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The present volume contains 9 (nine) research articles of the eminent Scholars of different Universities/ Institutes.

We are grateful to the contributors and all others who have helped in one way or other in the preparation of this volume. The Advisory Board and the Editorial Board will not be responsible for the views expressed by the authors in their articles.

At the end, I would like to extend my whole-hearted thanks to the Advisory Board and the Editorial Board and especially to 'JPS Infomedia' for bringing out the present volume despite of many constraints.

December, 2022

Prankrishna Pal
Editor

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India's Balance of Trade During Pre and Post Reform Era : Analyzing Trends and Variations through Structural Decomposition

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Abstract

India perhaps, though for quite some time, faced a critical balance of payment situation both in the pre and post liberalisation periods. It is true that a major component of India's balance of payments is her balance of commodity trade and it often appears as the main issue of concern in the formation of India's balance of payment strategy. Like preliberalisation period, India's balance of commodity trade is consistently negative in post liberalization periods also. It seems that circumstances surrounding India's balance of payments are possibly passing through drastic changes and the country is facing challenging tasks ahead. However, before we proceed to design the most appropriate corrective strategies, we should probably try to spell out the factors responsible for such an unwelcome situation. It is well documented that though the value of export is falling significantly short of that of import, there is quite a bit of fluctuation in the magnitude of this largely negative trend of balance of trade itself. The present paper tries to investigate the factors underlying such a precarious balance of trade situation in India during pre and post reform era and to suggest the possible directions along which India's trade policies need to be recast. In order to do this, following the methodology as presented in the Economic Survey of Europe in 1954, inter year Change in Balance of Trade(CBOT) has been decomposed into quantity change effect and price change effect . We observe that the quantity component has been major explanatory factor in the inter year changes of balance of trade both in pre and post reform era. Again, price change effect has been separated into general price level effect and terms of trade effect and we find that positive terms of trade effect is cancelled out by the negative general price level effect. Hence it appears that the deterioration in the trade balance was mainly due to the consequences of a large negative quantity effect and general price level effect though a small part of which had been cancelled out by a positive terms of trade effect.

Key Words : Balance of Trade, Quantity Effect, Price Effect, General price level effect, Terms of Trade effect

JEL Classification : F10

I. Introduction :

Though for quite some time, India perhaps faced a critical situation in respect of her balance of payment both in the pre and post liberalization periods. It is also possibly true that a major component of India's balance of payments is her balance of commodity trade. For a developing country like India, the balance of trade situation itself often appears as the main issue of concern in the formation of any balance of payment strategy. Like preliberalisation period, India's balance of commodity trade is consistently negative in post liberalization periods also. It seems that circumstances surrounding India's balance of payments are possibly passing through drastic changes and the country is facing challenging tasks ahead. However, before we proceed to design the most appropriate corrective strategies, we should probably try to spell out the factors responsible for such an unwelcome situation. It is well documented that in India though the value of export is falling significantly short of that of import (both in pre and post reform era), there is quite a bit of fluctuation in the magnitude of this largely negative trend of balance of trade itself.An attempt has been made in this paper to investigate the factors underlying such a precarious balance of trade situation in India during pre and post liberalization periods largely based on the methodology as depicted in the Economic Survey of Europe(1954) and to suggest the possible directions along which India's trade policies need to be recast. In other words, our objective is to study the trend and variation in the sizes of the various components of the interyear change in the trade balance of India during pre and post reform phases and to suggest certain possible direction in which our trade package requires reshaping so that appropriate balance of payment strategy can be formulated.

Now, as far as commodity trade balance is concerned, the relevant points mentioned below are to be noted. First, it is expected that the prices of exports and that of imports will not always move in the same fashion and same direction over time and this disparity itself results in a change in the value of the terms of trade over years . Hence, the contribution of a change in terms of trade in the change in balance of trade should deserve close attention. Secondly, if the prices of both exports and imports are constant, but the volume of either changes, then the balance of trade also will change. Thirdly, even if there is a proportional change in the prices of both exports and imports and the volume of both exports and imports remain same, the balance of trade expressed in money terms will alter. Hence, it seems that the money value of the change in the balance of trade may be decomposed into the following components (as proposed by the Economic Survey of Europe (1954) and Stuvel (1956).

1) The effect of quantity change
2) The effect of price change.

Again, price change effect can be decomposed into-

2A) The general price level effect.

2B) The terms of trade effect.

Now, the paper has been organized as follows:

In section-I, after highlighting the background and purpose of the paper, section -II reviews the relevant literature. Data base of the study and methodological framework have been presented in section-III and section-IV respectively. The results and their interpretations are discussed in section -V. Section-VI deals with concluding remarks with some policy implication.

II. Literature Review :

We find several studies relating to the components of change in trade balances for India and other countries. While Auten(1958) analyses the effect of price and quantity changes in the Latin American trade balance, Phetero, Lee and William(1960) highlight the impact of terms of trade on the U.S trade balance. Stuvel(1956) depicts a new approach to the measurement of terms of trade effect through multiplicative and additive analysis. Stewart and Ghani(1986) develop the best type of trading strategy depending on the general world environment. They assert that when world trade is growing fast and without substantial fluctuations, there are many advantages to a pro-trade strategy.Worswick(1956) studies theoretically the components of a change in the balance of trade by considering the World Economic Report(1950-51) and the Economic survey of Europe in 1954. Of the two breakdowns(Quantity and Price Effect) of a change in the balance of trade which have been applied in practice , he gave reasons for rejecting the World Economic Report procedure(1951). In 1953 , United Nations, Economic and Social Council studies the repercussions of changes in terms of trade on the economics of countries in the process of development.

As far as Indian economy is concerned, the existing literature on the components of change in trade balances are quite illuminating and exciting too. Da Costa(1986) investigates the determinants of India's balance of commodity trade exploring the movements of individual components over the period 1970-71 to 1981-82. Sharma, Mehta and Moore(1981) analyse the balance of trade of India, 1950-51 to 1976-77. Sengupta(1995) spells out the components of trade balances of India during late seventies and early eighties. Pal and Pal (1996) depicts the structure of India's foreign trade emphasizing on commodity composition and diversification for the period 1971 to 1987. Mitra and Pal (2014) decomposes the growth of Foreign Trade in Sri Lanka and suggest that the price growth rates are positive for all the commodities irrespective of

time periods. Atkin , Khandelwal and others (2017) studied the Indian export growth and firm performance through a randomized experiments. Gopinath and Lahiri (2019) advocate that Indian export growth has remain tepid. The constraints appear to be low productivity, low scale of production and institutional frictions.

In this paper, our target has been to identify the gaps (basically at the empirical level in the existing literature in the Indian context and to fill in the gap as far as possible. In the methodological side to some extent and also to some extent in respect of choice of data and to large extent through the interpretation of results , we have tried to obtain some useful policy implications suggesting the possible directions along which India's trade policies need be framed.

III. Proposed Methodology:

The United Nations economic report suggests two alternative methods of decomposing the inter-year change in balance of trade presented in the World Economic Report- 1950-51 and in the Economic Survey of Europe in 1954.

A) The World Economic Report (1950-1951) :

In The World Economic Report 1950-51, the volume effect is defined as-

$$(\sum e_1P_0 - \sum i_1 q_0) - (\sum e_0P_0 - \sum i_0q_0) \quad \ldots\ldots (1)$$

Where e_0, e_1, i_0 and i_1, are the quantities of individual items exported and imported in years 0 and 1 respectively, P_0, P_1, q_0 and q_1 are the prices of those items.

The terms of trade effect is defined as-

$$\sum i_1q_0 (\sum e_1 P_1 / \sum e_1P_0 - \sum i_1q_1 / \sum i_1q_0) \quad \ldots\ldots (2)$$

The general price level effect is defined as-

$$(\sum e_1P_0 - \sum i_1 q_0) (\sum e_1P_1 / \sum e_1P_0 - 1) \quad \ldots\ldots (3)$$

B) The Economic Survey of Europe (1954) :

In the Economic Survey of Europe (1954), the volume effect is defined as-

$$= (\sum e_1P_0 - \sum e_0P_0) - (\sum i_1q_0 - \sum i_0q_0) \quad \ldots\ldots (4)$$

Where e_0, e_1, i_0 and i_1, are as usual the quantities of individual items exported and imported in years 0 and 1 respectively and P_0, P_1, q_0 and q_1 are the prices of those items.

The terms of trade effect is defined as-

$$(\sum e_1P_1 - \sum i_1q_1) - Pm (\sum e_1P_0 - \sum i_1q_0) \quad \ldots\ldots (5)$$

The general price level effect is defined as -

$$(Pm - 1)(\sum e_1 P_0 - \sum i_1 q_0) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

Where pm is the general price level and is defined in the survey as -

$$Pm = (\sum e_1 P_1 - \sum i_1 q_1) / (\sum e_1 P_0 - \sum i_1 q_0) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(7)$$

The Nature of the Problem :

Though,we can think of an easy intuitive interpretation of the above components, but when we consider the question of breaking down any actual statistical change in the trade balance into the above three components (Quantity Effect, General Price Level Effect and Terms of Trade Effect) we face, particularly, the indexing problem. However, the procedure outlined in one of the above two approaches, namely the World Economic Report (1950-51) is rejected as the procedure has been shown to be an asymmetrical one. Supposedly, the symmetrical procedure is highlighted in the Economic Survey of Europe (1954) which offers a large number of breakdowns. As the direction of the movements of the terms of trade will indicate whether the terms of trade effect will be positive, zero, or negative, the choice of the breakdown procedure seems to be uniquely linked with the choice of indexes to measure the terms of trade. To make the terms of trade effect conceptually simple and also amenable for easy computation , we may chose either Paasche or Laspeyres export and import prices supplied by most of the trade statistics publications. G.D.N Worswick (1956) has pointed out that the Economic Survey of Europe (1954) procedure is symmetrical with respect to exports and imports and the procedure of World Economic Report (1954) appears to be asymmetrical in two respects. In the 1st place, the terms of trade effect, $\sum i_1 q_0$ refers only to imports. Secondly, the indicator of the general level of prices is $\sum e_1 P_1 / \sum e_1 P_0$ which is nothing butthe Paasche index of export prices.

In the present exercise, we have developed a methodology to decomposethe inter-year change in trade balances following the breakdown procedure as suggested by the Economic Survey of Europe (1954) which is, as mentioned earlier, symmetrical with respect to both exports and imports.

Basically, the method of splitting the change in balance of trade over the years is essentially set in a partial equilibrium framework. Both the World Economic Report (1950-1951) and the Economic Survey of Europe(1954) procedure use the additive analysis and change in trade balance is distributed over the components - Quantity Effect (QE), Terms of Trade Effect (TOTE) and General Price Level Effect (GPLE).

As indicated earlier (equation–4), according to the Economic Survey of Europe (1954) procedure, the volume effect or quantity effect (QE) is defined as follows-

$$QE = \left(\sum e_1 P_0 - \sum e_0 P_0\right) - \left(\sum i_1 q_0 - \sum i_0 q_0\right)$$

$$= = \sum \left(e_1 - e_0\right) P_0 - \sum \left(i_1 - i_0\right) q_0$$

Where e_0, e_1, i_0 and i_1, are the quantities of individual items exported an imported in years 0 and 1 and P_0, P_1, q_0 and q_1 are the prices of those items.

Now, the quantity effect (QE) can be interpreted in the following way :

When the balance of trade changes as a result of changes in the quantity of exports and imports only at an unchanged prices , the change in the balance of trade is called the quantity effect(QE). Now by subtracting QE from the total change in trade balance(CBOT), we get the Price Effect(PE). In other words,

PE = CBOT - QE

The change in the balance of trade (CBOT) is given by-

$$CBOT = \left(\sum e_1 P_1 - \sum e_0 P_0\right) - \left(\sum i_1 q_1 - \sum i_0 q_0\right)$$

So, we are now in a position to find out the price Effect (PE) which is given by-

PE= CTB- QE

$$= \left[\left(\sum e_1 P_1 - \sum e_0 P_0\right) - \left(\sum i_1 q_1 - \sum i_0 q_0\right)\right] - \left[\left(\sum e_1 P_0 - \sum e_0 P_0\right) - \left(\sum i_1 q_0 - \sum i_0 q_0\right)\right]$$

$$= \left[\left(\sum e_1 P_1 - \sum e_0 P_0\right) - \left(\sum i_1 q_1 - \sum i_0 q_0\right) - \left(\sum e_1 P_0 - \sum e_0 P_0\right) + \left(\sum i_1 q_0 - \sum i_0 q_0\right)\right.$$

$$= \sum e_1 P_1 - \sum e_0 p_0 - \sum i_1 q_1 + \sum i_0 q_0 - \sum e_1 P_0 + \sum e_0 P_0 + \sum i_1 q_0 - \sum i_0 q_0$$

$$= \sum e_1 P_1 - \sum i_1 q_1 + \sum e_1 P_0 + \sum i_1 q_0$$

$$= \sum e_1 \left(P_1 - P_0\right) - \sum i_1 \left(q_1 - q_0\right) \quad \text{.....(8)}$$

Equqtion-8 may be interpreted as the balance of trade change as a result of changes in the prices at unchanged volumes.

The price component again can be split into two subcomponents- General Price Level Effect(GPLE) and the Terms of Trade Effect(TOTE)

Terms of trade effect is defined as follows-

$$TOTE = \left(\sum e_1P_1 - \sum i_1q_1\right) - Pm\left(\sum e_1P_0 - \sum i_1q_0\right) \quad \text{.....(8A)}$$

General Price Level Effect (GPLE) can be defined as-

$$GPLE = (Pm\text{-}1)\left(\sum e_1P_0 - \sum i_1q_0\right) \quad \text{.....(8B)}$$

Where $Pm = \left(\sum e_1P_1 - \sum i_1q_1\right) / \left(\sum e_1P_0 - \sum i_1q_0\right)$

Equation-8A may be interpreted as the change in the balance of trade as a result of change in prices of exports and imports which bring changes in terms of trade only. Equation - 8Bstands for the change in balance of trade which is the result of those effects of price changes in exports and imports at unchanged volume and which are not reflected in the terms of trade.

It is possibly relevant here to mention an observation made by G.D.N Worswick(1956) in connection with the significance of general price level, Pm as defined in the equation- 8B. He raised a question here . Can we find a significant value of Pm according to which the expression for the terms of trade effect is positive, zero or negative? We notice that the terms of trade expression is of the following form-

$E = (a - b) - Pm\ (x - y)$ where a, b, x and y are all positive and $x \neq y$. In other words, we require to find a value of Pm such that E will be $>=$ or $<$ according as $a/x >=$ or $<$ b/y.It is proved by Worswick (1956) that $Pm = a + b / x + y$ is the only value which will satisfy this requirement.

IV. Data Base of the Study:

The data base of our study have been official reports, journals and books which are mainly of secondary type. For our study, the Directorate General of Commercial Intelligence and Statistics, Ministry of Commerce and Industry, Govt. of India and the Hand Book of Statistics on Indian Economy, Reserve bank of India provide us all the relevant information regarding the volume of exports and imports as well as the Unit value Index and Quantum Index of exports and imports at the national level.As different macroeconomic time series based on different base years (1978-79=100 and 1999-00=100) are not comparable, we have constructed a consistent chain linked time series data following the splicing method recommended by the CSO (2001).

V. Results of the Study:

This section of the paper focuses on the results of our study and their interpretation. Table-1 highlights the components of changes in balance of trade (CBOT) of India during Pre

Liberalisation Phase (1981-82-1990-91). The change in balance of trade for any inter year period is defined as the change in export value minus the change in import value for that inter year. A positive value of CBOT suggests that there is an improvement in the balance of trade situation as compared to that in the previous year. A negative value of CBOT ,on the other hand, shows that there is a deterioration in the balance of trade situation.

