$$y_t = \alpha + \beta_1 x_{1t} + \beta_2 x_{2t} + \beta_3 x_{3t} + u_t$$

where, α = a constant term

β_i (i =1,2,3) is the regression coefficient of the ' i'th variable (regressor) under study

u is the error term $u \sim N(0, \sigma^2)$

Here , y_t = Growth of rice production in the 't'-th period ;

x_{1t} = Change in Net irrigated area as a percentage of net sown area in the 't'-th time;

x_{2t} = Change in the Number of small farmers benefitted by crop insurance during kharif season in the 't'-th time

x_{3t} = Change in rainfall during kharif season in the 't'-th time :

The problem of multicollinearity has been checked in terms of Variance Inflation Factor. Johansen Co-integration test has been conducted to investigate the existence of any long term relationship among the variables of the study. Now to understand the influence of climate change (change in rainfall trend) on the inclusion of farmers in crop insurance schemes for ten major rice producing states of the nation for the period 1999-2000 to 2009-10, the study tries to estimate the following regression equation in terms of White's heteroskedasticity consistent standard error and covariance by incorporating the Dummy variable (Di , where i denotes the 'i'th state under study)

$$Z_i = \alpha + \beta D_i + u_i$$

Where Z_i denotes the % of the farmers of the 'i'th state with respect to the total number of farmers included in the nation under NAIS scheme

D_i is the dummy variable where

$D_i = 1$ for decreasing trend in rainfall &

$D_i = 0$ for increasing trend in rainfall

u is the error term & $u \sim N(0, \sigma^2)$

All computations have been done by using the statistical software package EVIEWS

III. Empirical Analysis

It has long been known that many economic time series, especially macroeconomic time series, are non-stationary. Thus to initiate the time series analysis, the stationarity status of each series of data is examined by applying standard Unit Root Tests of Augmented Dickey Fuller (ADF) and Phillips- Perron (PP).

Let , Y_t = Rice production in India in the 't'-th period ;

X_{1t} = Net irrigated area as a percentage of net sown area in India in 't'-th time;

X_{2t} = Number of small farmers benefitted by crop insurance scheme during kharif season in the 't'th time

X_{3t} = Rainfall in India during kharif season in the 't'-th time ;

The Unit Root test result shows that except the rainfall data other series of data are non-stationary at level but becomes stationary in first difference at 1% level of significance. The rainfall data is stationary both at level and at first difference. Table 1 & 2 in Appendix summarise this result. For example, the production data of rice over time in the nation is non-stationary. But when the log differences of the production values are taken into consideration to measure the growth rate of rice production over time, the data series become stationary. In this test of Unit Root, the null hypothesis is framed as : the series has a unit root against the alternative hypothesis that the series has no unit root. When ADF test is done to test the null hypothesis, the value of the test statistic becomes (-6.9729) with the corresponding Mackinnon one tailed p-value equaling to 0.0001. This result rejects the null hypothesis and the alternative hypothesis that the series has no unit root has been

accepted. The same process is applied for PP test. In this way the Unit Root Test is done for all other data set of other variables as well.

Since regression analysis can be done only with stationary series of data, the variables under study can be redefined as :-

y_t = Growth in rice production in the 't'-th period ;

x_{1t} = Change in Net irrigated area as a percentage of net sown area in the 't'-th time;

x_{2t} = Change in the Number of small farmers benefitted by crop insurance during kharif season in the 't'-th time

x_{3t} = Change in rainfall during kharif season in the 't'-th time ;

Then the study tries to estimate the coefficients of the following regression equation by Ordinary Least Square techniques :-

$$y_t = \alpha + \beta_1 x_{1t} + \beta_2 x_{2t} + \beta_3 x_{3t} + u_t$$

Where α = a constant term

β_i (i =1,2,3) is the regression coefficient of the ' i'th variable (regressor) under study

u_t is the error term & $u \sim N(0, \sigma^2)$

The regression result is summarized in Table 3. The result shows that these three variables together can explain 75.74% variation in the production of rice in the nation. The F-statistic is also significant at 1% level, indicating that the model is a good fit. Moreover,

$\beta_1 = (0.0156)^{**}$ $\beta_2 = (0.0123)^{***}$ $\beta_3 = (0.0003)^{***}$

This indicates that 1% increase in net irrigated area as a percentage of net sown area increases production of rice by 0.0156% and this result is significant at 5% level. Similarly, 1% rise in inclusion of small farmers in crop insurance schemes raises production of rice by 0.0123% and this result is significant at 1% level. Lastly, 1% increment (fall) in rainfall causes rice production to grow (fall) by 0.0003% and this result is also significant at 1% level.

The economic intuition of the result is very clear. The success of new farming techniques in the nation adopted from the mid 1960s necessitated the increasing use of irrigation among others. Net irrigated area as a percentage of net sown area can be

treated as a technology variable in the study. With the rise in net irrigated area as a percentage of net sown area, production of rice is expected to grow.

The number of small farmers benefitted from crop insurance during the kharif season is, obviously, the insurance variable in the study. One of the important determinants of the spread of crop insurance in the nation is how many farmers in the nation are under the insurance coverage. Higher this number, the greater is the spread of crop insurance. Since insurance is one of the most important risk mitigation tools in farming, greater the spread of crop insurance, higher will be rice production.

Rainfall during kharif season is the climate variable in the study. Fluctuations in rainfall will lead to production fluctuation as well. The result indicates that decrease in rainfall during kharif season leads to shortfall of rice production. Thus climate change has significant impact on production of rice and thereby has added to risk in farming rice.

The problem of multicollinearity is checked in terms of Variance Inflation Factor (VIF) and that is summarized in Table 4. The rule of thumb for this test is that if the values of centered VIF of the variables under study are less than 5, then we can confidently conclude that there exist no problem of multicollinearity among them. The result shows that the value of centered VIF for all of these variables (regressors) is even less than 2. This confirms that there exists no multicollinearity problem among the variables under study.

Then Johansen Co-integration Test has been conducted to investigate the existence of any long term time invariant relationship among the variables of the study. Tables 5 & 6 summarize the result. Here this test considers only Y_t, X_{1t} & X_{2t} series, which are non stationary at level but stationary at first difference. Both the Trace test & Max – Eigen value test indicate 1 co- integrating equation at 0.05 level.

Normalised co- integrating co-efficients (S.E. in parentheses)

Y_t	X_{1t}	X_{2t}
1.0000	590.6815	- 1864.613
	(456.622)	(317.018)
		t stat = 5.88

Thus the study indicates that there is a long term time invariant relationship between growth in production of rice and the number of farmers included in the crop insurance scheme in the nation.

The trend of monsoon rainfall in these states for the period of time from 1999-2000 to 2008-09 is shown in Table 7.

Table 8 summarizes the dummy regression result showing that climate change has significant impact (at 10% level of significance) on farmers, inclusion in the crop insurance scheme.

Lastly, the only diagram used shows how the number of small farmers is included in crop insurance schemes over time and the figure clearly shows that farmers' inclusion in crop insurance schemes has increased rapidly particularly from 1999-2000, when NAIS scheme was introduced in the nation.

IV. Conclusion

The study concludes that both increase in monsoon rainfall during kharif season and inclusion of small farmers in crop insurance schemes in India over time has positively affected production growth of rice. Since during the last four decade, the monsoon rainfall in India has weakened significantly due to climate change, risk in farming of this major food crop of this nation has increased to a great extent. Since cultivation of this crop is the source of livelihood of majority of farmers in the nation who are not only small and marginal in nature but are also financially excluded, this problem occupies serious concerns in public discourse and policy framing for the government. Unending chain of farmers' suicides in recent times in many parts of the nation in recent times has justified the intensity of the problem. Crop Insurance can play a significant role in mitigating this production risk. This study has clearly shown that there is a significant positive association between fluctuation in rainfall due to climate change and the number of farmers included in crop insurance programmes. Moreover, there is also a significant long term relationship between the number of farmers included in crop insurance programmes and the increase in production growth of rice. To redress the problem of agrarian distress in the whole nation, the solution is not only a technological quick-fix, but the need of the hour is to promote crop insurance programme to increase the production growth of crops like rice and ensure financial inclusion of small and marginal farmers . But unfortunately, the spread of crop insurance in the nation is still not satisfactory in terms of the number of farmers

covered, area covered & claims to premium ratio. The Government should make the farmers aware about the benefits of the programme and will also encourage many private insurance companies to provide such policies to protect this vulnerable section of the population. The Government should also take proper care to invest sufficiently to extend the irrigation facility in the nation. Water conservation in terms of rainwater harvesting should get special attention in village level planning documents of the government. There should be intensive research in development of accurate climate information technology and improvement in weather forecasting. The proper designing of Weather Based Crop Insurance schemes is the key for success. Catastrophe modeling is an evolving science that aids policy makers and other stakeholders in managing the risk from natural disasters. Models focus mainly on the impact of rapid-onset disasters (for example, earthquakes, hurricanes, floods) on public or private infrastructure. This risk assessment paradigm must be adapted to slow-onset disasters (for example, drought). Catastrophe modeling offers new tools with which to assess the economic impact of extreme weather events. Very often, production risks and their financial impacts are underestimated or misdiagnosed, leading to interventions that are inappropriate and ineffective. The government should promote the development of catastrophe risk models and other risk assessment tools. Remote sensing is the emerging technology with potential to offer plenty of supplementary, complimentary and value added functions for crop insurance. Governments should grant insurers access to reliable and timely agricultural and weather data, which allow them to properly assess the underlying agricultural risks and design and price actuarially sound insurance products. The role of national statistical offices is essential in collecting agricultural data, not only for policy purposes but also for insurance purposes. The Weather Department also plays a central role in providing weather data to the insurance industry. A relatively dense network of tamper-proof weather stations is essential to the development of weather index insurance products.

To conclude, it is said that 'farming is a profession of hope' and a dedicated effort is needed to revive Indian agriculture such that the farmers of the nation feel farming as a hopeful profession for the future. Effective implementation of crop insurance programme will make this dream come true. The pride and confidence of farmers and farming need to be restored.

APPENDIX

Table :1 : Unit Root Test (At Level)

Augmented Dickey Fuller Test			Phillips Perron Test		
Series	Test statistic	p-value	Series	Test statistic	p-value
Y_t	-2.4646	0.3379	Y_t	-2.197	0.4593
X_{1t}	-2.6550	0.2643	X_{1t}	-2.504	0.3219
X_{2t}	-2.2482	0.437	X_{2t}	-2.243	0.437
X_{3t}	-6.4634	0.0005	X_{3t}	-6.464	0.0005

Source : Author's Calculation

Included in test equation : trend and intercept

Null Hypothesis : The series has a unit root

For ADF test lag length : Schwarz Info criterion ; maximum lag : 3

p-values of ADF test are calculated on the basis of Mackinnon(1999) one tail test

Table :2 : Unit Root Test (In First Difference)

Augmented Dickey Fuller Test			Phillips Perron Test		
Series	Test statistic	p-value	Series	Test statistic	p-value
Y_t	-6.9729	0.0001	Y_t	-7.5267	0.0000
X_{1t}	-4.7256	0.0025	X_{1t}	-4.7716	0.0023
X_{2t}	-6.0965	0.0002	X_{2t}	-6.1505	0.0002
X_{3t}	-7.7363	0.0000	X_{3t}	-20.6760	0.0001

Source : Author's Calculation

Included in test equation : trend and intercept

Null Hypothesis : The series has a unit root

For ADF test lag length : Schwarz Info criterion ; maximum lag : 3

p-values of ADF test are calculated on the basis of Mackinnon(1999) one tail test

Table 3 : Regression Result

Method : Least Squares | Included Observations : 17

R-squared : 0.7574 | **Adjusted R-squared : 0.6968**

F-statistic : 12.4917 | **Prob(F-statistic) : 0.0005**

Variable	Co-efficient	t-stat	p-value
α	-0.0058	-0.5674	0.5809
x_{1t}	0.0156	2.5098	0.0274
x_{2t}	0.0123	3.9510	0.0019
x_{3t}	0.0003	7.7003	0.0000

Source : Author's Calculation

Table : 4 Result of Variance Inflation Factor Test

Variable	Co-efficient Variation	Centered VIF
α	0.000	NA
x_{1t}	3.88E-05	1.641
x_{2t}	9.65E-06	1.820
x_{3t}	2.25E-09	1.597

Source : Author's Calculation

Table 5 : Co integration Result

Johansen Co integration Test

Trend Assumption : Linear Deterministic Trend

Series : Y_t, X_{1t}, X_{2t}

Lags interval (in first difference) : 1 to 1 Mac-kinnon- Haug- Michelis (1999) p - values

Unrestricted Co integration Rank Test (Maximum Eigen value)

Hypothesized no. of CE(s)	Eigen value	Max- Eigen statistic	0.05 critical value	P - value
None	0.8950	33.8186	21.13162	0.0005
At most 1	0.3842	7.2746	14.2646	0.4572
At most 2	0.1062	1.6842	3.8414	0.1949

Source : Author's Calculation

Table 6 : Co integration Result

Johansen Co integration Test

Trend Assumption : Linear Deterministic Trend

Series : Y_t, X_{1t}, X_{2t}

Lags interval (in first difference) : 1 to 1 Mac-kinnon- Haug- Michelis (1999) p - values

Unrestricted Co integration Rank Test (Trace)

Hypothesized no. of CE(s)	Eigen value	Trace statistic	0.05 critical value	P - value
None	0.895082	42.777	29.797	0.001
At most 1	0.384288	8.9589	15.494	0.369
At most 2	0.106211	1.68427	3.814	0.194

Normalised co- integrating co-efficients (S.E. in parentheses)