Table-1 : Components of Changes in Balance of Trade of India during Pre Liberalisation Phase(1981-82-1990-91) in US$ Million

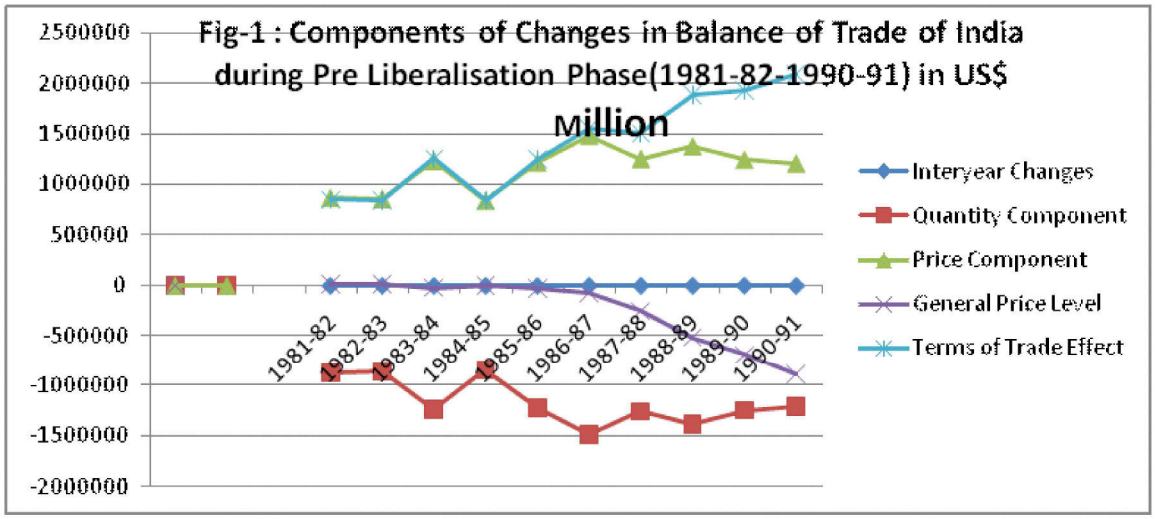
Year	Interyear Changes in Balance of Trade in Current Values	Quantity Component in Interyear Changes in Balance of Trade	Price Component in Interyear Changes in Balance of Trade	General Price Level Effect, a subcomponent, C1 of C	Terms of Trade Effect, a sub component, C2 of C
	A	B	C=C1 + C2	C1	C2
1981-82	-6469.00	-871934.62	865465.62	16979.65	848485.97
1982-83	-5679.00	-862931.05	857252.05	16187.71	841064.34
1983-84	-5861.50	-1239279.78	1233418.27	-20830.24	1254248.52
1984-85	-4534.20	-843003.70	838469.49	2097.90	836371.59
1985-86	-7162.40	-1220499.79	1213337.39	-31095.15	1244432.54
1986-87	-5982.00	-1486861.67	1480879.67	-68411.15	1549290.81
1987-88	-5067.20	-1257111.55	1252044.35	-252609.68	1504654.03
1988-89	-5526.80	-1381288.92	1375762.12	-517131.07	1892893.18
1989-90	-4606.70	-1246586.09	1241979.39	-690109.36	1932088.75
1990-91	-5927.30	-1212292.86	1206365.55	-889477.75	2095843.31

Source : Author's own calculation based on the methodology described.

It is observed from table-1 that inter year changes in balance of trade in current values has been consistently negative for the whole range of years of our study, ie, Pre liberalisation period(1981-82-1990-91).A close look at the table reveals that , during the said period, significant deterioration in inter-year change in balance of trade occurred in 1985-86(-7162 Million US$). This resulted from the negative contribution of quantity effect (-1220499 Million US$) and general price level effect (-31095 Million US$) though a part of this was cancelled out by positive terms of trade effect (+1244432 Million US$). In other words, negative quantity effect has outweighed the net positive price effect(General Price Level Effect + Terms of Trade Effect) resulting the significant negative change in balance of trade in 1985-86. Nowif we look at the quantum value and unit value of

exports and imports(Table-7 in Appendix) we find that over the years-1984-85 to 1985-86,the volume of import at constant prices ie, quantum index of import has increased from 156 to 182 while the quantum Index of exports was decreased from 121 to 111. It seems that the volume of major import components i.e., 'Crude Petroleum' , 'Electricals and Electronics Equipments','Machinery and Transport Equipments' have increased in 1985-86 and it is reflected in the increase of quantum index of imports. On the other hand , during the same period mentioned above, while unit value of import decreased from 162 to 159 , unit value of exports increased from 170 to 175 thereby resulting a positive terms of trade effect.

The results as highlighted in Table-1 is also depicted by the figure-1.



Source : Table-1

Table-2 depicts the relationship(Correlation Matrix) between various components of changes in trade balance during pre liberalisation phase-(1981-82- 1990-91). Though our sample size is small, estimated results show that simple correlation between change in trade balance and terms of trade effect is positive. An explanation of this type of correlation may be given in this way. An increase in the net barter terms of trade, other things being given, would, through a decrease in expenditure on imports relative to earnings from exports, result in decrease in the trade deficit. At the same time, it is also true that a rise in the net barter terms of trade, if externally originated, could, through a terms of trade induced rise in domestic real income expand import and worsen the trade balance. For other components,as expected, simple correlation between change in trade balance and general price level is negative, while that between change in trade balance and quantity effect is positive.

Table-2 : Relationship between Various Components of Changes in Trade Balance (Pre Liberalisation Phase-(1981-82- 1990-91).

The Correlation Matrix				
	Change in Trade Balance	Quantity Effect	Terms of Trade Effect	General Price Level Effect
Change in Trade Balance	1.0000	0.1011	0.1565	-0.2868
Quantity Effect	0.1011	1.0000	-0.7623	0.4060
Terms of Trade Effect	0.1565	-0.7623	1.0000	-0.9009
General Price Level Effect	-0.2868	0.4060	-0.9009	1.0000

Source : Author's own calculation based on Table-1

Table-3 highlights the components of changes in balance of trade of India during Post Liberalisation Phase-I (1991-92 -2000-01). During this phase, liberalization process has started but may not get enough time to deepen its impact.

Table-3 : Components of Changes in Balance of Trade of India during Post Liberalisation Phase-I(1991-92-2000-01).

Year	Interyear Changes in Balance of Trade in Current Values	Quantity Component in Interyear Changes in Balance of Trade	Price Component in Interyear Changes in Balance of Trade	General Price Level Effect, a subcomponent, C1 of C	Terms of Trade Effect, a sub component, C2 of C
	A	B	C=C1 + C2	C1	C2
1991-92	-1545.10	-382132	380586.9	-32369.2	412956.1
1992-93	-3344.4	-494560	491215.4	-41698.6	532914
1993-94	-1067.9	-359730	358662.3	-79795.9	438458.2
1994-95	-2323.9	-891940	889615.8	-423742	1313358
1995-96	-4880.4	-891631	886750.9	-746161	1632912
1996-97	-5662.7	-386258	380594.9	-366055	746649.4-
1997-98	-6478.1	-1519630	1513151	-1598681	3111832

Contd.....

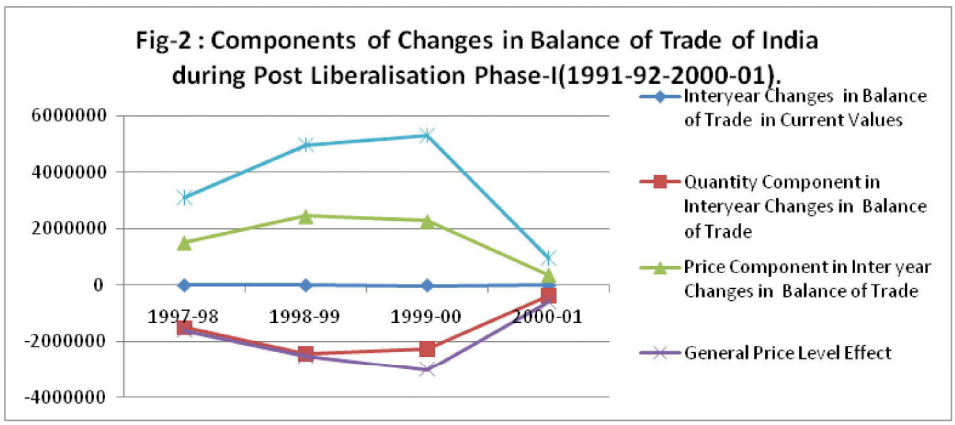
Contd.....

1997-98	-6478.1	-1519630	1513151	-1598681	3111832
1998-99	-9170.0	-2457961	2448791	-2527566	4976357
1999-00	-12848.3	-2290355	2277506	-3024068	5301574
2000-01	-5976.2	-372271	366295.3	-577453	943748.1

Source : Author's own calculation based on the methodology described.

It is observed from table-3 that like pre liberalisation period (1981-82-1990-91), inter year change in balance of trade has been consistently negative for the post liberalization phase-I (1991-92-2000-01) also. During this phase, significant deterioration in inter year change in balance of trade took place in 1999-2000 (-12848 Million US$). It is due to the negative contribution of quantity effect (-2290355 Million US$) which has outweighed the positive price effect (2277506 Million US$) in which general price level effect (-3024068 Million US$) and terms of trade effect (+5301574 Million US$) are moving in opposite direction generating positive price effect as positive terms of trade effect is not totally cancelled out by the negative general price level effect. Looking at the quantum value and unit value of exports and imports(Table-8 in Appendix), we find that over the years-1998-99 to 1999-2000, the volume of imports at constant prices ie, quantum index of imports was increased from 644 to 705 while the quantum index of exports was increased from 399 to 461. Again, the significant increase in the volume of imports of 'Crude petroleum', 'Organic Chemicals', 'Machinery and transport equipment' in 1999-2000 has resulted in the increase in volume index of imports. During the same period mentioned above, on the other hand , while unit value of import has increased from 408 to 450 , unit value of exports has increased from 604 to 680 thereby resulting a positive terms of trade effect.

The above results (presented in Table-3) are also shown in the following line diagram.



Source : Tabe-3

Table-4 shows the relationship(Correlation Matrix) between various components of changes in trade balance during post liberalisation phase-I (1991-92-2000-01). Based on small sample size, estimated results show that simple correlation between change in trade balance and terms of trade effect is negative in this phase. The negative association between change in balance of trade and terms of trade may be explained in this way. A fall in the net barter terms of trade, other things remaining the same, would through an increase in expenditure on imports relative to earnings from exports result in increase in the trade deficit. True that a fall in the net barter terms of trade, if externally originated, could through a terms of trade induced fall in domestic real income curtail import and improve the trade balance. It is also observed from the table that simple correlation between change in trade balance and general price level and that between change in trade balance and quantity effect is positive.

Table-4 :Relationship between Various Components of Changes in Trade Balance (Post LiberalisationPhase-I (1991-92-2000-01)

The Correlation Matrix				
	Change in Trade Balance	Quantity Effect	Terms of Trade Effect	General Price Level Effect
Change in Trade Balance	1.0000	0.8056	-0.8788	0.9204
Qyantity Effect	0.8056	1.0000	-0.9877	0.9618
Terms of Trade Effect	-0.8788	-0.9877	1.0000	-0.9928
General Price Level Effect	0.9204	0.9618	-0.9928	1.0000

Source : Author's own calculation based on Table-3

The components of changes in balance of trade of India during Post Liberalisation Phase-II(2001-02 -2019-20) are highlighted in table-5.This phase corresponds to time points when liberalization process had got enough time to have its substantial impact on the economy.

Table-5 : Components of Changes in Balance of Trade of India during Post Liberalisation Phase-II(2001-02-2019-20)

Year	Interyear Changes in Balance of Trade in Current Values	Quantity Component in Interyear Changes in Balance of Trade	Price Component in Interyear Changes in Balance of Trade	General Price Level Effect, a subcomponent C1 of C	Terms of Trade Effect, a sub component C2 of C
	A	B	C=C1 + C2	C1	C2
2001-02	-7586.60	-312577.12	304990.52	-39624.47	344614.99
2002-03	-8692.70	-223360.67	214667.97	-44305.10	258973.07
2003-04	-14306.50	-789147.30	774840.80	-387379.02	1162219.82
2004-05	-27981.50	-1261199.74	1233218.24	-1321760.90	2554979.14
2005-06	-46075.20	-1520035.97	1473960.77	-2505987.74	3979948.51
2006-07	-59321.10	-1638160.00	1578838.90	-3730912.85	5309751.75
2007-08	-88535.00	-2359791.57	2271256.57	-7906525.76	10177782.33
2008-09	-118401.30	-15171667.94	15053266.64	-62724317.25	77777583.89
2009-10	-109621.50	-5193020.53	5083399.03	-20277223.89	25360622.92
2010-11	-118632.90	-4949760.70	4831127.80	-27319586.75	32150714.55
2011-12	-183355.60	-766088.49	582732.89	-5630986.86	6213719.74
2012-13	-190336.00	-610465.39	420129.39	-4460532.91	4880662.30
2013-14	-135797.90	1517622.72	-1653420.62	10666530.97	-12319951.58
2014-15	-137681.40	2078669.88	-2216351.28	14473544.39	-16689895.66

Contd.....

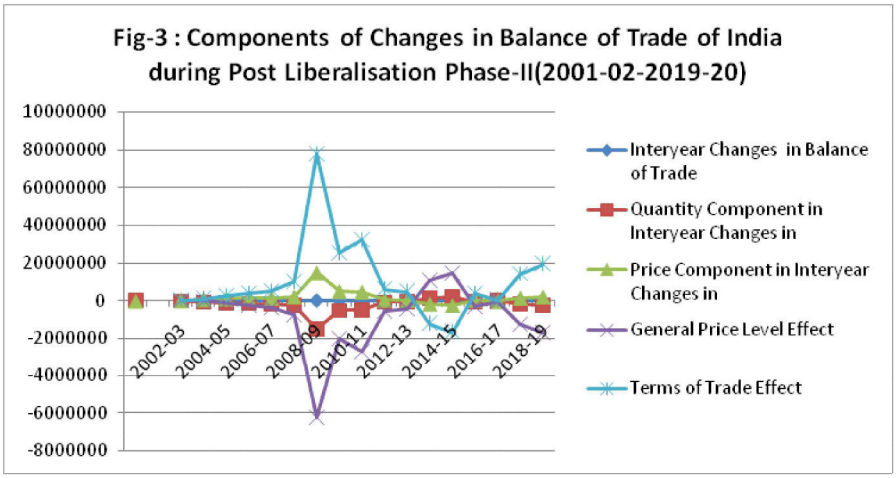
Contd.....

2015-16	-118716.70	-594888.98	476172.28	-3423290.65	3899462.93
2016-17	-108504.60	-94372.74	-14131.86	-559824.78	545692.93
2017-18	-162202.10	-1777957.90	1615755.80	-12577026.62	14192782.42
2018-19	-162202.10	-2420988.00	2258785.90	-17125732.06	19384517.97
2019-20	98121.10	-2320322	2418443.10	-17125732	19544175

Source : Author's own calculation based on the methodology described.

From table-5 , we see that like pre liberalisation period((1981-82-1990-91) and post liberalization phase-I((1991-92-2000-01), change in balance of trade has been consistently negative for the post liberalization phase-II(2001-02 -2019-20) also. During this phase, significant deterioration in inter-year change in balance of trade occurred in the year , 2012-13(-190336Million US$). This resulted from the negative contribution of both quantity effect (-190336Million US$) and general price level effect (-4460532Million US$) though a part of this was cancelled out by positive terms of trade effect (+420129 Million US$). In other words, `the negative quantity effect has outweighed the net positive price effect (General Price Level Effect + Terms of Trade Effect) resulting the significant negative change in balance of trade in 2012-13. A quick look at the quantum value and unit value of exports and imports (Table-9 in Appendix) reveals that over the years-2011-12 to 2012-13, the volume of import at constant prices ie, quantum index of importshas increased from 246 to 261 while the quantum Index of exports has increased from 331 to 357. One of the reasons for increase in volume index of import is no doubt the increase in volume of 'crude petroleum', 'machinery and transport equipments', plastics and chemicals'imports. During the same period,as cited above, while unit value of import has increased from 425 to 459, unit value of exports has increased from 268to 345 thereby resulting a positive terms of trade effect.