Y_t	X_{1t}	X_{2t}
1.0000	590.6815	- 1864.613
	(456.622)	(317.018)
		t stat = 5.88

Table :7 Trend in monsoon rainfall and inclusion of small farmers in crop insurance schemes over time

Name of the major rice producing states in India	Trend in monsoon rainfall during 1999-2000 to 2008-09	No. of farmers insured from Rabi 1999-2000 to Rabi 2008-09 under NAIS	Area in hectare insured from Rabi 1999-2000 to Rabi 2008-09 under NAIS
Andhra Pradesh	Decreasing	18920261	29738526.44
Assam	Decreasing	139988	106376.08
Bihar	Increasing	3726639	4527110
Chattisgarh	Decreasing	5756368	11943212.69
Karnataka	Increasing	9177415	15512411.19
Orissa	Decreasing	9107973	9300845.33
Tamil Nadu	Decreasing	2386179	3441279.97
Uttar Pradesh	Decreasing	13259914	18235279.77
West Bengal	Increasing	7088296	3633598.43
All India		134669208	210910865.39
	% value of major states	51.65	45.73

Source : AIC Reports (various issues) , Meteorological Department of Government of India

Table 8 : Regression Result with Dummy variable

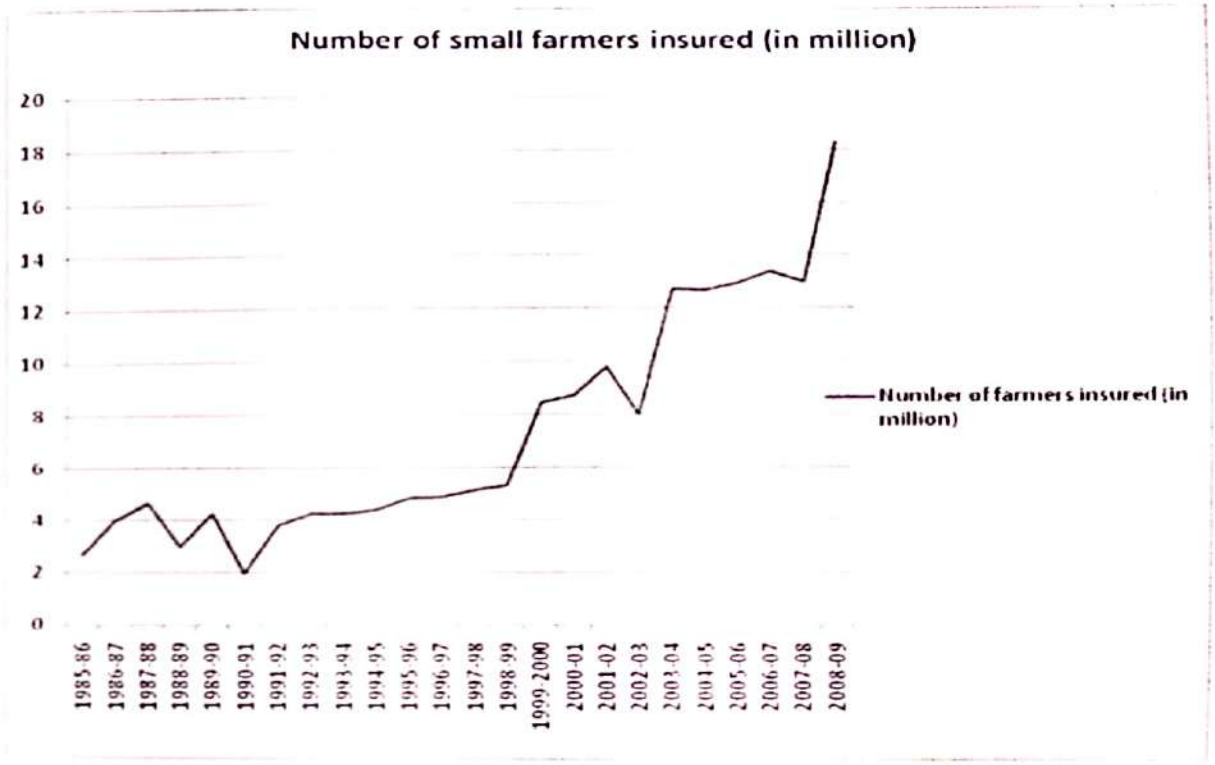
Included observations : 10 R squared = 0.19

White heteroskedasticity consistent standard errors and co variance

Variable	Co-efficient	t- stat	P-value
α	4.9433	4.5898	0.0018
D_i	4.4209	1.8561	0.0990

Source : Author's Calculation

Diagram : Inclusion of small farmers in crop insurance schemes over time



Source : AIC Report (various issues)

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Socio-economic Explanation of Less wealthy-Wealthy Gap in Child Under-nutrition in India

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Abstract

It is evident that the average level of child health and malnutrition in wealthier section of population in India is substantially lower than in less wealthier section. But, why do differences in child health and malnutrition exist between the poor and better-off in India, despite health systems delivered explicitly aimed at eliminating inequalities in access to health care? A little is known about the determinants explaining such excess in less wealthier population. The present study systematically assesses the relative contribution of socioeconomic factors in explaining the wealthy-less wealthy gap in child malnutrition (z-scores (h/a)) using 3rd round National Family Health Survey. The Oaxaca decomposition (Oaxaca 1973) method with extensions by Cotton, Reimer and Neumark, are used to explain the gap in mean outcome of child malnutrition. The large part of the less wealthy disadvantage in child malnutrition is attributable to the disadvantage in household wealth, and maternal education, mother's age at 1st baby birth; higher birth order etc. and those disadvantages contributed a large to widening the wealthy-less wealthy gap. In addition to strengthening public health programmes for reducing child malnutrition in less wealthy section, substantial efforts must also be made to improve household living conditions and female education levels, knowledge and awareness about child care and motherhood.

JEL Classification : *D63, I18, J13, O15*

Key Words : *Child Malnutrition, socioeconomic correlates, gap in malnutrition, relative factors contribution.*

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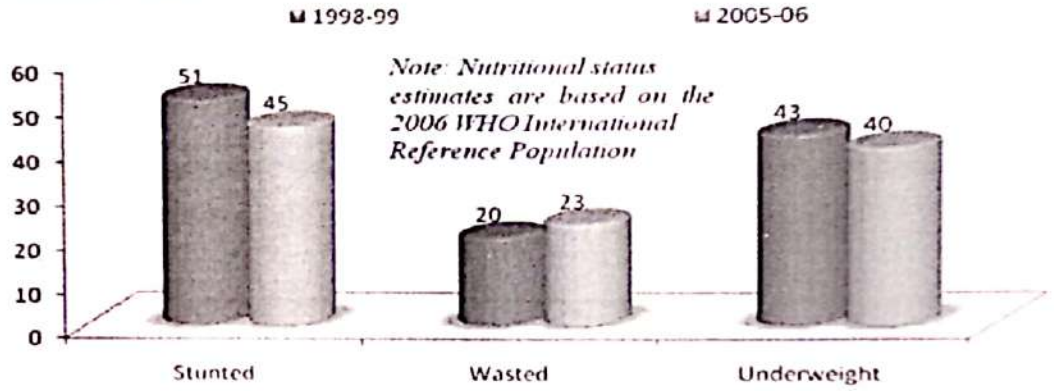
Introduction

Malnutrition among children is one of the major public health concerns in developing countries. Malnutrition is usually a consequence of poverty, low level of education, poor environment and housing, lack of safe drinking water, poor health care services (Peña and Bacallao, 2002; Madise *et al.*, 1999; UNICEF, 1998). The evidence of short and long-term consequences of nutritional deficiencies includes increased risk of both morbidity from infectious diseases and mortality; it reduces long-term physical development, cognitive skills, consequently learning abilities and enrolment in schools and productivity in later life (Tarozzi and Mahajan, 2007; De Onis *et al.*, 2010). Malnutrition measured by child z-scores height for age has the long term nutritional status of children (Trapp and Menken, 2005). Poverty along with rising costs of health care services has been a leading cause of inequality in health and health care utilization in India. Child malnutrition is significantly higher in disadvantaged socioeconomic group compared to their counterpart (Cai and Chongsuvivatwong 2006; Poel, O'Donnell and Doorslaer 2009; Bocquier, Madise, and Zulu 2011).

In developing countries, gaps in health-related outcomes between the rich and the poor are large (Gwatkin DR. 2003, Wagstaff A. 2002). This gap limits poor people's potential to contribute to the economy. Gaps in child malnutrition on an average between rich and poor countries are wide and there is evidence of growing inequity within countries also (Victora et al. 2000; Mulholland et al. 2008). Persistent differences in child health and malnutrition by socio-economic status (SES) have long been a serious health policy concern in many countries in the world, especially in developing economies (Koolman et al 2004). There is a substantial progress in reduction of child mortality and malnutrition, but children from poor or disadvantaged households remain disproportionately vulnerable across all regions of the developing world including India (UNICEF 2010). It is observed that the non-poor Indian continues to receive a larger share of public resources, in terms of health care facilities (Balarajan, Selvaraj and Subramanian 2011) though child malnutrition in India has declined marginally during 1998-99 to 2005-06 as shown in figure-1. There exists a wide range of gap of malnutrition in each of three categories between poorest (least wealthy) and richest (wealthiest) children in India as shown in Table-1.

Figure I: Trends in malnutrition status of children aged three years, India - 1998-1999, 2005-2006



Source: Report of NFHS-I (1998-99) & NFHS-III, (2005-06)

Table I. Less wealthy – wealthy gap in child malnutrition of under-five children in India

	Z-score (h/a)			Z-score (w/h)			Z-score (w/a)			
	% child <-3	% child <-2	Mean z score	% child <-3	% child <-2	Mean z score	% child <-3	% child <-2	Mean z score	N
Least wealthy	34.2	59.9	-2.3	8.7	25	-1.2	24.9	56.6	-2.2	11,689
Top Wealthy	8.2	25.3	-1.1	4.2	12.7	-0.7	4.9	19.7	-1.1	6,577
Gap	26	34.6	-1.2	4.5	12.3	-0.5	20	36.9	-1.1	5,112
total	23.7	48.0	-1.9	6.4	19.8	-1.0	15.8	42.5	-1.8	35,084

Source: Extracted by authors from individual level records of NFHS-III, 2005-06.

Though a number of studies have documented urban-rural differentials in health and health-care (Islam and Azad 2008; Wang et al. 2010; Pham et al. 2011, Kumar & Mohonti 2013), but very few studies have explained the differentials in health and health care between poor- non poor population in Indian context. The study of poor-rich differentials in health status should not; solely aim to quantify their magnitude only, rather should explore the factors responsible for this gap. Existing literature has highlighted the gap between poor and rich in the utilization of basic maternal and child health services in India as a whole (Chattopadhyay and Roy, 2005; Ladusingh and Singh, 2007; Mohanty and Pathak, 2008) but the underlying reasons are not explored. Several studies have investigated socioeconomic factors affecting child malnutrition in India (Jain 1985; Kravdal 2004; Mohanty 2011; Singh et al. 2011; Po and Subramanian 2011), but none has examined the factors influencing the gap of less wealthy–wealthy in child malnutrition in India. The present study aims to fill in this research gaps. It is expected that the present study may be helpful to design pro-poor health policy in India.

II

Objective of the study, Data and Methods

Numerous studies explore the determinants of child malnutrition as cited above but the present study aims to explain the distribution of the less wealthy and wealthy gap of child malnutrition (z-score (h/a)) in terms of the factor specific relative contributions. The decomposition methods reveal that how far and to what extent the gap of child malnutrition (between wealthy and less wealthy) is explained by socio-economic variables.

Data Source:

Child z-scores (height for age) under five and related socio-economic variables[†3] are drawn from 3rd round of National Family Health Survey (NFHS-III): 2005-06. Here, out of 51556 children, 35084 (68%) are found to be malnourished (negative z-scores) in respect of height-for-age.

Outcome Variable and Exposure Variables

The standard deviation of anthropometric value or Z-scores below median (all negative values) indicates the malnutrition for under-five children with those of comparable children in the reference populations. The present study uses both continuous cardinal z-scores as well as binary outcomes of Z scores for two distinct methods as discussed in the following section. Suppose there are two wealth groups wealthy and less-wealthy. Wealthy (W) and less wealthy (LW) are categorized based on median value of wealth. The Raw Mean Gap in malnutrition level (RG) = |Mean Z-score$_W$ – Mean Z-score$_{LW}$|, which will be decomposed into relative contribution of factors using OLS method (Oaxaca method, 1973).

The analysis of descriptive statistics is a proper guideline for selection of subsection of explanatory variables, which have more explanatory power of malnutrition[†4]. Following variables that can influence under five child malnutrition level, are broadly categorized under three heads as noted below (Wagstaff *et al.* 2003; Warnecke *et al.* 2008; Subramanian *et al.* 2006, 2008; Mounts et al. 2011; Pou and Goli 2012):

Child level variables: age in month, gender, birth order, birth interval, size of birth

Maternal Health Characteristics: education of mother, underweight mother, mother's age at first baby birth, Duration of breast feeding

Household and Community Level Factors: family wealth score, place of residence, household size, access to health facility, safe water, toilet facility, societal category, religion etc.