The above results (highlighted in table-5) are also depicted in the following diagram.



Source- Table-5

Table-6 reveals the relationship (Correlation Matrix) between various components of changes in trade balance during post liberalisation phase-(2001-02 -2019-20). Though the sample size is small, estimated results show that simple correlation between change in trade balance and terms of trade effect is negative. An explanation of this type of correlation has already been given earlier. It is also observed from the table that simple correlation between change in trade balance and general price level and that between change in trade balance and quantity effect is positive.

Table-6 : Relationship between Various Components of Changes in Trade Balance (Post Liberalisation Phase-II (2001-02-2019-20)

The Correlation Matrix				
	Change in Trade Balance	Quantity Effect	Terms of Trade Effect	General Price Level Effect
Change in Trade Balance	1.0000	0.0389	-0.1317	0.1550
Qyantity Effect	0.0389	1.0000	-0.9842	0.9761
Terms of Trade Effect	-0.1317	-0.9842	1.0000	-0.9992
General Price Level Effect	0.1550	0.9761	-0.9992	1.0000

Source : Author's own calculation based on Table-5

VI. Conclusions:

In this paper, we have tried to identify and to study the trends and variations in the sizes of the various components prevalent in the Indian economy during pre and post reform era in the inter year change in the trade balance and to suggest certain possible direction in which our trade package requires reshaping so that appropriate balance of payment strategy can be formulated.

We observed that change in balance of trade has been consistently negative both in the pre reform((1981-82-1990-91) and post reform era (1991-92-2019-20) in India. As far as the components of the change in trade balances are concerned, we found that the quantity component has been major explanatory factor in the inter year changes of balance of trade in India both in pre and post reform periods. The deterioration in the trade balance was mainly due to the consequences of a large negative quantity effect and general price level effect though a small part of which has been cancelled out by a positive terms of trade effect.

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Appendix :

Table-A1 : The Unit Values and Quantum Values of Exports and Imports (1980-81-1990-91)
(Base Year :1978-99=100)

	Unit Value Index		Quantum Value Index	
Years	Imports	Exports	Imports	Exports
1980-81	134	109	138	108
1981-82	133	124	151	110
1982-83	136	132	155	117
1983-84	126	151	185	113
1984-85	162	170	156	121
1985-86	159	175	182	111
1986-87	139	179	212	121
1987-88	160	195	205	140
1988-89	186	232	224	152
1989-90	228	277	228	175
1990-91	268	293	238	194

Source: Directorate General of Commercial Intelligence and Statistics,Ministry of Commerce and Industry.GOI.

Table-A2 : The Unit Values and Quantum Values of Exports and Imports (1991-92-2000-01)
(Base Year :1978-99=100 and 1999-00=100)

	Unit Value Index		Quantum Value Index	
Years	Imports	Exports	Imports	Exports
1991-92	309	370	228	209
1992-93	331	422	282	223
1993-94	327	474	329	258
1994-95	325	495	408	293
1995-96	351	484	515	384
1996-97	400	505	512	412
1997-98	404	589	562	386
1998-99	408	604	644	399
1999-00	450	680	705	461
2000-01	487	624	698	571

Source: Directorate General of Commercial Intelligence and Statistics,Ministry of Commerce and Industry. GOI

Table-A3 : The Unit Values and Quantum Values of Exports and Imports (2001-02-2019-20)
(Base Year : 1999-00=100)

	Unit Value Index		Quantum Value Index	
Years	Imports	Exports	Imports	Exports
2001-02	112	103	103	126
2002-03	128	106	109	150
2003-04	132	114	128	161
2004-05	157	131	150	179
2005-06	179	139	174	206
2006-07	206	158	191	227
2007-08	210	166	218	245
2008-09	239	194	490	267

Contd.....

Contd.....

2009-10	215	196	288	264
2010-11	243	223	311	304
2011-12	425	268	246	331
2012-13	459	345	261	357
2013-14	518	312	233	378
2014-15	518	300	235	397
2015-16	701	623	214	290
2016-17	867	705	220	313
2017-18	867	705	260	322
2018-19	554	402	291	348
2019-20	463	395	299	373

Source: Directorate General of Commercial Intelligence and Statistics, Ministry of Commerce and Industry, GOI.

Exchange Rate Volatility: An Indian Perspective

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Bhaskar Goswami**

Abstract

The present paper is a humble attempt to explore and examine the volatility of the foreign exchange market in India. For the purpose of analysis, only the bilateral exchange rate between US dollar and Indian rupees has been considered for the period January 1991 to December 2020. The different volatility models like, GARCH, EGARCH, TGARCH are used and finally a comparison among these classes of models is made to ascertain the best fit model. In turns out that EGARCH (1,1) is the best in terms of capturing the nature of volatility in the foreign exchange rate. This particular result bears testimony that the foreign exchange market has a close resemblance with other asset markets in India, like share market (A.K Mishra et.al,2007 and P.K Mitra, 2017, B. Goswami and M.Hussain, 2021, P.Duttilo et.al 2021) where asymmetric information plays a crucial role.

Key Words : Foreign exchange rate, Volatility, Asymmetric Information

JEL Classification : **G10, G150**

I. Introduction :

The foreign exchange market is largely high and liquid market in the world with worldwide average turnover of $5.3 trillion , which makes foreign exchange as highly global trading asset. Issues related to foreign exchange rate have always been the interest of researchers in modern financial theory. Exchange rate, which is the price of one currency in terms another currency, has a greater impact on the volume of foreign trade and investment. Its volatility has increased during last two decades and is thought of as harmful for economic welfare. Volatility plays a vital role in foreign exchange rate return, derivative pricing, hedging, risk management and optimal portfolio selection. The concept of volatility relates to the uncertainty or risk about an asset's value. A higher volatility means that an asset can assume a large range of values, while a lower volatility implies that an assets' value does not change dramatically, even though it changes over time. The

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exchange rate fluctuates according to the conventional demand and supply mismatch of currencies. The exchange rate volatility will reduce the volume of international trade and the foreign investment.

As a first step, we examine the characteristics of the foreign exchange rate. We, then, proceed to check the volatility aspects of the foreign exchange rate. There are many steps involved in this procedure. First step is the graphical plotting of the monthly exchange rate data, followed by its descriptive statistics. Then the monthly exchange rate returns are tested for stationarity. At the last step we estimated various GARCH models like, GARCH (1,1), TGARCH (1,1), EGARCH (1,1) and GARCH-M (1,1) i.e., both symmetric and asymmetric approach to analyze the volatility of the exchange rate returns. In India, volatility issue mainly related to dominant financial assets, such as company shares, have been well researched and documented. Only a few studies on foreign exchange rate volatility have been carried out. The second section of this paper presents literature review in the third section we have the methodology used in this paper and describe the relevant data sources. The fourth section deals with the result and discussion of the analysis of the data. Finally, fifth section provides the concluding remarks.

SECTION 2: LITERATUREREVIEW

The issue of foreign exchange rate volatility has gained importance in the research studies since 1973, when many countries shifted towards flexible exchange rate from fixed exchange rate regime. India adapted the flexible exchange rate regime lately in early 90's, possibly as an outcome of economic reforms of 1991.

Study on foreign exchange rate volatility is an important topic for financial economics and there are many existing research works present in this field. Some of them were discussed below.

PK Mitra (2017) in his study discussed the dynamics of volatility spillover between foreign exchange rate return and Indian stock market. He mainly used NIFTY and SENSEX for stock market and top four traded currencies in India (USD, EURO, GBP, JPY). GARCH and co integration method was applied in this study for the time period 2008 to 2016 on daily basis and the result showed long run relationship between them. A.K Mishra et.al (2007) also explored volatility spillover between foreign exchange market and stock market of India. The result showed both the markets are integrated to each other. S. Panda and R.K Mohanty (2015) also explored the exchange rate volatility issue in their study. They mainly examined the impact of exchange rate volatility on exports in Indian context for period 1970-71 to 2011-12. The result showed Indian exports were negatively affected by exchange rate volatility but positively affected by World GDP.

The use of Generalized ARCH (GARCH) was first introduced by Bollerslev (1986), which is an extension of ARCH model to allow for a more flexible lag structure. ARCH model was first applied by Hsieh (1988) for modeling currency exchange rate. He investigated whether daily changes in five major foreign exchange rates contain any non-linearities or not. He concludes that a further generalized form of ARCH i.e., GARCH model to investigate the nonlinearity of the five foreign currencies. Since then, the application of these models to currency exchange rate gained popularity, such as, Hsieh(1989b), Bollerslev, T. (1990),Takezawa (1995) and Brooks (1997), Hopper (1997). Soumya Kanti Ghosh (2002) examined the impact of daily forex market interventions by central bank (RBI) using daily exchange rate data from March 1993 to July 2000. He found that direct intervention of RBI was more effective than indirect intervention to check the foreign exchange volatility. Choo Wei Chong et al. (2002) attempted to study various GARCH models to check the foreign exchange volatility of Malaysian Rinngit to the Pound Sterling on daily data from January 1990 to March 1997. Suliman Zakaria Suliman Abdalla (2012) applied both symmetric and asymmetric approach of GARCH models to estimate exchange rate volatility of 19 Arab countries using daily exchange rate data for a period of 1st January 2000 to 19th November 2011. He concluded that the exchange rate volatility can be adequately modeled by various GARCH models. Many researchers indicate some relationships between foreign exchange volatility and news or information on other macroeconomic fundamentals (including rate of interest, GDP, inflation and money supply), for example, Mckenzie and Faff (2004), Engel and Kenneth(2005), Mark (2009).

EGARCH was introduced by Nelson in 1991. For stock indices, Nelson's EGARCH model is proven to be best model. In 1987, Engel developed GARCH-M to formulate the conditional mean as function of conditional variance as well as an autoregressive function of the past values of underlying variables.

Javed Bin Kamal and A.K Enamul Haque (2016) examined the dependence between stock market and foreign exchange market of Bangladesh, India and Sri Lanka using daily data from July 31, 2009, to July31, 2013 and applied ARMA-GARCH type model to obtain the appropriate result. They found both Bangladesh and Indian market provided more diversification than Sri Lankan market. Isita Mukherjee and Bhaskar Goswami (2017) examined the volatility pattern of the daily return of select commodity futures in India and explored whether the commodity futures satisfy the Samuelson Hypothesis using daily data from 2004 to 2012 and applied GARCH(1,1) model. They found that there was a presence of persistent volatility and prevalence of long memory for the select commodity futures, except potato futures. Suman Das and Saikat Sinha Roy (2021) identified the turning points in volatility patterns in BRICS currency

market.They used a univariate Markov regime switching model on daily data between April 2006 and March 2018. They found that Chinese yuan is less volatile and South African rand is highest volatile currency among BRICS currency market.

SECTION 3: METHODOLOGY and DATA SOURCE

Data: The data on foreign exchange rate are obtained from the international financial statistics by international monetary fund (IMF), Washington D.C., and cover the period from January 1991 to December 2020. Here we selected Indian currency in terms of US dollar because US dollar is a globally accepted currency, so to check the volatility or effectiveness of foreign exchange market, we need to focus on domestic currency rate (spot) against US dollar.

Descriptive statistics: To analyze the characteristics of the monthly data of foreign exchange rate (spot) during the study period, the descriptive statistics show the mean (X), Standard-deviation (σ), Skewness (S), Kurtosis (K), Jarque-Bera statistics results.

We calculated the coefficients of Skewness and Kurtosis to check whether the exchange rate series is skewed or leptokurtic. To test the null hypothesis of normality, Jarque-Bera test statistic (JB) has been applied as follows,

$JB = N\text{-}k/6[S^2+1/4(K-3)^2]$, ---------- Equation.1

Where N is number of observations, S is coefficient of Skewness, K is the coefficient of Kurtosis, k is the number of coefficients used to create the series, JB follows a chi-square distribution with 2 degrees of freedom (d.f.) If the JB statistics is greater than the table value then null hypothesis of the normal distribution is rejected.

Test of Stationarity: To test the stationarity of the data, we performed Augmented Dickey-Fuller (ADF) test (Dickey and Fuller 1979). For this test we fitted a regression equation,

$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} +$ ---------- Equation.2

Where α is a constant, β the coefficient on a time trend and p the lag order of autoregressive process. The null hypothesis is that there is a unit root present in the series, i.e., $\gamma=0$ against alternative hypothesis $\gamma<0$.

The Generalized ARCH Model (GARCH):

GARCH (p, q) model (Bollerslev,1986) assumes that volatility of a series at time t is not only affected or influenced by q past squared returns but also by p lags estimated past volatility. GARCH (1,1) model is given as:

$R_t = \mu + \varepsilon_t$ (mean equation) ---------- Equation.3

$\sigma^2_{t-1} = \Psi + \alpha\varepsilon_{t-1} + \beta\sigma^2_{t-1}$ (variance equation) ---------- Equation.4

Where $\Psi > 0$ and $\alpha \geq 0$, $\beta \geq 0$ and R_t is the return at time t, μ is the average return and ε_t is the residual return at time t. Parameters α and β are the ARCH and GARCH effect. If the value of β is sufficiently large, then the volatility is persistent. Higher value of α indicates an insensitive reaction of the volatility to market moments.

Exponential GARCH model (EGARCH):

The exponential GARCH model by Nelson and Cao (1991) is another form of the GARCH model. An EGARCH(p,q) is given as:

$$\log\sigma^2_t = \Psi + \sum\beta_k g(Z_{t-k}) + \sum\alpha_k \log\sigma^2_{t-k} \quad \text{---------- Equation.5}$$

Where k ranges 1 to q and $g(Z(t) = \Theta Z_t + \lambda(|Z_t| - E(|Z_t|)))\sigma^2_t$ is the conditional variance , Ψ, α, β, Θ and λ are coefficients. Since $\log\sigma^2_t$ may be negative, there are no sign restrictions for the parameters.

GARCH-M:

The GARCH in mean (GARCH-M) model adds a heteroskedasticity term into the mean equation. It has the specification:

$$y_t = \beta x_t + \lambda\sigma_t + \varepsilon_t \quad \text{---------- Equation.6}$$

The residual $\varepsilon_t = \sigma_t \times z_t$

Threshold GARCH (TGARCH):

The Threshold GARCH model was introduced by Zakoian in 1994. The specification of this model is one on conditional standard deviation instead of conditional variance:

$$\sigma_t = K + \delta\sigma_{t-1} + \alpha^+_1 \varepsilon^+_{t-1} + \alpha^-_1 \varepsilon^-_{t-1} \quad \text{---------- Equation.7}$$

Where $\varepsilon^+_{t-1} = \varepsilon_{t-1}$ if $\varepsilon_{t-1} > 0$, and $\varepsilon^+_{t-1} = 0$ if $\varepsilon_{t-1} \leq 0$. Likewise, $\varepsilon^-_{t-1} = \varepsilon_{t-1}$ if $\varepsilon_{t-1} \leq 0$ and $\varepsilon^-_{t-1} = 0$ if $\varepsilon_{t-1} > 0$.

SECTION 4: RESULT AND DISCUSSION

This section deals with the results obtained from the analysis. Firstly, we have plotted the data on the graph and check if there is any volatility clustering, Figure. 1A and Figure. 1B.