Methods: Oaxaca & Related decompositions

Suppose malnutrition is our outcome variable. The wealthy and the less wealthy are two groups in the society. Assume malnutrition is explained by a vector of socio-economic determinants, x, according to a regression model:

$$CM_i = \begin{cases} \beta^{lw} x_i + \varepsilon_i^{lw} \text{ if less wealthy} \\ \beta^{w} x_i + \varepsilon_i^{w} \text{ if less wealthy} \end{cases} \qquad \text{(I)}$$

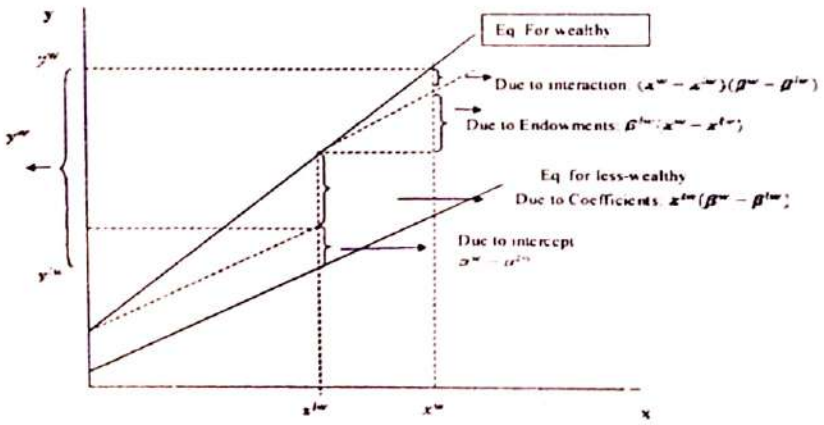
where the vectors of β parameters include intercepts. The result is that the less wealthy have a higher absolute (or more negative) mean value of malnutrition (CM) than do the wealthy.

The general decomposition (Oaxaca; 1973) of the gap in mean outcome, CM^{LW} and CM^{W}, is equal to (as shown in the figure 2)

$$CM^{lw} - CM^{w} = \Delta x \beta^{w} + \Delta \beta x^{lw} + \Delta x \Delta \beta, \qquad \text{(II)}$$
$$= E + C + CE$$

where x^{LW} and x^{W} are vectors of socioeconomic explanatory variables evaluated at the means for the less-wealthy and the wealthy, respectively. The gap in mean outcomes can be thought of as deriving from a gap in endowments (E), a gap in coefficients (C), and a gap arising from the interaction of endowments and coefficients (CE).

Figure 2 Oaxaca Decomposition



Source: (Jones, Kelley 1984, O'Donnell, López-Nicolás, and van Doorslaer 2005, O'Donnell, van Doorlsaer, and Wagstaff 2006).

The's decomposition is a special case of the following decomposition:

$$CM^{LW} - CM^{W} = \Delta x[D\beta^{LW} + (I - D)\beta^{W}] + \Delta\beta[Dx^{W} + (I - D)x^{LW} \text{ (III)}$$

where I is the identity matrix and D is a diagonal matrix of weights. In the single explanatory case, x is a scalar rather than a vector, I is equal to one, and D is a weight. Oaxaca in this context suggested either $D = 0$, or $D = 1$, as the two extreme possibility. Cotton (1988) suggested weighting the differences in the x's by the mean of the coefficient vectors, giving us

$$\text{diag}(D)=0.5(\text{Cotton}), \quad \text{(IV)}$$

where diag(D) is the diagonal of D. Reimers (1983) suggested weighting the coefficient vectors by the proportions in the two groups, so that if f_{NP} is the sample fraction in the wealthy group, then

$$\text{diag}(D)=f_{NP}(\text{Reimers}). \quad \text{(V)}$$

In addition to Oaxaca's two decompositions and the additional two proposed by Cotton and Reimers, there is a fifth proposed by Neumark (1988), which makes use of the coefficients obtained from the pooled data regression, β^{P}:

$$CM^{LW} - CM^{W} = \Delta x\beta^{P} + [x^{LW}(\beta^{LW} - \beta^{P}) + (x^{W}(\beta^{P} - \beta^{W})] \text{(Neumark)}. \quad \text{(VI)}$$

IV

Results:

Socioeconomic determinants for less wealthy, wealthy and total sample (linear method)

The coefficient estimates, means, and predictions for each x for each sample group are presented in the Table-II. The outcome variable in the present setting, CM_i is the compromised or negative malnutrition z-scores (h/a) ranging from -1SD to -6 SD. The explanatory variables are specifically chosen that can be considered as critical predictors of child malnutrition and can systematically explain a major part of less wealthy- well off differential. Therefore, the same set of explanatory factors related to the child birth, the maternal health factors and household, as well as the community level are included to carry out decomposition analysis. The linear estimation procedure, as worked out by Wagstaff, van Doorslaer, and Watanabe (2003) is done for less wealthy group, wealthy group and pooled sample separately. The estimation

process includes log of household wealth scores (lnwealth), square term of child age in months (age^2), square term of mother's completed years of schooling (edu^2) and square term of log of household wealth scores (lnw^2) as continuous explanatory variables and uses dummy (=1) for the representative of all other explanatory variables. The first step is to see whether the regression coefficient vector, differs significantly between the less wealthy and wealthy group. Most of the variables are significant in explaining child malnutrition for all three sets of regression except duration of breastfeeding and square of mother education for less wealthy and wealthy groups, higher birth order, female child for wealthy group and Muslim religion for less wealthy group (Table-II). All the exposure variables are tested for possible multi-colinearity before putting them into the final OLS regression model.

Table–II Regression coefficients and variable specific predictions for child malnutrition

Variables	Wealthy				Less wealthy				Pooled		Difference in Prediction
	Coeffi	t-stat	Mean	Prediction	Coeffi	t-stat	Mean	Prediction	Coeffi	t-stat	
Age (month)	-0.55	-10.86	31.37	-17.33	-1.14	-19.19	31.16	-35.47	-1.02	-25.52	18.14
Age	0.04	12.98	265.3	11.32	0.08	20.7	277.17	20.91	0.06	24.68	-9.59
Birth order 2	25.03	9.79	0.38	9.53	30.38	10.92	0.24	7.27	29.00	15.3	2.26
Higher birth order	2.24	**1.07**	0.33	0.73	16.68	7.27	0.24	3.95	9.15	5.88	-3.22
bi024	-24.05	-8.71	0.58	-14.04	-28.59	-9.2	0.48	-13.60	-28.03	-13.41	-0.44
bi2548	-7.55	-2.91	0.28	-2.10	-11.08	-3.87	0.39	-4.36	-10.30	-5.29	2.26
Female child	-2.76	**-1.75**	0.47	-1.28	-5.25	-2.92	0.49	-2.55	-4.09	-3.39	1.26
Size of birthvl	-16.11	-4.55	0.05	-0.84	-14.94	-4.05	0.06	-0.96	-15.83	-6.13	0.12
sizeobirthl	-16.77	-7.12	0.13	-2.16	-10.05	-4.06	0.16	-1.60	-13.41	-7.77	-0.56
durationmo~	-0.08	**-1.72**	20.08	-1.62	-0.09	**-1.55**	21.54	-1.95	-0.11	-2.96	0.33
motheragea~	1.56	6.61	21.00	32.82	0.76	2.62	18.72	14.16	1.28	6.96	18.66
underweigh~	-11.73	-6.38	0.26	-3.01	-7.96	-4.34	0.43	-3.39	-9.95	-7.61	0.38
edumother	2.04	9.48	7.52	15.32	2.50	5.52	2.22	5.54	2.97	16.96	9.79
edumo2	-0.03	**-0.81**	23.62	-0.61	0.11	**1.3**	11.25	1.27	-0.07	-5.91	-1.89
logwealthscore	60.27	16.32	12.28	740.34	14.92	7.88	11.03	164.54	25.55	18.56	575.80
lw2	47.54	4.34	0.08	3.77	3.32	2.78	0.35	1.16	6.62	8.95	2.61
rur	7.98	4.55	0.43	3.41	7.66	2.85	0.86	6.58	7.47	4.95	-3.17
accesstohe~y	3.73	2.33	0.55	2.05	3.78	2.05	0.41	1.57	3.56	2.89	0.48
safewater	3.97	1.92	0.19	0.76	4.13	2.07	0.29	1.22	3.44	2.4	-0.46
toiletfaci	-3.76	-1.85	0.26	-0.96	-8.62	-3.64	0.79	-6.82	-6.11	-3.93	5.86
sc	-26.03	-11.12	0.17	-4.52	-30.38	-11.68	0.20	-5.93	-28.84	-16.33	1.41
st	-24.73	-10.36	0.17	-4.09	-40.11	-14.21	0.15	-6.12	-33.32	-17.94	2.03
obc	-16.74	-8.66	0.33	-5.61	-28.14	-12.62	0.34	-9.56	-22.89	-15.39	3.96
muslim	-27.09	-12.28	0.16	-4.29	3.54	**1.46**	0.17	0.60	-10.13	-6.14	-4.89
otherrelig~n	41.16	18.22	0.15	6.38	-26.57	-9.54	0.12	-3.27	7.96	4.49	9.65
_cons	-936.64	-20.78									
Total prediction		-172.68	-936.64	-359.5		15.99		-359.5	-492.4	-29.38	-577.11
R^2 0.15 0.11		0.129									
Adj R^2		0.108 0.15									
mean vif		1.38				1.47				1.44	

Note: Dependent variable z-scores are multiplied by 100. Source: computed by author from individual level records of NFHS-III

Decomposition of gap in mean differential in child malnutrition in India (Linear method)

The less wealthy–wealthy raw mean differential (RG) in child malnutrition is reported in table III (or in the last column of Table II from sum of the difference in prediction the between the wealth groups).

The first part of decomposition analysis shows how the Raw Mean Gap in malnutrition level (RG) (= |Mean Z-score$_W$ – Mean Z-score$_{LW}$|) into gap due to the endowment (E), the coefficient (C), and the interaction (CE) (between gap in endowments and gap in coefficients) using OLS method (Oaxaca method). Results show that the gap in endowments and the interaction accounts the higher portion of the raw mean gap in outcomes relative to the gap in the coefficients.

Table III Raw mean differential between groups and its specification

Mean Z-Score wealthy (W)	Mean Z-Score less wealthy (LW)	Raw differential (RG= H-L)	Due to endowment (E)	Due to coefficient (C)	Due to interaction (CE)
-172.68	-226.36	53.68	39.90	-28.03	41.80

Note: z-scores are multiplied by 100. Source: computed by author from individual level records of NFHS-III

The third part of decomposition (table-IV) shows the explained portions of the outcome gap on the basis of the values of E, C and CE for different decomposition method used with different degrees of weight (D) from 0 to 1. The first and second columns correspond to the Oaxaca decomposition in equations IV2 and V2 , where $D = 0$ and $D = 1$, respectively. The third and fourth columns correspond to Cotton's and Reimers' decompositions, where the diagonal of D equals 0.5 and $f_w = 0.45$ (if total sample is divided by mean of family wealth scores), respectively. The final column is for more realistic Neumark's decomposition taking pooled coefficients as weight instead of arbitrary selection of weight. It is clear that the total explained part of the difference in the mean values of child malnutrition between less wealthy and wealthy group in India varied in two extreme cases from 74.33% in Oaxaca (if D=0) to 152.21% Oaxaca (if D=1) and all other cases lie between the two. The contributing factors account for the vast majority of the difference in child malnutrition between two wealth groups in India, irrespective of the above methods used. Beyond the explanatory variables considered for the present study, some of the unobserved

socioeconomic variables in the heterogeneity of population are responsible for the unexplained part shown in the last row of the table IV. The Neumark's decomposition method captures (99.80%) almost 100% of raw differentials by the contributing factors specified in the model.

Table IV Decomposition of explained and unexplained part of Raw differential.

Weight (D)	Oaxaca (D=0)	Oaxaca (D=1)	Cotton(0.5)	Raimers (0.426)	Neumark
Unexplained (U) = {C+(1-D)EC}	13.78	-28.03	-7.12	-5.03	0.11
Explained (V) = E+D*CE	39.90	81.70	60.80	58.71	53.57
%V= V/R	**74.33**	**152.21**	**113.27**	**109.38**	**99.80**
%U= U/R	25.67	-52.21	-13.27	-9.38	0.20

Source: computed by author from individual level records of NFHS-III

Relative contribution of explanatory variables:

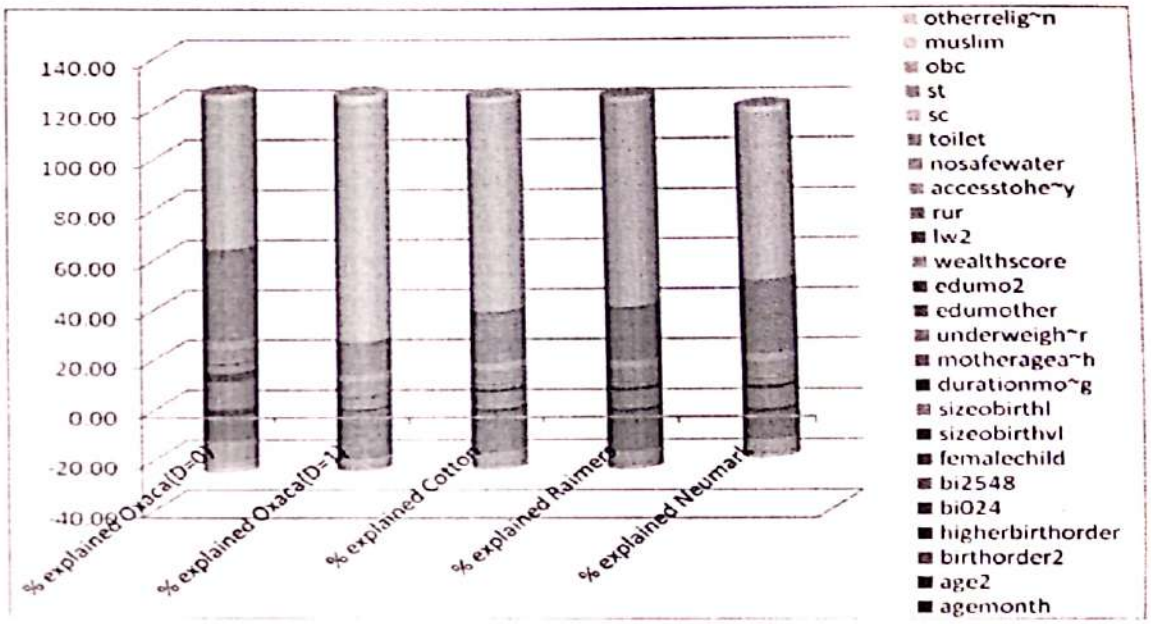
The contributions of the individual β's can be found by taking the group difference in the variable specific predictions given in table V. The explained part of the Raw Gap (RG) is equal to the sum of the variable specific contributions. Though the contribution of individual determinants play a tiny part (other than family wealth scores) itself in explaining group differential in child malnutrition, the relative importance of factors are very crucial in policy urgent (table V). Focusing on the % of explained column in table V corresponding to Cotton, Raimers and Neumark's decomposition, it is found that family wealth scores, mother's education, underweight mother, mother's age at first baby birth, birth order, proper toilet facility, actually favor the wealthy in reducing the gaps in child malnutrition between less wealthy and wealthy, whereas the gaps in the remaining variables like, lower birth interval, rural residence etc. pushes the poor in widening the gap. This implies the fact that if the less wealthy sections are benefited for those variables like wealthy sections then the group differential of child malnutrition might be nullified. Moreover, in case of Neumark, out of all favoring variables to the wealthy, the gap in family wealth scores (59.81%) and mother's education (29.37%), accounts for the bulk (almost 90%) of the explained gap between two groups. A comparative picture among the above mentioned methods can then be presented, as in figure 3, showing the variable specific contributions as a percentage of total explained (taking 100 %).