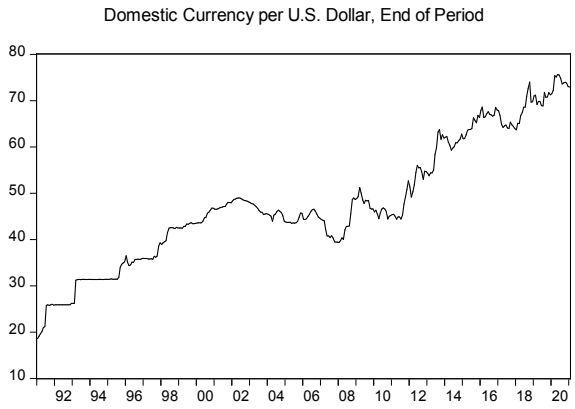

Figure. 1A

***Source: Author's Own Calculation**

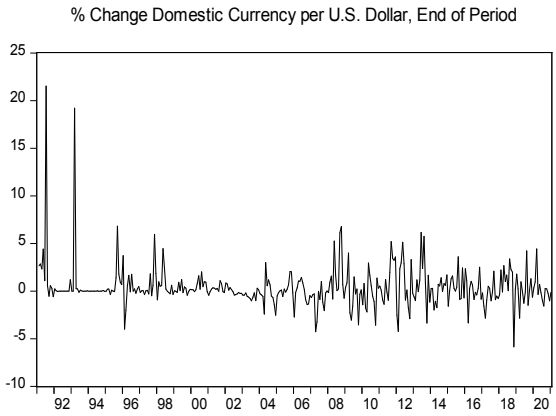

Figure. 1B

***Source: Author's Own Calculation**

The above two figures confirm the presence of volatility in the foreign exchange market. In the early years of the sample data, volatility was minimal but during the 2008 global crisis we clearly saw volatility clustering. During 2012-2014 there was also volatility clustering and in the period of 2018-19 also there was a significant change in exchange rate.

Result of Descriptive Statistics

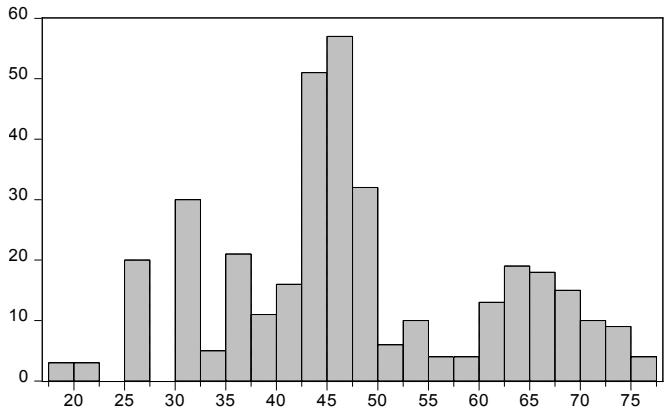

Figure. 1C

Series: DOMESTIC_CURRENCY_PER_U_	
Sample 1991M01 2021M01	
Observations 361	
Mean	47.73305
Median	45.72650
Maximum	75.64000
Minimum	18.58270
Std. Dev.	13.40193
Skewness	0.258393
Kurtosis	2.371723
Jarque-Bera	9.954564
Probability	0.006893

Table. 1

***Source: Author's Own Calculation**

From the above table we can see that we have total 361observations. The average value of the variable foreign exchange rate is 47.73305 and the variation of this variable from its mean value is 13.40193. The p value of the JB test statistic rejects the null hypothesis of normally distributed data. Hence the distribution is not normal distribution like other financial assets. Given the value of kurtosis (which is less than 3) we can rightly call the distribution as leptokurtic.

Result of Stationarity test:

From the Figure 1A we clearly see that there is a trend in exchange rate series. So, the next step for volatility checking is to perform unit root test of exchange rate series. Normally the financial time series data are more or less non-stationary in nature. To test stationarity of the data series we used Augmented Dickey-Fuller (ADF) test. We employed ADF test both with intercept and trend and we also checked the result both at level and first difference.

Null Hypothesis: USD/INR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		**-2.374045**	**0.3925**
Test critical values:	1% level	-3.983900	
	5% level	-3.422426	
	10% level	-3.134078	

*MacKinnon (1996) one-sided p-values.

Table.2

Null Hypothesis: D(USD/INR) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		**-16.28006**	**0.0000**
Test critical values:	1% level	-3.983900	
	5% level	-3.422426	
	10% level	-3.134078	

*MacKinnon (1996) one-sided p-values.

Table.3

***Source: Author's own calculation using Eviews10 software**

Table 2 describes the result of unit root test (Augmented Dickey-Fuller Test) of the exchange rate data series with intercept and term at level. The lag length in both level and first difference data are calculated by SIC (Schwarz Information Criterion). The result shows there is no stationarity of the series because the probability value is greater than 0.05 that means there is a unit root in the series. For volatility checking we need stationary data series for further research. So, we take

the first difference of the data series to check the stationarity. Table 3 gives us the result of stationarity test at first difference and the result is quite satisfactory because the probability value is less than 0.05 that means it rejects the null hypothesis of presence of unit root in the data series.

Result of GARCH (1,1) model:

Dependent Variable: USD/INR

Equation mentioned in Eviews10:

GARCH = C (3) + C (4) * RESID (-1) ^ 2 + C (5) * GARCH (–1)

Variable	Co efficient	Std error	z-Statistic	Prob
C	**0.438530**	0.167666	2.615494	**0.0089**
USD/INR	**0.992843**	0.003507	283.0704	**0.0000**

Variance

C	**0.002836**	0.001753	1.618362	**0.1056**
RESID(-1)^2	**0.054014**	0.007748	6.971572	**0.0000**
GARCH(-1)	**0.946184**	0.005451	173.5821	**0.0000**

	Value		Value
R-squared	0.995219	Mean dependent var	47.81402
Adjusted R-squared	0.995206	S.D. dependent var	13.33186
S.E. of regression	0.923068	Akaike info criterion	**2.515131**
Sum squared resid	305.0355	Schwarz criterion	**2.569105**
Log likelihood	-447.7237	Hannan-Quinn criter	2.536592
Durbin-Watson stat	1.694785		

Table 4: GARCH(1,1) model using Eviews10 software*Source: Author's Own Calculation

From the Table 2, we get mainly two sets of equation one is mean equation and other is variance equation. The dependent variable that is exchange rate is calculated at level in this model.

The mean equation: ERt= 0.438530 + 0.992843ERt-1 ---------- Equation.8

In the equation 8, ERt represents mean value of the foreign exchange rate (USD/INR) at time t and also ERt-1 represents same value for the previous period (t-1). Coefficients are positive and statistically significant.

Mean value of foreign exchange rate return is **0.438530** and its past value significantly predicts the current value by **0.9928.**

The variance equation: $h_t = 0.00283 + 0.94ht–1 + 0.054ut–1$ ---------- Equation.9

Here $\mathbf{h_t}$ represents variance of exchange rate at time t and $\mathbf{h_{t-1}}$ represents previous period variance of exchange rate returns and $\mathbf{u_{t-1}}$ indicates disturbance term of previous period.

Coefficients of the constant variance term of, the ARCH and GARCH parameters are positive and statistically significant at the 1% level.

This gives the result of **GARCH (1,1)** model. The time varying volatility includes a constant term (0.00283) plus its past value that is $\mathbf{h_{t-1}}$ (0.94) and a component which depends on past value of the error term, which is, $\mathbf{u_{t-1}}$ (0.054).

The AIC and SCcriterion is also minimum in GARCH (1,1) model compared to other higher order GARCH models.

These findings clearly establish the presence of time varying conditional volatility of foreign exchange rate (USD/INR).This result also indicates that the persistence of volatility shocks, as represented by the sum of the ARCH and GARCH parameters is large (0.054+0.94) and is close to 1. It denotes that the effect of today's shock remains in the forecasts of variance for many periods in future. So, we can say that the present shocks in foreign exchange market will remain for many years.

Estimation Result of EGARCH (1,1) model:

Dependent Variable: USD/INR

Equation mentioned in Eviews 10:

LOG (GARCH) = C (3) + C (4) * ABS(RESID (–1)/@ SQRT(GARCH(–1))) + C (5)

*RESID (–1)/@SQRT (GARCH (–1)) + C(6) * LOG (GARCH(–1))

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.195580	0.080842	2.419279	**0.0156**
USD/INR	0.997148	0.001771	562.9734	**0.0000**

Variance

C(3)	-0.006973	0.011858	-0.588035	**0.5565**
C(4)	0.030865	0.017445	1.769252	**0.0769**
C(5)	-0.122017	0.011370	-10.73138	**0.0000**
C(6)	1.008295	0.002769	364.1254	**0.0000**

	Value		Value
R-squared	0.995197	Mean dependent var	47.81402
Adjusted R-squared	0.995183	S.D. dependent var	13.33186
S.E. of regression	0.925253	Akaike info criterion	**2.349328**
Sum squared resid	306.4813	Schwarz criterion	**2.414096**
Log likelihood	-416.8790	Hannan-Quinn criterion.	2.375081
Durbin-Watson stat	1.694063		

Table 5: EGARCH (1, 1) model using Eviews10 software
***Source: Author's Own Calculation**

Table 3 describes the result of EGARCH (1,1) model for volatility checking of exchange rate series (USD/INR) and the data series is calculated at level term.

From the Table 3 we get an average foreign exchange rate return 0.195580 and its past value which significantly predicts the present value by 0.997

The conditional variance equation in EARCH (p,q) is the log of variance series (ht), which makes the leverage effect exponential rather than quadratic. This ensures that the estimates are non-negative. Here we estimate EGARCH (1,1) test for volatility checking of exchange rate (USD/INR). Here, C(3)=constant term, C(4)=ARCH effects, C(5)=asymmetric effects and C(6)= GARCH effects. The coefficient of the asymmetric term is negative (-0.122) and statistically significant at the 1% level. In exponential terms, C (5) = λ = e^–0. 122 = 0.885 which indicates that for foreign exchange rate (USD/INR), bad news has larger effect on the volatility of foreign exchange rate than good news. So, we can see that EGARCH(1,1) test is more robust and revamped form of GARCH modelling to check volatility where the asymmetric effect plays a major role. The **AIC and SC** result also give lower result comparative to GARCH (1,1) test.

Estimation result of GARCH-M(1,1) using variance:

Dependent Variable: USD/INR Equation mentioned in Eviews10:

GARCH = C (3) + C (4) * RESID (–1) ^ 2 + C (5) * RESID (–1) ^ 2 * (RESID (–1) < 0) +C (6) * GARCH (–1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	0.144484	0.103721	1.392997	**0.1636**
C	0.524138	0.183347	2.858721	0.0043
USD/INR	0.989402	0.004296	230.3018	0.0000

Variance

C	0.002841	0.001781	1.594948	0.1107
RESID (-1)^2	0.053476	0.007974	6.706571	**0.0000**
GARCH (-1)	0.946519	0.007876	120.1795	**0.0000**

	Value		Value
R-squared	0.995237	Mean dependent var	47.81402
Adjusted R-squared	0.995210	S.D. dependent var	13.33186
S.E. of regression	0.922677	Akaike info criterion	**2.513913**
Sum squared resid	303.9261	Schwarz criterion	**2.578681**
Log likelihood	-446.5043	Hannan-Quinn criterion.	2.539666
Durbin-Watson stat	1.707850		

Table 6: GARCH-M(1,1) using Eviews10 software *Source: Author's Own Calculation

The above table shows the result of GARCH-M(1,1) test for checking exchange rate volatility of India and data series is calculated at level. The mean equation of the model shows the GARCH term is not statistically significant, but its inclusion substantially increases the significance of the GARCH term in variance equation.

From the result it can be said that the asset (foreign currency) in the question may not be risky to hold.

Estimation result of TGARCH (1,1) model:

Dependent Variable: USD/INR

Equation mentioned in Eviews10:

GARCH = C (3) + C (4) * RESID (–1) ^ 2 + C (5) * RESID (–1) ^ 2 * (RESID (–1) < 0) + C (6) * GARCH (–1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	**0.197189**	0.158399	1.244885	**0.2132**
USD/INR	**0.996859**	0.003700	269.4216	**0.0000**

Variance

C	-0.002656	0.000540	-4.918735	0.0000
RESID(-1)^2	-0.000984	0.006328	-0.155435	**0.8765**
RESID(-1)^2*(RESID(-1)<0)	**0.096332**	0.011003	8.755226	**0.0000**
GARCH(-1)	**0.982894**	0.006495	151.3206	**0.0000**

	Value		Value
R-squared	0.995184	Mean dependent var	47.81402
Adjusted R-squared	0.995171	S.D. dependent var	13.33186
S.E. of regression	0.926483	Akaike info criterion	**2.427764**
Sum squared resid	307.2968	Schwarz criterion	**2.492532**
Log likelihood	-430.9975	Hannan-Quinn criter.	2.453517
Durbin-Watson stat	1.689079		

Table 7: TGARCH (1,1) using Eviews10 software *Source: Author's Own Calculation

Above table describes TGARCH (1,1) model to check exchange rate volatility in Indian context and dependent variable USD/INR is calculated at level in this model.

Table 5 gives us mean and conditional variance equations. From the mean equation we can see that the mean value is 0.197 and its past value predicts it well by 0.9968 and also statistically significant.

The variance term gives us both positive and negative shocks impact on exchange rate and also the asymmetric term. The coefficient in the asymmetric term is positive (0.096332) and

statistically significant at 1% level and thereby indicates that for this exchange rate there are asymmetries in the news.

Bad effects have larger impact on exchange rate return than good news.

Comparative discussion of various GARCH models:

In this study, we have checked volatility of Indian Foreign exchange market through various types of GARCH (Generalized Autoregressive Conditional Heteroscedasticity). Although there are no particular rules to choose the best model of volatility checking, but in this study, we have mainly focused on the significance of the model based on minimum value of AIC and SC. We mainly employed GARCH (1,1), EGARCH (1,1), GARCH-M (1,1) and TGARCH (1,1) to check the volatility of USD/INR for the last three decades and all the models take the value of exchange rate at level series. According to the above- mentioned result, EGARCH (1,1) gives us smallest AIC and SC values as well as significant result. EGARCH model mainly captures the impact of asymmetric effect on the data series. In EGARCH (1,1) the asymmetric term is significant and negative which means the impact of bad news on USD/INR has higher impact than the good news. All the models give significant result in capturing the exchange rate volatility, but EGARCH (1,1) model has lowest AIC and SC value compared to other models. So, EGARCH model is preferred over other models to capture volatility of exchange rate in Indian context.

SECTION 5: CONCLUSIONS

An investigation about the nature and pattern of volatility of Indian foreign exchange market was the primary motive of the present paper. For that purpose, the bilateral exchange rate of US dollar and Indian rupees was considered as it is an acceptable proxy representation of overall exchange rate movements. The study spans from January 1991 to December 2020. Different volatility models, both symmetric and asymmetric models,were applied to test for the best fit model. As it turns out from the analysis, the nature of exchange rate volatility in Indian foreign exchange market can be best represented by EGRACH (1,1) model signifying that bad shocks have more impact than good shocks. Asymmetric information generally has more explanation regarding the nature of volatility in the exchange rate in the Indian context. Similar results were obtained by N.T Hung (2021), K Jebran and A. Iqbal (2016), P.K Mitra (2017), P. Panda and M Deo (2014). Such an observation has pertinent policy suggestion aiming towards reduction in asymmetrical information so as to curtail the volatility in the forex market.

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Revisiting the Relationship between External Debt and Economic Growth in India

Farah Hussain[1] and Santi Gopal Maji[2]

Abstract

The study investigates the relationship between external debt and economic growth in India over the period 1991 to 2020, considering the role of financial development, macroeconomic policies and human capital. We use an index of macroeconomic policies using three indicators - trade openness, consumer price index (CPI) and fiscal deficit to proxy for trade, monetary and fiscal policies respectively, computed using principal component analysis following the OECD methodology. Time series analysis is used to examine this relationship. ARDL approach to co-integration and error correction model is adopted to know the long-run and short-run dynamics of the relationship. The impulse response functions are employed to study the impact of external shocks on growth due to external debt. We find that economic growth and external debt in India have a significant long-term relationship. More precisely, we find a negative impact of external debt on economic growth in both the long run and short run.

Keywords: External Debt; Economic Growth; Financial development; Time series analysis; India.

JEL classification: H630; O400; C22

I. Introduction :

Governments in developing countries often resort to public debt, which is an important fiscal instrument, to attain the goal of economic development. Public debt raised from external sources also termed as the external debt of a country has become a significant source of revenue for the developing countries to bridge the existing gap between domestic saving and investment in such economies. During the mid-sixties, developing countries in the world turned towards an outward-oriented development policy and increasingly borrowed from external sources to accelerate the pace of growth of their economies (Costa, 1991). In India, it was in the post-independence

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period when the volume of external debt started growing to achieve the development strategies under the various five-year plans. It increased from 1.8 percent of GDP at the end-March 1955 to about 17 percent by end-March 1970 (Jain and Guria, 2017). After the economic reforms in 1991, there have been considerable changes in the volume as well as the composition of India's external debt. However, with the experience of the balance of payment crisis in the 1990s, India had followed a prudent external debt policy and has managed to keep the external debt within sustainable levels (Guria and Sokal, 2020). India's external debt has undergone a compositional shift from government to a non-government sector with the expansion of economic activities by the private sector as well as a rapid rise in short-term debt since the mid-2000s. Over the last one and a half decade India's external debt grew consistently and significantly. A cursory look at the figure 1 below reveals that the absolute amount of external debt of India has tremendously increased since 2007. The rise in external debt was attributed mainly to the rising commercial borrowings and short term credit due to the expansion of economic activities in the country during this period.

Figure 1:Trend of India's External Debt

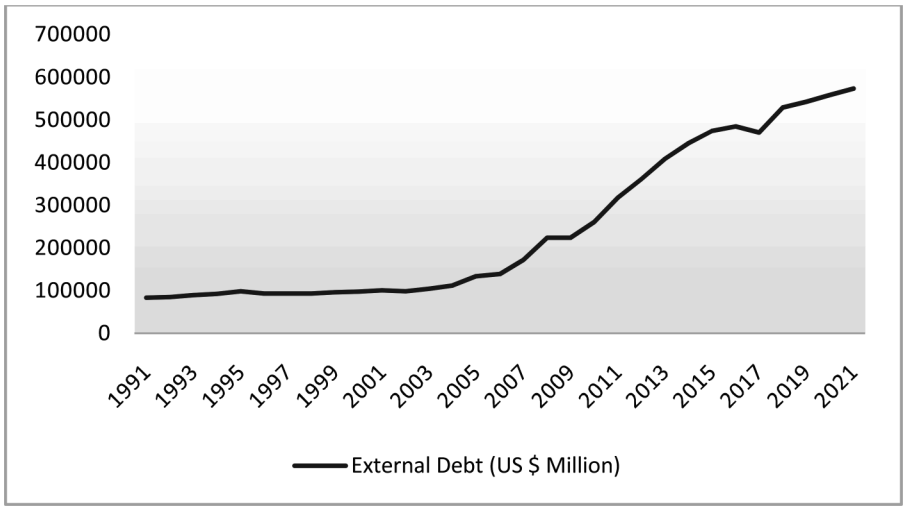
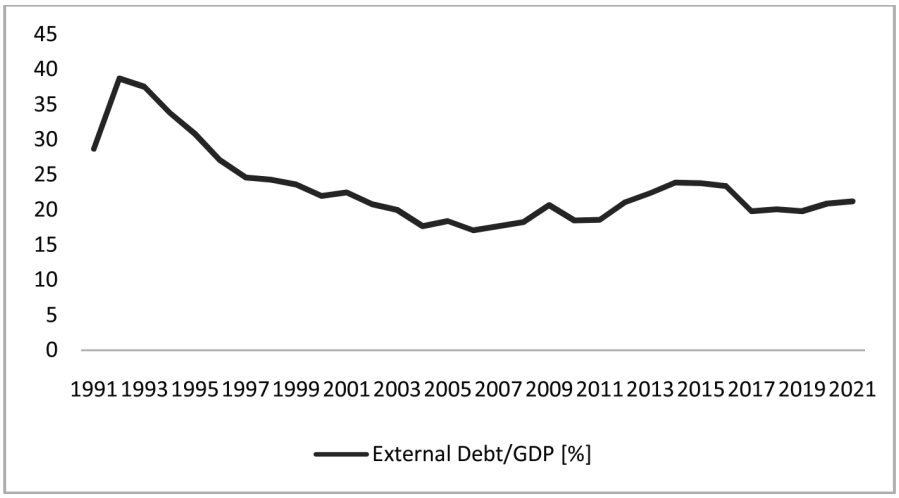
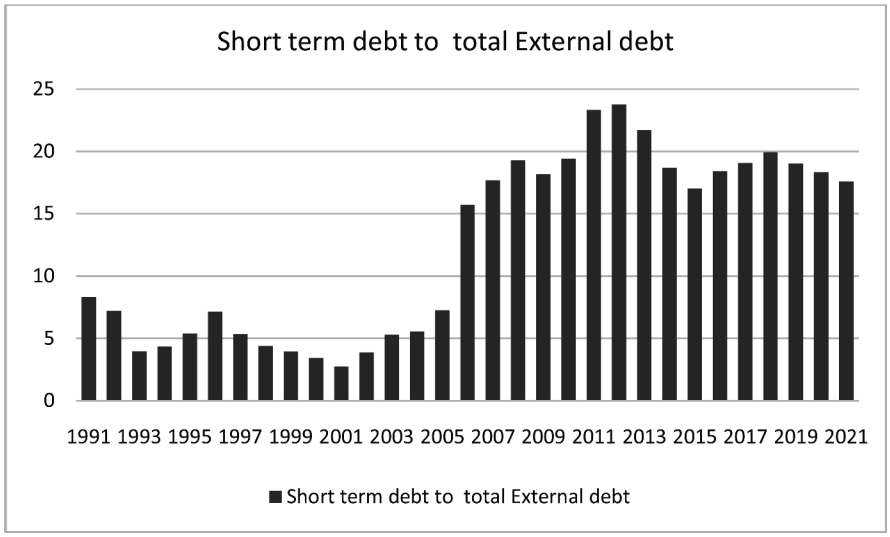


Figure 2:Trend of India's External Debt to GDP ratio



The external debt of the country was however within manageable limits. The external debt to GDP ratio for India since 2000s has remained within a comfortable zone, close to 20 per cent as seen in figure 2 above. Economies with low debt-to-GDP ratio are in a better position to repay their debt and at a low risk of credit default. India's short-term debt to total external debt has increased significantly since 2006 as seen in figure 3 below. Rising short term debt is considered riskier for an economy as the short term debt is repaid from foreign currency reserves in a shorter duration of time. This in turn affects the economy's ability to repay its external debt.

Figure 3:Trend of India's short-term debt to total external debt (in per cent)



The composition of India's external debt has also changed in recent times with non-government borrowing accounting for the greater bulk of external debt. As per RBI's data on 2021, the share of government debt to total external debt was around 19 per cent while the same was around 81 per cent for non-government debt. External debt of a country may not necessarily be detrimental to growth provided the nation uses the funds productively and improves its capacity to grow at a faster rate. Excessive borrowing, however, increases the vulnerability of a country to external shocks and crises. Large amount of external debt crowds out private investment as well because of increased interest rates. Rising external debt leads to higher interest rates making investment costlier and thus affecting private investment in the economy.

Apparently, data on key external debt indicators reflect that the current external debt of India is under control and it is sustainable. India is performing better than the other emerging market economies in respect of external debt to GDP ratio and debt service ratio (Guria and Sokal, 2020). Although there is no immediate reason for concern, yet the turbulence in the global economy, falling Indian rupee against the US dollar and rising inflation in the country, may all affect future debt repayment burden for India and a higher external debt to GDP ratio. Understanding the seriousness of the matter we wish to determine if India's external debt has been utilised for economic expansion i.e., whether the external debt is helping the economy to grow. It is considered important because if the borrowed amounts are not properly channelized, it will lead to future accumulation of external debt and also can increase the future repayment burden. Hence, this study is a modest attempt to investigate the relationship between external debt and economic growth in India over the period 1991 to 2020 using time series analysis, considering the role of macroeconomic policies, financial development and human capital.

The paper is organized as follows. Section 2 deals with the review of literature. Section 3 presents the data and methodology adopted in this study. While the empirical results are discussed in section 4, concluding remarks are presented in section 5.

2. Literature Review

The theoretical literature on the association between external debt and economic growth is centred around four schools of thought: Classical, Neo-classical, Ricardian and Keynesian. The Classical school of thought that rests itself on the principle of laissez-faire was of the opinion that public debt hampers economic growth (Barik and Sahu, 2020; Hilton, 2021). According to them, public borrowing which isused to finance government expenditure causes a decline in the level of savings or capital formation in the economy.The neo-classical economist suggested a negative impact of public debt on economic growth due to the unfavourable effect of public debt on real

macroeconomic variables. According to Diamond (1965) domestic borrowing and external debt in particular crowds-out private investment due to changes in tax rates to meet the future tax burden.This view is also found in the Myers (1977) debt-overhang hypothesis. According to this hypothesis, when external debt grows beyond a certain limit, it discourages investment in the economy as investors apprehend that higher taxes would be imposed on the economy to service the debt (Ali and Mustafa, 2012). Economic theories, therefore, advocate using a reasonable level of debt for enhancing economic growth in both developed and developing countries (Kharusi and Ada, 2018). Although there is no unanimity in the literature on the direction of the association between public debt and economic growth, theoretical literature mentions the both positive and negative effects of public debt on economic growth.

The Keynesian view suggests a direct relationship between public debt and economic growth. It holds that public expenditure financed by public borrowing has a positive multiplier effect on the economy. Moreover, they are of the view that public debt crowds in private investment because increased public spending made possible with public borrowing, boosts the level of economic activity in a country (Saungweme and Odhiambo, 2019). In this context, the dual gap theory finds mention in the literature. According to the dual gap theory, investment is a function of savings. As the latter is found to be inadequate in developing countries in matching the level of investment required, external debt could increase the inflow of capital needed to achieve the targeted rate of growth. As such, the government of these countries resorts to external borrowing to fill the saving and investment gap (Adegbite et al., 2008). Clements et al. (2003) indicate that external debt has a positive impact on the investment and growth of a country up to a threshold level. However, it may adversely affect the growth if most of the funds are utilized for repayment of debt instead of investment. Empirically Kasidi and Said (2013) find a positive association between external debt and economic growth in the case of Tanzania.

Furthermore, the Ricardian Equivalence theorem mentions of a neutral effect of public debt on economic growth (Barro 1979, 1990). According to this theorem, people can perceive that the government might raise future tax rates to repay the existing debt. Hence, the public would save the money received from the government in the form of increased public spending or lower tax rates in the present to be able to pay higher tax rates in the future. The Ricardian Equivalence theorem thus holds that the fiscal policy of the government has no impact on aggregate demand or national output. An increase in government spending is balanced off by a reduction in spending by the private sector (Ofori-Abebrese and Pickson, 2018).

On the other hand, if external debt exceeds a certain limit, it would very likely create a negative impact on economic growth as explained in the debt overhang hypothesis. Iyoha (1996) finds an

inverse relationship between external debt and economic growth in sub-Saharan African countries due to the crowding-out effect. In the case of Pakistan, Akram (2011) and Rais and Anwar (2012) have also observed similar findings. Arguing in a similar way, Isu (2010) demonstrates a negative association between external debt and economic growth in Nigeria. Presbitero (2012) observes that developed nations are more efficient in utilization of external debt for economic growth as in comparison to developing nations. Based on a sample of 114 developing countries, the study finds that debt is negatively associated with economic growth when the quantum of debt is very high i.e. more than 90% of the GDP. Kharusi and Ada (2018) examine the relationship between external debt and economic growth in the case of Oman. Employing an autoregressive distributed lag cointegration approach, the study finds a negative impact of external debt on economic growth. The study recommends the productive use of external debt for enhancing the economic growth of the country.

Empirical studies have also identified the non-linear associations between external debt and economic growth. Patillo et al. (2002) and Patillo et al. (2004) observed a non-linear inverted U-shaped relationship between external debt and growth in developing economies. At lower levels, external debt and growth are found to be positively related, while such a relationship is observed to be negative at higher levels. The effect of external debt on economic growth is also found to vary between the short run and long run. While the short-run effect on economic growth is found to be positive, in the long run, a negative impact is observed (Abubakar and Mamman, 2020).

Dey and Tareque (2019) analysed the role of macroeconomic policy in investigating the relationship between external debt and economic growth in the economy of Bangladesh. They considered implanting the role of macroeconomic policy in absorbing the negative effect of external debt. Employing an autoregressive distributed lag (ARDL) bounds testing approach to cointegration, the study finds a negative association between external debt and economic growth. Further, the findings of the study indicate that macroeconomic policy has a positive effect on economic growth, which implies that sound macroeconomic policy leads to higher economic growth. In the Indian context, Bal and Rath (2014) found evidence of a long-term equilibrium relationship between external debt and economic growth for the period 1980 to 2011. Using an ARDL model, they found a negative impact of external debt on economic growth in the long run while in the short run, the impact was observed to be positive. The existing literature on the role of financial development and macroeconomic policies in the determination debt-growth nexus is relatively scarce in the Indian context. Moreover, it is meaningful to analyse the recent changes in the trend of the external debt position of the country as it portrays the debt scenario of the country and its sustainability. Thus, it seems imperative to take up this study to understand the

relationship taking into account the role of macroeconomic policies and further, to determine the long-run and short-run dynamics of the relationship.

3. Variables and Methodology

The study is based on secondary data for a period of thirty years from 1991 to 2020 (annual data). We have obtained the data for economic growth and external debt for the Indian economy from the World Bank database. Gross domestic product, *GDP* is used as the measure of economic growth that represents the size of the economy. On the other hand, we have used the ratio of external debt to GDP as the measure of external debt, *EXD*.

We include a set of control variables in our model that are likely to impact economic growth. We consider particularly the role of macroeconomic policies, financial development, and human capital in influencing economic growth. Following Burnside and Dollar (2000) and Dey and Tareque (2019), we use an index of macroeconomic and fiscal policies relating to trade, monetary and fiscal policies. Trade openness, consumer price index (CPI) and fiscal deficit are used as the proxies for trade, inflation, and fiscal policy respectively. Trade openness is the sum of exports and imports normalized by GDP. Trade openness reflects the extent of trade integration of an economy with the rest of the world, and it is expected to contribute positively towards economic growth. While some studies suggest a positive impact of trade openness on growth such as Frankel and Romer (1999), Dollar and Kraay (2004), Chang et. al. (2009), there are also empirical studies that found contradictory or a negative relationship like Vlastou (2010), Polat et. al. (2015) and so on. The consumer price index captures the level of inflation in an economy and the fiscal deficit represents the government budget. Inflation and budget deficit are both expected to harm growth. Using the method of principal component analysis and following the OECD methodology we compute a composite index, *IMEP* to represent the trade, monetary and fiscal policies. We first adopt a Principal Component Analysis (PCA) analysis to obtain the factor loading. Then, respective weights for each component are calculated employing the OECD (OECD, 2008) methodology. Finally, we construct the composite index IMEP. The data for the fiscal deficit is obtained from various publications of the Handbook of Statistics on the Indian economy, RBI and that for CPI and trade openness are obtained from World Bank.