Table V Relative contribution (%) of explanatory variables in the explained part of Raw Gap

	Explained for different weight (D)											
Variables	E (D=0)	%V= V/R	C	CE	E(D=1)	%V= V/R	Cotton	%V= V/R	Raimers	%V= V/R	Neumark	%V= V/R
agemonth	-0.24	-0.61	18.26	0.13	-0.12	-0.15	-0.18	-0.30	-0.19	-0.32	-0.22	-0.41
age2	-0.90	-2.25	-9.08	0.39	-0.51	-0.62	-0.70	-1.16	-0.72	-1.23	-0.73	-1.36
birthorderII	4.29	10.75	-1.28	-0.75	3.54	4.33	3.91	6.44	3.95	6.73	4.10	7.65
Birthorder2	1.52	3.81	-3.42	-1.31	0.20	0.25	0.86	1.42	0.93	1.58	0.83	1.55
bi024	-3.09	-7.74	2.16	0.49	-2.60	-3.18	-2.84	-4.68	-2.87	-4.88	-3.03	-5.65
bi2548	1.27	3.19	1.39	-0.41	0.87	1.06	1.07	1.76	1.09	1.86	1.18	2.21
femalechild	0.10	0.26	1.21	-0.05	0.05	0.07	0.08	0.13	0.08	0.14	0.08	0.15
sizeobirthvl	0.18	0.45	-0.08	0.01	0.19	0.24	0.19	0.31	0.19	0.32	0.19	0.36
sizeobirthl	0.31	0.77	-1.07	0.21	0.51	0.63	0.41	0.67	0.40	0.68	0.41	0.76
durationmo~g	0.13	0.33	0.21	-0.01	0.12	0.14	0.13	0.21	0.13	0.21	0.16	0.30
motheragea~h	1.73	4.33	15.10	1.84	3.57	4.36	2.65	4.35	2.55	4.35	2.92	5.45
underweigh~r	1.35	3.38	-1.61	0.64	1.99	2.43	1.67	2.74	1.64	2.79	1.69	3.15
edumother	13.25	33.22	-1.02	-2.44	10.81	13.23	12.03	19.79	12.15	20.70	15.73	29.37
eduno2	1.40	3.51	-1.56	-1.72	-0.32	-0.39	0.54	0.89	0.62	1.06	-0.87	-1.63
lwealthscore	18.71	46.89	500.22	56.87	75.58	92.50	47.14	77.53	44.30	75.45	32.04	59.81
lw2	-0.89	-2.24	15.41	-11.9	-12.81	-15.67	-6.85	-11.27	-6.25	-10.65	-1.78	-3.33
rur	-3.30	-8.28	0.28	-0.14	-3.44	-4.22	-3.37	-5.55	-3.37	-5.74	-3.22	-6.02
accesstohe~y	0.51	1.28	-0.02	-0.01	0.50	0.62	0.51	0.84	0.51	0.87	0.48	0.90
nosafewater	-0.43	-1.07	-0.05	0.02	-0.41	-0.50	-0.42	-0.69	-0.42	-0.71	-0.36	-0.66
toilet	4.61	11.56	3.85	-2.60	2.01	2.46	3.31	5.44	3.44	5.86	3.27	6.10
sc	0.65	1.64	0.85	-0.09	0.56	0.68	0.61	1.00	0.61	1.04	0.62	1.16
st	-0.51	-1.27	2.35	0.19	-0.31	-0.38	-0.41	-0.67	-0.42	-0.72	-0.42	-0.79
obc	0.14	0.36	3.87	-0.06	0.08	0.10	0.11	0.19	0.12	0.20	0.12	0.22
muslim	-0.04	-0.11	-5.22	0.37	0.33	0.40	0.14	0.23	0.12	0.21	0.12	0.23
otherrelig~n	-0.85	-2.13	8.34	2.16	1.31	1.61	0.23	0.38	0.12	0.21	0.25	0.47
Total	39.90	100	-577.1	41.80	81.70	100	60.80	100	58.71	100	53.57	100

Source: computed by author from individual level records of NFHS-III

Figure 3 Comparative analysis of relative contribution of factors in percentage of total mean gap in child malnutrition, India, 2005-06.



Source: computed by author from individual level records of NFHS-III

The Oaxaca decomposition method explained above thus allows identifying how the gap in each of the β's and mean contribute to the overall explained gap. As far as the contribution of x's are concerned, most of the explained part of the malnutrition gap is attributable to the gap in family wealth scores and mother's completed years of schooling. The bars in figure 3 indicate the overall contributions of the x's in percentage of total explained gap. The percentage contribution of factors in bars in all five methods shows that the bulk of the gap (around 90%) in malnutrition is from family wealth scores and mother's completed years of schooling. Thus, the offsetting effects from either each of the β's or mean's are notably unimportant to the overall explained gap. Thus the less wealthy have a lower nutrition intercept in the height-for age equation, but this can be largely counterbalance by the effect of family wealth scores and mother's completed years of schooling because those are weaker for the less wealthy.