Financial development, *FD* in this study is proxied by the ratio of private credit to GDP. It is a widely used indicator of financial development that indicates the extent of financial intermediation achieved by financial institutions in an economy. Theory and empirical evidence suggest that financial development promotes economic growth as financial development has multiple advantages for an economy such as better resource allocation, reduced information cost, reduced

cost of corporate governance, and so on (Guru and Yadav, 2019). Finally, the role of human capital is also considered and it is measured by the secondary school enrolment ratio, ER in the absence of a more appropriate measure. Human capital is expected to have a positive effect on economic growth as skilled and educated workforce are likely to be more productive (Ramzan and Ahmad, 2014). The data for financial development and human capital areobtained from World Bank database.

To investigate the relationship between economic growth and external debt in the Indian economy, we use the following model for our study in line with existing empirical studies such as Akram (2013), Dey and Tareque (2109), Abubakar and Mamman (2020).

$GDP_t = \propto + \beta_1 EXD + \beta_2 FD + \beta_3 IMEP + \beta_4 ER + \varepsilon_t$ ----------[1]

Here, $\propto$ is the intercept, β_1 β_2 & β_3 are the coefficients of the explanatory variables *EXD, FD, IMEP* and *ER* respectively and ε_t is the error term.

Principal Component Analysis (PCA): PCA uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of uncorrelated variables called principal components. The transformation in PCA is defined in such a way that the first principal component has the highest variance thereby accounting for most of the variability in the data, and each succeeding component in turn has the next highest possible variance under the constraint that it would be orthogonal to the preceding components. We obtained the Eigen values for each component as the size of an Eigen value indicates the amount of variance in the principal components

The results of a PCA are discussed in terms of component scores, sometimes called factor scores and loadings. To select the number of factors, we adopt two criteria: eigenvalue greater than one and individual contribution of the factor to the explanation of overall variance by more than 10 per cent. We use varimax rotation to maximize the shared variance with the aim of identifying the factor upon which data load.

OECD methodology: After obtaining the factor loadings, we employ OECD methodology for construction of the composite index using the following steps. First, we compute the normalization of factor loadings by dividing the square of factor loading by summation of the square of factor loadings of all the variables. Next, factors are aggregated by assigning a weight to each of them equal to the proportion of the explained variance in the data set. The weight is computed by:

$$\text{weight} = \frac{\text{maximum normalized factor loading}}{\text{ratio of explained to total variance of the respective factor}}$$

Where, the ratio of explained to total variance = $\frac{\text{explained variance of the respective factor}}{\text{total explained variance}}$

Finally, the composite index is estimated by applying the following formula :

Composite index = $\sum_{i=1}^{n}$(weight of each variable × original value of the variable) Where, n is the number of variables.

ARDL co-integration : The study adopts the autoregressive distributed lag (ARDL) approach proposed by Pesaran and Shin (1999) to estimate the short-run and long-run components of the undertaken model, given by equation 1. In using the ARDL model, the lag order of the model is first determined and then the co-integrating relationship is estimated by OLS. ARDL approach to test co-integration can be applied to time series data which has a combination of time series that are integrated of order zero I (0) and integrated of order one I (1). This is an advantage over the conventional co-integration testing that requires the time series to be integrated of the same order. However, none of the variables should be I (2) i.e., integrated of second-order or such data would invalidate the methodology. The ARDL technique is found to be appropriate for small or finite sample sizes (Pesaran et al., 2001) and hence, it is found to be suitable to apply in this study. Further using this ARDL approach, the long-run and the short-run components of the model can be estimated simultaneously. The ARDL specification of the model to be estimated is described by the following equation.

$$\Delta GDP_t = \infty_0 + \sum_{i=1}^{n}\beta_i \Delta EXD_{t-i} + \sum_{i=1}^{n}\delta_i \Delta FD_{t-i} + \sum_{i=1}^{n}\theta_i \Delta IMEP_{t-i} +$$

$$\sum p_1 \Delta ER_{t-i} + \gamma_1 EXD_{t-1} + \gamma_2 FD_{t-1} + \gamma_3 IMEP_{t-1} + \gamma_4 ER_{t-1} + \in_t \quad \text{--------[2]}$$

In this equation, β_i, δ_i, θ_i and ρ_i represents the short-run coefficients of the model, while the parameters γ_1, γ_2, γ_3 and γ_4 describes the long-run relationship. The null hypothesis of no co-integration, $H_0 : \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = 0$ is tested against the alternative hypothesis of the presence of co-integration.

ARDL bound test procedure: The bound testing procedure is based on the F-test of the joint significance of the coefficient of lagged variables. The null hypothesis of no co-integration is tested to determine if there is a long-term association among the variables. Literature mentions two sets of critical values as reported by Pesaran and Pesaran (1997), Pesaran *et al.* (2001). These are the critical value bounds that are compared to the computed value of the F statistic to establish whether the regressors are purely I(1), purely I(0), or mutually cointegrated. If the computed F statistic exceeds the upper critical value, the null hypothesis of no long-run relationship can be rejected. Similarly, if the test statistic falls below the lower critical value, the null hypothesis is not rejected. In either of the cases, the underlying order of integration of the variables (zero or one) is

irrelevant. However, if the test statistic falls between the two critical bounds, the result is indecisive and calls for unit root testing before proceeding with the ARDL technique (Narayan, 2004; Sehrawat and Giri, 2015).

Vector Error Correction Modelling: Vector Error Correction Modelling (VECM) is a special case of the VAR model that provides important information on the short-run relationship between any two cointegrated variables.

Engle and Granger (1987) indicated the imbalances occurring in time series in the short run could be eliminated with an error correction mechanism. The time path of any variable is influenced by the extent of its deviation from the long-run equilibrium level. VECM helps to find evidence on the short-run causality among variables concerned for models that are not stationary in their levels but are in their differences (i.e., I(1)).

We obtain the short-run estimates of our model using the following VECM specification

$$\Delta GDP = \alpha_1 + \sum_{i=1}^{m} \beta_1 \Delta GDP_{t-i} + \sum_{i=1}^{m} \beta_2 \Delta EXD_{t-i} + \sum_{i=1}^{m} \beta_3 \Delta FD_{t-i}$$

$$+ \sum_{i=1}^{m} \beta_3 \Delta IMEP_{t-i} + \sum_{i=1}^{m} \beta_4 \Delta ER_{t-i} + b_1 ect_{t-1} + \varepsilon_t$$

Where, ect is the error correction term, β_1, β_2, β_3, β_4 are the short term coefficients of GDP, FD, IMEP, and ER respectively. The error correction term is the residual from the above estimated co-integration equation. It explains the short-run deviations from the long-run equilibrium. Its lagged value represents the disturbances of the last period that bears impact upon the current period. Hence, if the coefficient of the error correction term is found to be statistically significant, then the system is in a state of short-run disequilibrium. On the other hand, if the coefficient of error correction term is found to be statistically insignificant it would imply that the system under investigation is in the short-run equilibrium.

4. Results and Discussion:

Construction of the index, IMEP: Principal Component analysis (PCA) is run on the original data set of the three variables- trade openness, consumer price index (CPI) and fiscal deficit. The Eigen values in Table 1 below indicate that the first principal component explains about 59 per cent of the standardized variance. Hence, the first principal component is a more relevant measure of the macroeconomic and fiscal policies, as it explains the variations of the dependent variable better than any other linear combination of explanatory variables. The first principal component is used to obtain the factor scores. Subsequently, the OECD methodology is applied to obtain the composite index following the steps explained in the methodology section above.

Table 1: Results of the Principal Components analysis

Principal component	Eigen values	% of variance	Cumulative variance
1	1.761	58.69	58.69
2	0.897	29.91	88.60
3	0.342	11.40	100

Unit Root tests : Table 2 portrays the results of the Augmented Dickey-Fullerand the Phillips Perron unit root tests of all the variables under consideration to know about the stationary conditions of time series variables.

Table 2: Unit Root Test Results (1991-2020)

Variables	ADF				Phillips-Perron			
	With intercept		With trend and intercept		With intercept		With trend and intercept	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
GDP	1.22	-4.64*	-3.22***	-4.36*	1.21	-4.79*	-3.18	-4.43*
EXD	-1.40	-6.98*	-1.49	-8.04*	-1.46	-6.30*	-1.49	-8.04*
IMEP	-3.25**	-5.75*	-3.20	-6.02*	-3.08**	-6.02*	-3.04	-5.88*
FD	-0.27	-1.89	-2.68	-4.07**	-0.43	0.00*	-1.69	-4.32**
ER	-0.42	-5.19*	-2.07	-5.06*	-0.43	-5.17*	-2.30	-5.06*

* indicates significance level at 1%, ** indicates significance level at 5%, *** significance level at 10%.

Source: Author's own calculation

It is observed from the results that the order of integration of the variables is mixed i.e., either I (10) or I (0). While IMEP is stationary at levels, all the other variables are stationary at their first differences. Variables that are non-stationary at levelswereconverted to their first differences and subsequently tested for stationarity in their first differences. The results of both Augmented Dickey-Fuller and the Phillips Perron unit root tests are identical. As none of the series are integrated of order 2 and above, we apply the ARDL bounds test for cointegration.

Bounds test: It is important to determine the optimal lag length before conducting the bounds test as the F statistic is sensitive to the number of lags used in the test. Using the Schwartz

Bayesian criterion (SBC), the optimal lag order is determined for our dataset. In the next step, we have carried out the bounds cointegration test. The results of the bounds test are presented in Table 3.

Table 3: Results of the ARDL Bounds test

Dependent variable	**F-test**	**Decision**
GDP	10.510***	Co-integrated
EXD	4.168**	Co-integrated
ER	4.193**	Co-integrated
FD	4.237**	Co-integrated
IMEP	4.917***	Co-integrated
Critical values	**Lower bound**	**Upper bound**
1 % 5 % 10 %	3.07 2.26 1.9	4.44 3.48 3.01

Source: Author's own calculation

Note: *** indicates significance at 1% level; ** indicates significance at 5% level.

The results in Table 3 indicate that cointegration is established in all the equations as the F statistic is found to exceed the upper bound in all the cases. Hence, a long-term relationship is observed among the variables. However, we want to determine the impact of external debt on economic growth and therefore, proceed to estimate the ARDL model specified in equation 2 above, using ARDL (2,3,1,0,2) specification.

The results of the ARDL estimation presented in Table 4 below reveals that the co-efficient of external debt is significant and negative in explaining the level of economic growth at 1 percent level of significance. This indicates that external debt and economic growth are inversely related, higher external debt does not essentially lead to higher economic growth rather it negatively affects economic growth. The inverse relation could be attributed to factors such as crowding out of private investment and channelizing debt funds to unproductive uses. Empirical studies like Mitra (2006) and Bahal et. al., (2020) have found evidence in support of crowding out of private investments due to public investments in the Indian economy. Quite evidently, increased amount of

external loans is also coupled with higher amount of interest payments. As per Centre for Monitoring Indian Economy, external debt has increased by 1.75 times in last 10 years (since 2007-08), while interest payments have gone up by more than three times. According to latest data reported by World Bank, interest payment constituted almost 19.4 per cent of total expenses in India in 2019. Thus, public expenditure if met out of public borrowing will have a negative impact on economic growth of the country. Among the control variables, we find that enrolment ratio and financial development are both significant while the co-efficient of IMEP turns out insignificant. The co-efficient of both enrolment ratio and financial development are positive which suggest their positive impact on economic growth. As IMEP is insignificant, we can infer that the macroeconomic policies of the country have not been able to absorb the negative impact of external debt on growth. In the lower part of the table, we include the results of the robustness tests. The results confirm that the model is free from autocorrelation and heteroscedasticity. The Jarque-Bera normality test has confirmed that the estimated residuals are normal.

Table 4: Estimated long run Co-efficients(Dependent variable: GDP)

Variable	Co-efficient	t-statistic	Probability
EXD	-0.024***	-3.649	0.002
ER	0.026***	7.053	0.000
FD	0.024***	4.632	0.000
IMEP	-0.318254	-1.054	0.310
Constant	13.98***	79.193	0.000
Robustness indicators			
R^2		0.99	
Adjusted R^2		0.99	
Breusch-Godfrey LM test, χ^2 (2)		2.098[0.165]	
Jarque-Bera Normality test χ^2 (2)		0.076[0.963]	
Heteroskedasticity tests		1.573[0.208]	

Source: Author's own calculation

Note: *** indicates significance at 1% level.

VECM Analysis: The short-run dynamics of the model are studied by using the ECM version of the ARDL model. The results of the ECM analysis are presented in Table 5 below.

Table 5: Estimated short run co-efficients (dependent variable: GDP)

Variable	Coefficient	t-Statistic	Prob.
D(GDP(-1))	0.188	2.243	0.042
D(EXD)	-0.008	-9.251	0.000
D(EXD(-1))	-0.003	-2.281	0.038
D(EXD(-2))	-0.002	-2.883	0.012
D(ER)	0.001	0.874	0.397
D(ER(-1))	-0.002	-4.647	0.001
D(IMEP)	-0.016	-5.481	0.001
ECT(-1)	-0.128	-9.251	0.000

Source: Author's own calculation

Note: *** indicates significance at 1% level; ** indicates significance at 5% level.

In the short run as well we find a significant and negative impact of external debt on economic growth. We have already mentioned above that short-term external debt has grown tremendously in India causing the external debt to grow as well. Short term loans are riskier, creates pressure on the foreign exchange reserves and the situation is made worse with the falling rupee. Short term loans thus have a negative impact on economic growth. Moreover the error correction term that explains the short-run adjustment process is found significant at 5 percent. This further confirms the existence of cointegration or the long-run relationship between external debt and economic growth. The coefficient of the error correction term bears a negative sign indicating that the equilibrium is convergent to the long-run equilibrium path.

Stability Tests: We have generated the CUSUM plots to check the stability of the model as shown in Figure 4-5. Both cumulative sum (CUSUM) andthe cumulative sum of squares (CUSUMSQ) of recursive residuals are observed to be significant at 5 per cent level. The two plot are seen to lie inside the critical bands at 5 per cent level. It indicates the stability of the co-efficients of the estimated ARDL model.

Figure 4:CUSUM plot

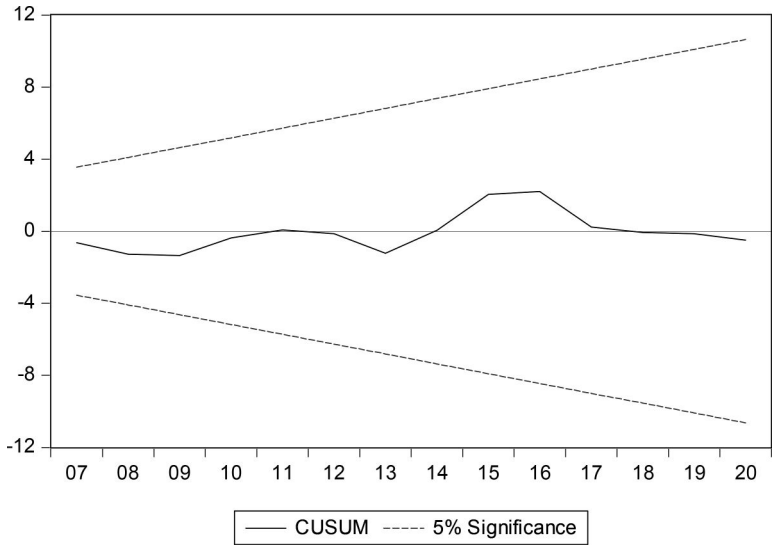
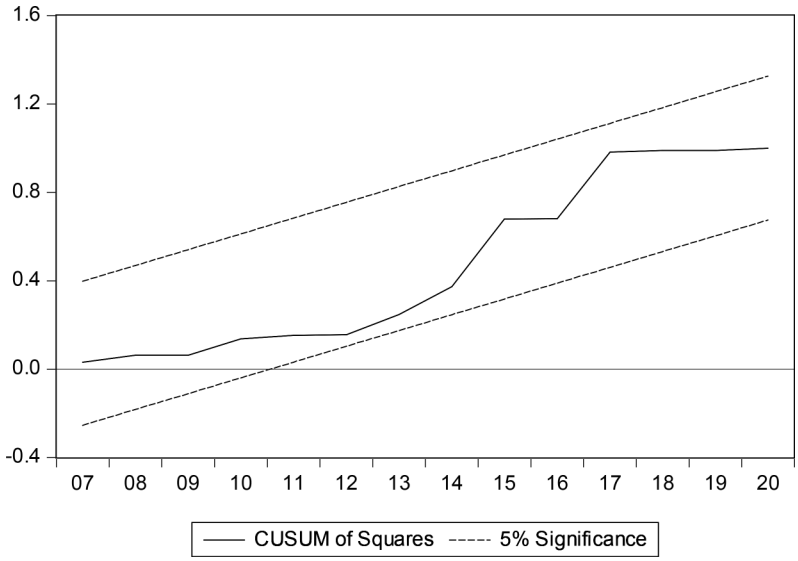


Figure 5: CUSUMSQ plot



5. Conclusion:

The study investigated the nature of the relationship between economic growth and external debt in India from 1991 to 2020. We found that economic growth and external debt in India have a significant long-term relationship. More precisely, we found a negative impact of external debt on

economic growth in both the long run and short run. Our findings are in line with studies like Saxena and Shanker (2018), Kharusi and Ada (2018) and Barik and Sahu (2021) in the context of emerging economy.The findings of the study support the debt overhang hypothesis.India's external debt has undergone a significant compositional shift after the 1990s and it has been coupled with prudent debt management policies in the country. While the share of government debt in the overall external debt has declined, the non-sovereign debt of the country has increased from around 41 percent in 1991 to 81 percent in 2021.

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Human Skills of Migrant Types- A State Level Study from India

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Abstract

In India, people always moved from one place to an other from time immemorial. In the present day, we observe three types of migration- Temporary, Semi-permanent and Permanent. Temporary migration is generally seasonal. People go to other places to augment their earnings in the lean season (Keshri and Bhagat 2010; Sengupta and De 2018). Semi-permanent migration is often based on a quest for a better life. This decision has a probability of a reverted if the end is not very happy. Permanent migration, on the other hand, is often a lifelong decision. People shift their roots to a completely new place for many reasons. We have to be very clear about the aim of our present study. It is not a study of the nature of migration or its causes. It is a study of the type of skills the migrants bring with them. We then suggest policies to attract skilled migrants. In the present study, we emphasize on the human skills of the different types of migrants indexed by literacy rates. We try to understand the level of literacy rates of these three types of migrants using the Census data. In this paper, we are interested in studying the nature of the skill that the migrants carry with them. For this we have censored our data into two parts: migrants who have some human skills and those they do not. Tobit is merely used to study what are the factors that affect the probability of migrant belonging to any of these sets. This probability is different for different category of migrants. So we have used different tobit models in our exercise. For analytical purpose we have considered theTobit regression along with its marginal effects to understand the impact of our chosen parameters on the literacy rate of various migrant types. It is very curious to know whether there are any differences among the different types of migrants in this regard. Our analysis shows that the percentage of literates among the migrants is explained by a number of factors. For Permanent migrants economic factors (such as consumption) are important. For Semi- permanent and Temporary, the Law and Order situation is more vital. This indicates a clear dichotomy among the migrant types.

Keywords : Migration, Literacy, Crime rate, Rural-Urban Divide

JEL : J61, A20, K14, I30

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I. Introduction :

Man, is by nature, a migratory animal (Harari, 2014). Anthropology estimates that Homo sapiens evolved in Africa about one million BC. They migrated to various parts of the world. Even before them, some of the species of Homo category (such as Homo Erectus, etc.) also spread over the world. In the out-of-Africa theory, it is argued that by migration the Homo sapiens spread over the various parts of the world. In some cases they intermingled with other species of the homo spectrum. However the domination of Homo sapiens is so much that genetically there is very little trace left of the non-Homo sapiens brethren.

It is agriculture that fast left to settled life, the rise of cities, towns and villages and stable societies however even after the start of civilization, the migration of man is continued unabated. People migrated in search of food, shelter and a better livelihood. They also migrated when the areas they lived in became inhospitable either due to natural or manmade causes. Anthropology says the migratory nature is a basic nature of the human gene. Settled life is a construction that humans artificially erected on the scope of migration.

The phenomenon of migration is age-old. It shows the trends of social changes. From the historical point of view, during the process of industrialization and technological progress, people migrated from one place to another not only in search of new economic opportunities. Improved communications, better livelihood, transport networks, conflicts over natural resources, and good education have created unprecedented levels of mobility.

Along with fertility and mortality, migration is an important phenomenon of population change. Migration is an indication of social and economic disparities between the place of origin and the place of destination (UNEPA, 1993).According to the Human Development Report 2009, migration is an important livelihood strategy for many people in the world. In the famous paper, Lucas argued that brains and capital flock to the places where their abundance. This is because their return is higher in the conglomerate where their plenty of food.

People shift their roots to a completely new place for many reasons. In the present study, we emphasize the human skills of the different types of migrants indexed by literacy rates.[3] We try to

[3]Basu and Foster (1998) have emphasized the importance of literacy rate in divulging human skills. In this regard he distinguished between proximate and isolated illiterates. The proximate illiterates remain in the family where at least some are literate. The isolated illiterates are not in any company of any literates. In the former case the illiterates gets some advantage of their literate family members to decode the knowledge encompassed in written documents. Hence they are in an advantageous position compared to the isolated illiterates in the process of learning. For details see description of the variables.

understand the level of literacy rates of these three types of migrants using the Census data. It is very curious to know whether there are any differences among the different types of migrants in this context.

An important form of migration is marriage migration. It was Gary Becker (1973, 1974) who first promulgated the logical basis behind marriage. In Becker's word "For example, the gain to a man and woman from marrying compared to remaining single is shown to depend positively on their incomes, human capital, and relative difference in wage rates".

In India, marriage is a long run investment decision of building up fixed social capital. Hence marriage is also motivated by the same economic motives in which a person purchases his/ her livelihood (Becker 1973, 1974). Hence the driving force between marriage migration and labour migration are generally not much divergent to each other. Bhagat and Kesri (2020) in their figure 11.3 have shown that there is almost a coincidence of peak age of migration rate among males and females. This coincides to age group 20-25. They argue that most of the female migrations are caused by marriage while male migration is motivated mostly by the search of livelihood. In a way it demonstrates a close coincidence between these two types of migration.

The main objectives of the study are as follows:

a) To categorize the migrants according to their stay in the place of migration.

b) To understand the distribution of human capital as indexed by literacy rates among the various types of migrants.

c) To ascertain the factors that determine the inflow of literate migrants of various forms.

d) We have considered among the factors crime rate as one of the important deterrents for attracting skilled migrants.

We have to be very clear about the aim of our present study. It is not a study of the nature of migration or its causes. It is the study of the type of skills the migrants bring with them. We then suggest policies to attract skilled migrants. It is perfectly legitimate to use the Tobit model in this case[4].

There are very few papers that try to explain crime rate[5] as an explanatory variables and the differences in the skill acquired by various type of migrants in India. There are rarer still works

[4]Sengupta (2013) have applied logit regression to understand the factors influencing rural urban migration. Again Eshetu and Beshir (2022) used tobit regression to unravel the factors that affect the level of remittances of rural -urban migrants to their families in Southern Ethiopia.

[5]Simpson (2017) has considered crime rate at the migrant's place to be an important push factor in determining the rate of migration. We however consider crime rate at destination to be a deterrent factor.

that considers crime rate to be an explanatory variable. Our paper tries to address both these issues.

The paper is organized as follows. First,we discuss the review of the literature regarding migration in Section-2. In Section-3, we give our basic data structure. In Section 4, we bring about analytics of the literacy of migrant types by using Censored Tobit regression. We have provided the marginal effects to understand the impact of the percentage change in the value of factors. In Section-5 we conclude.

2. Review of Literature:

The problem of migration is complex. Various socio-economic factors play an important role here. We document some of the major writings in this field. Writings on migration may be both theoretical and empirical. The theoretical literature tries to posit migration decisions within the aims and objectives of a rational agent. The empirical literature on the other hand focused on the various perspective of migration decisions. Even in modern India, the issue of migration has remained of paramount importance.

Dolado.et.al (1994) argues that immigrants contribute to human capital accumulation. They estimate a structural model including immigrants' human capital. Their analysis was characterized by low-skilled migration concentrated in the manufacturing sector.

According to Ravi Srivastava and S.K. Sasikumar (2003) migration is influenced by the pattern of development and by the social structure. Uneven development, inter-regional disparity, socio-economic disparity, and the educational policy adopted since Independence are the main causes of seasonal migration in India.

Ram B. Bhagat (2008) explained that migration is affected by the monthly consumer expenditure of the household which shows that the migration rate is higher for higher MPCE and vice-versa.

Reena Badiani and Abla Safir (2008) have studied the conditions of temporary migrations in India and have explained the same as a result of climate shocks. In India, poor rural people migrate temporarily to non-farm work residing permanently in their place of origin even if the income earned from the place of origin is the same as that earned in the place of destination. This may be the result of diversification in the occupational structure or may be to increase the potential income of the household. The paper argued that temporary migration increases as a result of a decrease in rainfall or due to idiosyncratic shocks which forced to migrate for short terms outside the village to work in the informal sectors.

Veena Jha (2008) argued that inter-state migration in India could be an important catalyst in trickling down the benefits of growth from high-growth to low-growth states. According to her, inter-state migration has shown a considerable change in recent decades, showing a more permanent form of migration than a temporary one. Also, she has advised to increase the human skills of migrants so as to increase their opportunities and income over time and at the same time, the health care and education, schooling and training facilities of the migrants require special attention on the part of the government.

Temporary migration was intended to benefit migrants and their families in their homes. Seasonal migration was based on the presence of enhancement of their long-run resources. It sometimes helped them to go out of their low past identities and fetch income that are not especially reserved for them. The point has been stressed by Shashi Tharoor (2017) in his recent writings.

Hunt (2010) provides evidence on the impact of highly skilled migration has raised innovation in the US on innovation. They find that a one-percentage-point increase in the share of immigrant college graduates in the population increases patents per capita by 6%.

Majumder and Naaz (2017) deal with the nature of migration in India in the post-reform period. Here there is a distinction between pull factors and push factors. It is argued that among male, migration is more oriented to taking part in the destination job and not in any search procedure. The pull factor becomes more important in the post-reform period. The better off states have higher net out migration than the poorer states. It is argued that the condition of the source region becomes the major factor in determining the decision to migrants.

Ray, Naaz, Khasnobis and Majumder (2020), argue that there are two separate flows of migration, on the one hand, there are people with high skills who migrate for better remuneration. On the other, there are very poor people who migrate in order to eke out a meaningful livelihood in the severe stress of poverty and unemployment. They used data for three districts of rural West Bengal. They have found a wide divergence in terms of socio-economic achievements between the various types of migrants/natives. These disparities are reflected not only in income but also in the attainment of human skills. In many cases, migration is a successful way out of the poverty state. However there are several stresses in the native perception of the migrant workers. This brings a kind of vulnerability to them.

We have gone through the various papers on migration and its causal linkages. There has been a serious dearth in the literature. In the context of India, we have seen very few findings that try to categorize migrants into various subsets of duration. Treating migrants in a homogeneous

way can be a serious lacuna to a proper understanding of their relations with the various socio-economic factors. Missing also is the human capital acquisition of the migrants and their relationship to a host of important variables. We hope the present paper will be able to address both serious questions in at least a preliminary way. In fact these questions are the main driving forces behind the present exercise.

3. Data and Methodology:

In order to explain the potential skill level of the migrants, they are categorized in three groups, namely, Temporary, Semi-Permanent and Permanent migration. This division of the migrants aims at portraying the distressed condition of the temporary migrants as compared to the semi-permanent and permanent migrants. In this study, migrants whose duration of residence is less than one year (< 1 year) are termed as Temporary migrants, migrants whose duration of residence is between one to four years (1-4years) are called Semi-permanent and those whose duration is five years and more (>=5years) is termed as Permanent migrants. Temporary migration is the temporary movement of people for better economic opportunities (Lucas, 2004).

There is a huge supply of both skilled and unskilled labour forces in the country that comprises temporary and semi-permanent migrants. They move from one place to another for better employment opportunities and a better standard of living which improves their socio-economic condition. In most of the cases, the temporary migrants move out of agricultural work to non-agricultural work since the income earned from the non-agricultural sector is larger than that earned from the agricultural sector (Lewis, 1957).

Much before the period of liberalization, the country is seeing large-scale temporary and semi-permanent movement of people within the country. However the number has much increased due to the increase in the country's population in recent times. In India, temporary migration of people is high in rural regions, while semi-permanent and permanent migration is high in urban regions.

Table-1 summarizes the result for India[6]. A part of the semi-permanent migrants is seasonal migrants. Temporary migration is quite high in an urban areas compared to its rural counterparts in India. The percentage of temporary migrants in rural areas stands at 3.52% and in urban areas,

[6]Table A1 in appendix presents the percentage of temporary, semi-permanent and permanent migrants in all states of India. State and UTs in India are political units only. In many cases UTs later become state such as Arunachal Pradesh, Mizoram and others. In other cases the states become UTs such as Jammu and Kashmir. So it is very difficult for any researcher to sharply distinguish between these two categories. In fact there are many works that deals without distinguishing between these two political units (Waingankar and Thatkar, 2012; Bhagat and Keshri, 2020).

the figure stands at 4.39%. But in some states like Chandigarh, Haryana, Maharashtra, the percentage of temporary migrants in rural regions is comparatively high. These migrants are mostly unskilled and thus prefer to remain within their favorable area. Permanent migration is the highest in both the rural and urban areas. Migrants are coming at the place of destination for job opportunities and ultimately settling therein. Permanent migrants in India are low in absolute terms compared to those migrants of other countries (Reena Badiani and Abla Safir, 2008). However this is surprising since there are many non-agricultural works in India, particularly since 1990.

Table-1: Percentage of Total migrants in India

Area	Temporary	Semi-permanent	Permanent	Migrants Duration not stated
Total	3.86	14.02	66.16	15.96
Rural	3.52	12.56	68.74	15.18
Urban	4.39	16.30	62.13	17.18

Source: Authors calculation from 2011Census data.

According to the 2011 Census, the percentage of temporary migrants was very low compared to the percentage of semi-permanent and permanent migrants in all Indian states and UTs (see Table A1). This is true for all kinds of migrants in both rural and urban areas. Temporary migration is mostly comprised of unskilled and little or no educated labour forces possessing hardly any human capital. That is why they cannot afford to live in any region or place for a longer duration of time. So they prefer to move for better income opportunities. It can be seen that the majority of the poorly developed states of India have a high permanent migration rate with low temporary and semi-permanent migration rates such as Bihar, Jharkhand, Madhya Pradesh, Orissa, etc.

In this paper, we emphasize on the literacy rates of the migrants. Literacy is very important to economic development and individual as well as community well-being. An effective literacy skill opens the door to more employment opportunities so that the people bring out of themselves from poverty. It enables the development of the human mind and thoughts and enhances judging abilities.

The Human Development Report of 2009 has given a broad description of the fact that migrants on the whole benefit from migration. This may be true for many countries but the condition of the temporary migrants of India does not reveal the same. These migrants are categorized by low skills and lack of basic literacy and knowledge. Then it will be difficult for them to earn sufficiently and improve their living standard. Table-2 presents state-wise total literacy rate and the literacy rate of temporary, semi-permanent and permanent migrants in India.