V Conclusions and Policy Implications

Under-five malnutrition (negative z-scores height for age) is widely used as an indicator of adverse child health and nutritional status to present the hurdle in front

of wellbeing of the socioeconomic disadvantageous sections of society. The entire part of the study is mostly devoted to search the major socioeconomic factors that do not allow less wealthy India to reduce child malnutrition to that of wealthy India. But this is only relevant when there is substantial gap documented in between different subgroups in the society like rural- urban gap, male- female gap, poor-non poor gap etc. Here, in this analysis a huge absolute (about 30% over less wealthy mean malnutrition level) gap between less-wealthy and wealthy has been documented. The systematic analysis of the relative contribution of socioeconomic variables in wealthy- less wealthy differentials related to child malnutrition explain the relative less wealthy disadvantages with family wealth and mother's completed years of schooling. Considerably higher child malnutrition in less wealthy or disadvantageous sections of population in India indicates an unequal distribution and use of resources. To our knowledge, this is the threshold study in India that has systematically investigated the factors that underlie and explain the wealthy- less wealthy gap in child malnutrition. In addition, this study has also documented the significant contribution of community-level and socioeconomic factors like duration of breastfeeding, proper toilet facility, variables related to child birth etc. and thus has identified as important variables that contribute to further enhancing or reducing the less wealthy- wealthy gap in child malnutrition in India. The detection of relative important exposure variables is really needful to select the socioeconomic target groups for optimal utilization of limited resources by the policy planner.

The present study is not beyond the scope and limitation. Firstly, the study can be extended to any two complementary groups like rural- urban group, male- female group, poor-non poor group, employed-unemployed parents group etc. Secondly, the study is limited only for the 3rd round of National Family Health Survey and a comparative analysis using all three rounds could make the result more interesting. Thirdly, the study can be extended for other two cases of malnutrition by which one can find out the common relative important factors explaining the gap among all three forms of malnutrition. Lastly, in case of non-linear decomposition method if outcome variable is ordered category then, the methodological limitation is the constraint till the date and beyond the scope of this empirical work.

Endnotes:

The rationale for this is that the decompositions were devised to look at discrimination in the labor market. The analog of the wealthy or the non-poor would be whites or males, and the analog of less-wealthy or the poor would be blacks or women. In the

first decomposition the presumption is that it is blacks and women who are paid according to their characteristics, whereas whites and men receive unduly generous remuneration. In the second decomposition, the presumption is that whites and men are paid according to their characteristics, and it is blacks and women who are discriminated against.

2 Table: Definition of the dependent and independent variables used

Variable	Definition
Dependent variables:-	
CHILD MALNUTRITION	Continuous z-scores ranging from -6 sd to -1 sd

List of Explanatory variables for all three dependent variables:

Independent Variables		Definition
Child Level Variables	Age in month	Continuous ranging from 0-59 months,
	Age^2	-
	2nd Birth Order	= 1 if child is second child, 0 otherwise.
	Higher Birth Order	= 1 if child birth order is 3& more, 0 otherwise.
	Birth Interval 0-24 months	= 1 if gap between two consecutive births is 0-24 months, 0 otherwise.
	Birth Interval 25-48 months	= 1 if gap between two consecutive births is 25-48 months, 0 otherwise.
	Female child	= 1 if child is female, 0 otherwise.
	Very low size Birth	= 1 if size of child birth is very low, 0 otherwise.
	Low size Birth(< avg)	= 1 if size of child birth is lower than the average but not very low, 0 otherwise.
Parent Level Variables	Breastfeeding (months)	= 1 if the child breastfed up to 24 months, 0 otherwise,
	Mother age 1st birth	= 1 if mother's age at 1st baby birth is <21 years, 0 otherwise.
	Underweight mother	= 1 if the mother's BMI of the child is < 18.5, 0 otherwise.
	Mother's education(y)	Continuous in completed school years,
	Squire Mother's education(y)	-
Household Level Variables	Log Wealthscore	Continuous
	Squire logwealthscore	-
	Rural	= 1 if child lives in rural area, 0 otherwise.
	Family Size(>6)	= 1 if number of family member including child is <6, 0 otherwise.
	Access to health facility	= 1 if child visited health facility in last 3 months, 0 otherwise.
	No safe Water facility	= 1 if household not avail piped water or tube well, 0 otherwise.
	No toilet facility	= 1 if household has not proper toilet and sanitation facility, 0 otherwise.
	SC	= 1 if household from scheduled caste category, 0 otherwise.
	ST	= 1 if household from scheduled tribe category, 0 otherwise.
	OBC	= 1 if household from scheduled tribe category, 0 otherwise.
	Muslim	= 1 if household from Muslim community, 0 otherwise.
	Other Religion	= 1 if household from other than Hindu and Muslim community, 0 otherwise.

Source: Definitions are followed from NFHS-III, 2005-'06.

3 Table: Descriptive statistics of selected households and child variables (N=41306)

Child Level Variables		**Maternal Health Characteristics**		**Household and Community Level Factors**	
Age in month	mean z-score	**Mother's education**	mean z-score	**Wealth Index**	mean z-score
<6	-0.6	No education	-2.2	wq1	-2.3
6--8	-1	Primary	-1.9	wq2	-2.1
9--11	-1.2	secondary	-1.6	wq3	-1.9
12--17	-1.8	higher	-1	wq4	-1.6
18--23	-2.2		wq5	-1.1	
24--35	-2.2	**Under weight mother**	mean z-score	**Residence**	mean z-score
36--47	-2.1	BMI<18.5	-2.1	Rural	-2
48--59	-2	BMI ≥18.5	-1.7	Urban	-1.6
Size of birth	mean z-score	**MAFBB**	mean z-score	**HH size**	mean z-score
very small	-2.1	< 21 year	-2.4	<6 members	-2.3
small	-2	>21 years	-1.6	6 & above	-1.6
avg and more	-1.8	**DBF**	mean z-score	**AHF**	mean z-score
Sex	mean z-score	<6	-2.5	Yes	-1.9
Female	-1.9	7--12	-2.2	No	-2.3
Male	-1.9	13-18	-1.6	**Safe water**	mean z-score
Birth Order	mean z-score	19 & above	-1.8	Yes	-1.6
1	-1.6	No	-1.8		
2--3	-1.8			**Toilet facility**	mean z-score
4-and above	-2.2			Yes	-1.4
Birth interval	mean z-score		No	-2.2	
1st birth	-1.6			**Caste**	mean z-score
<25	-2.2	SC	-2.1		
25- 48	-2			ST	-2.1
>48	-1.7	OBC		-1.9	
	Other	-1.7			
				Religion	mean z-score
	Hindu	-1.9			
	Muslim	-2			
	Other Religion	-1.6			

Table shows sample mean z-score and its description for some selected household maternal, child variables and for different SES sub-group in capturing the prevalence of malnutrition. The mean z-score-stunted are seriously high in higher birth orders, lower birth intervals, small and very small birth size, with mother's no education, for SC & ST, with mother's first birth age <21, <6 months of breastfeeding, with micro-family composition and lower wealth. The analysis of descriptive statistics in

this analysis is thus a proper guideline for selection of subsection of explanatory variables, which have more explanatory power of malnutrition.

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