Table 2: State wise Literacy Rate of Different Types of Migrants in India

States	Total Literacy Rate	Literacy Rate of Temporary Migrants	Literacy Rate of Semi-Permanent Migrants	Literacy Rate of Permanent Migrants
Andaman and Nicobar Islands	86.63	75.27	78.18	78.01
Andhra Pradesh	67.02	61.93	66.86	56.57
Arunachal Pradesh	65.39	54.29	64.85	59.44
Assam	72.19	63.13	69.40	60.06
Bihar	61.8	54.02	51.77	36.76
Chandigarh	86.05	71.95	77.19	80.44
Chhattisgarh	70.28	64.29	72.85	50.85
Dadra and Nagar Haveli	76.24	73.83	77.95	70.66
Daman and Diu	87.1	71.00	76.95	45.98
Delhi	86.21	69.29	75.30	77.64
Goa	88.7	64.34	64.51	85.32
Gujarat	78.03	60.24	67.38	67.99
Haryana	75.55	54.67	71.58	58.21
Himachal Pradesh	82.8	71.50	81.43	68.49
Jammu and Kashmir	67.16	46.21	64.22	47.61
Jharkhand	66.41	62.44	63.82	44.26
Karnataka	75.37	63.73	70.49	65.80
Kerala	94	63.43	64.03	91.55
Lakshadweep	91.85	86.05	85.47	91.36
Madhya Pradesh	69.32	53.50	62.57	48.44
Maharashtra	82.34	59.35	68.92	75.72
Manipur	76.9	71.27	73.09	69.41
Meghalaya	74.43	61.95	66.61	69.57
Mizoram	91.33	73.45	80.65	90.99
Nagaland	79.6	75.17	78.79	80.71
Odisha	72.89	66.60	74.35	57.34
Puducherry	85.85	64.85	67.10	81.54
Punjab	75.84	58.35	66.07	65.21
Rajasthan	66.11	52.51	58.02	38.82
Sikkim	81.42	75.43	78.12	70.76
Tamil Nadu	80.09	68.05	71.92	73.95
Tripura	87.22	59.92	86.70	81.68
Uttar Pradesh	67.68	56.56	62.84	40.84
Uttaranchal	78.82	68.45	77.64	62.98
West Bengal	76.26	61.78	70.10	66.28
ALL INDIA	72.99	60.56	67.08	59.26

Source: Authors calculation from 2011Census data

The total literacy rate of all the Indian states is higher than the literacy rate of the migrants of those states. This indicates that the migrants in India have poor educational status than the overall educational status of the countrymen. Literacy rate of all the categories of migrants is low in rural India. This implies that the up-gradation of rural India and its people has to the prior objective of the Indian government since a big chunk of the GDP comes from that part.

Table 3: Literacy Rate According to Migrant Types in India

Area	Literacy Rate of Temporary Migrants	Literacy Rate of Semi-Permanent Migrants	Literacy Rate of Permanent Migrants
Total	60.56	67.08	59.26
Rural	53.89	61.06	47.52
Urban	68.92	74.33	79.60

Source: Authors calculation from 2011Census data

In table-3 we consider the rural-urban divide between various types of migrants. It is seen that, on the whole literacy rate of urban migrants is higher than that of the rural migrants. This is true for all the categories of migrants. The comparison between temporary and permanent migrants brings some important issues. If we do not consider the UTs and smaller states then a clear picture evolves. In the so called underdeveloped region (such as Bihar, Jharkhand, Uttar Pradesh, Orissa and others) the quality of permanent migrants is below that of the temporary migrants (see Table A2). In these states opportunity of skillful migrants is very low. So, highly skilled migrants never prefer these destinations for permanent residence. Temporary migrants may venture here in the hope of some earnings.

In the developed regions of the country (Gujarat, Maharashtra, Punjab others), highly skilled migrants opt for a permanent destination. In these areas, permanent migrants have a high level of literacy than temporary migrants. The difference between temporary and permanent migrants becomes quite clear with the simple tabular analysis. We now go for a more analytical review of this issue in the next section.

For the analytical purpose, we use the Tobit regression. Since our dependent variable is a censored one. Now we discuss the basic structure of the Tobit model[7].

[7]The exposition of the Tobit model closely follows from standard text books in econometrics (Wooldridge, 2002).

The Model

The Tobit model is a statistical model proposed by James Tobin (1958) to describe the relationship between a non-negative dependent variable y_i and an independent variable (or vector) x_i. The word To bit is taken from Tobin and adding "it" to it. The Tobit model can be described interms of a latent variable y*.

The structural equation in the Tobit model is:

$$y_i^* = \beta X_i + \varepsilon_i$$

Where $\varepsilon_i \sim N(0, \sigma^2)$. y* is a latent variable that is observed for values greater than truncation point τ and censored otherwise[8]. When the distribution is censored on the left, observations with values at or below τ are set to τ_y. The observed y is defined by the following measurement equation

$$y_i = \begin{cases} y_i^* \text{ if } y_i^* > \tau \\ \tau_y \text{ if } y_i^* \leq \tau \end{cases}$$

In the typical tobit model, we assume that $\tau = 0$ i.e. the data are censored at 0. Suppose, however that y_i^* is observed if $y_i^* > 0$ and is not observed if $y_i^* \leq 0$. Thus, we have

$$y_i = \begin{cases} y_i^* \text{ if } y_i^* > 0 \\ 0 \quad \text{if } y_i^* \leq 0 \end{cases}$$

Estimation

The use of τ and τ_y are just a generalization of having τ and τ_y set at 0. If a continuous variable y has a probability density function f (y) and τ is a constant, then we have

$$f(y) = [f(y^*)]^{d_i} \; [F(\tau)]^{1-d_i}$$

In other words, the density of y is the same as that for y* for $y > \tau$ and is equal to the probability of observing $y^* < \tau$ if $y = \tau$. *d* is an indicator variable that equals 1 if $y > \tau$ i.e. the observation is uncensored and is equal to 0 if $y = \tau$ i.e. the observation is censored. We know that

$$P(\text{censored}) = P\left(y^* \leq \tau\right) = \Phi\left(\frac{\tau - \mu}{\sigma}\right) = 1 - \Phi\left(\frac{\mu - \tau}{\sigma}\right)$$

[8]The tobit model can be generalized to take account of censoring both from below and/or from above. It can also take account of interval censored data.

$$\text{P (uncensored)} = 1 - \Phi\left(\frac{\tau - \mu}{\sigma}\right) = \Phi\left(\frac{\mu - \tau}{\sigma}\right)$$

Thus, the likelihood function can be written as

$$L = \prod_{i}^{N}\left[\frac{1}{\sigma}\Phi\left(\frac{y - \mu}{\sigma}\right)\right]^{d_i}\left[1 - \Phi\left(\frac{\mu - \tau}{\sigma}\right)\right]^{1-d_i}$$

In the traditional tobit model, we set $\tau = 0$ and parameterize μ as $X_i\beta$. This gives us the likelihood function for the tobit model:

$$L = \prod_{i}^{N}\left[\frac{1}{\sigma}\Phi\left(\frac{y_i - \beta X_i}{\sigma}\right)\right]^{d_i}\left[1 - \Phi\left(\frac{\beta X_i}{\sigma}\right)\right]^{1-d_i}$$

As Sigelman and Zeng (1999) point out, there are three expected values that we might be interested in. To simplify things, we'll keep looking at the case where censoring is at zero i.e. $\tau = 0$.

Expected value of the latent variable *y:**

$$E\,[y^*] = \beta X_i$$

Expected value of y | y > 0:

$$E\,[y \mid y > 0] = \beta X_i + \sigma\lambda(\alpha)$$

where, $\lambda(\alpha) = \dfrac{\Phi\left(\frac{\beta X_i}{\sigma}\right)}{\Phi\left(\frac{\beta X_i}{\sigma}\right)}$ is the inverse Mills ratio.

Expected value of y :

$$E\,[y] = \Phi\left(\frac{\beta X_i}{\sigma}\right)[\beta Xi + \sigma\lambda(\alpha)]$$

where, $\lambda(\alpha) = \dfrac{\Phi\left(\frac{\beta X_i}{\sigma}\right)}{\Phi\left(\frac{\beta X_i}{\sigma}\right)}$ is again the inverse Mills ratio.

Marginal Effects for Tobit Model

Just as there are three expected values, there are three possible marginal effects.

1. Marginal effect on the latent dependent variable, *y**

$$\frac{\partial E[y^*]}{\partial x_k} = \beta_k$$

Thus, the reported Tobit coefficients indicate how a one unit change in an independent variable x_k alters the latent dependent variable.

2. Marginal effect on the expected value for y for uncensored observations:

$$\frac{\partial E[y \mid y > 0]}{\partial x_k} = \beta_k \left\{ 1 - \lambda(\alpha) \left[\frac{\beta x_i}{\sigma} + \lambda(\alpha) \right] \right\}$$

where, $\lambda(\alpha) = \dfrac{\Phi\left(\dfrac{\beta X_i}{\sigma}\right)}{\Phi\left(\dfrac{\beta X_i}{\sigma}\right)}$. This indicates how one unit change in an independent variable x_k affects uncensored observations.

3. Marginal effect on the expected value for y (censored and uncensored):

$$\frac{\partial E[y]}{\partial x_k} = \Phi\left(\frac{\beta X_i}{\sigma}\right) \beta_k$$

$\Phi\left(\dfrac{\beta X_i}{\sigma}\right)$ is simply the estimated probability of observing an uncensored observation at these values of X. As this scale factor moves closer to one - fewer censored observations - then the adjustment factor becomes unimportant and the coefficient β_k gives us the marginal effect at these particular values of X. Though not a formal result, this marginal effect suggests a reason why, in general, OLS estimates of the coefficients in a Tobit model usually resemble the ML estimates multiplied by the proportion of uncensored observations in the sample.

Depending on the purpose the appropriate marginal effect has been used. Wooldridge (2002) recommends reporting both the marginal effects on E [y] and E [y | y > 0]. We have provided only the conditional marginal effect as it is more appropriate for censored regression.

4. Results and Discussion:

4.1 Description of the Variables Used

In the previous section, we have discussed the various type of categorization of migrants and their acquired literacy. Literacy is indeed a minimum standard norm for human skill acquisition. Still, its implication as an indicator can never be underestimated. The point was discussed very elegantly by Basu and Foster (1998). They considered two families- one family with no one literate and the other with at least one person literate. The human development implication for these two scenarios is very vast. In the first family, there is no way to decode any information given in the written words such as the instruction of using fertilizer, government notifications and so on. Hence they will fail to reap any benefit that may arise from this. For example, there may be misuse or underuse of fertilizer. Alternatively, the benefits of any government scheme may not be availed.

For the second family, the situation is completely different. In this family, there are persons who can decode such information. Hence persons who are not literate will also gain from this literacy. Thus the illiterates in this family are called proximate illiterates. They are differentiated from illiterates of the first family who are regarded as isolated illiterates. Isolated illiterates are doomed in darkness. Proximate illiterates are not. They get some benefits from being close to the literate.

This effect of literacy infuses its importance as a determinant factor in many ways. In the present analysis, we thus put much emphasis on the literacy levels of incoming migrants. Migrants are of various types: Temporary, Semi-permanent and Permanent. We peep into the literacy status of each type of migrant.

The present study uses a censored regression to analyze the impact of our chosen parameters on the literacy rate of various migrant types. We use the Tobit model separately for the three categories of literacy rate of the migrants. Tobit's model was introduced by Tobin. It involves a censored regression model in the econometric literature. In this analysis, the level of literacy rates of temporary, semi-permanent and permanent migrants are used as the dependent variable, while the independent variables consist of monthly per capita income, crime rate, percentage of workers and a locational parameter.

In order to explain the variation of the literacy rates of the migrants we use the set of variables that are deemed to be most important from a socio-economic perspective. The first factor is the monthly per capita expenditure. This data has been culled from NSSO 67th round data (2010-11) that seems to be more appropriate to the census data. MPCE is often regarded as an indicator of the economic opulence of a particular region. The higher the indicator better should be the economic condition of that place.

The next variable is the cognizable crime rate. This has been collected from Crime Bureau Reports for the relevant years. At the international level, it sometimes gets a rule of law index. Since such indices are not found at the state level, they proxy it by the cognizable crime rate. In fact there is a negative relation between the rule of law of a region and its crime rates. A high crime rate should deter a proximate migrant from choosing the place at its destination.

Another variable gives the percentage of workers. The data is collected from Census itself. If this percentage is high, it is conjectured that there will be little possibility of getting a job in that place. Or there may be stiff competition in the labour market. This should act as a deterrent towards any decision of migration.This is particularly true in India where a majority of jobs come from the informal sector. Census 2011 data also supports this conjecture of the structure of employment. It indicates that 53.62% of workers are in agricultural labour, cultivator and household work and only 13.76% are in the non-household categories that include skilled labour[9].

India is a heterogeneous country. There is almost a longitudinal difference between rural and urban India- Bharat versus India (Bardhan, 1984, 1985)[10]. So we divide it into urban India and rural India and we use a locational dummy. So we have used a rural dummy to attach this divide in our analysis.

Lastly, we consider the location of literate migrants. Here by location, we mean either rural or urban. The Census Bureau's urban-rural classification is a delineation of geographic areas, identifying both individual urban areas and the rural areas of the nation. The Census Bureau's urban areas represent the densely developed territory and encompass residential, commercial, and other non-residential urban land uses. The Census Bureau delineates urban areas after each decennial census by applying specified criteria to the decennial census and other data. "Rural" encompasses all population, housing, and territory not included within an urban area.Table-4 shows the summary statistics of literacy rates of three types of migrants (LRT, LRSP & LRP)[11] and average MPCE, cognizable crime rate, percentage of workers and a locational dummy of all states in India. Summary statistics give an overview of the data we are working with.

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[9]In an important work Simpson (2017) has found out that the low rate of unemployment at the destination attracts more in migration.

[10]Bardhan (1984, 1985) discusses the differences in forces that make up the rural and urban India. In urban areas the industrial and business entrepreneurs often play a major role. In rural areas the big land lords and rich farmers dominates. This difference in domination brings about a strong asymmetry in the working of political economy in the rural and urban areas.

[11]LRT =Literacy Rate of Temporary migrant, LRSP=Literacy Rate of Semi-Permanent migrant, LRP=Literacy Rate of Permanent migrant.

Table 4: Summary Statistics of the Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
LRT (Literacy Rate of Temporary Migrants)	70	65.45	10.06	39.29	86.53
LRSP(Literacy Rate of Semi-Permanent migrant)	70	71.53	9.15	47.95	88.57
LRP(Literacy Rate of Permanent Migrants)	70	69.90	17.55	27.86	96.35
Average MPCE	70	2213.2	750.65	1003	4642
Cognizable crime rate	70	0.74	2.78	0.03	19.12
Percentage of workers	70	47.96	21.60	0	98.6
Rural dummy	70	0.5	0.50	0	1

Source: Authors calculation from 2011Census data.

Table-4.1 shows the summary statistics of all dependent and independent variables used in Tobit regression analysis.

Table 4.1: Summary Statistics of the Dependent and Independent Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Log LRT	70	4.17	0.16	3.67	4.46
Log LRSP	70	4.26	0.13	3.87	4.48
Log LRP	70	4.21	0.3	3.33	4.57
Log Average MPCE	70	7.64	0.35	6.91	8.44
Log Cognizable crime rate	70	-1.43	1.01	-3.37	2.95
Log Percentage of workers	70	3.63	0.97	-0.11	4.59
Rural dummy	70	0.5	0.5	0	1

Source: Authors calculation from 2011Census data.

4.2 Analytical Results and Discussion

Now we delve into the results of the Tobit analysis. We have done three Tobit regressions- each with the literacy of various types of migrants.

We begin with the Tobit regression between the literacy rate of temporary migrants and other

variables considered in our study. First, we take the relationship between the literacy rate of temporary migrants and their various covariates. We see that there is no relation between per capita consumption with the possibility of temporary migrants being literate. This means that income is not always a major driving force to lure literate temporary migrants. This is quite logical. Most of the temporary migrants come as unskilled workers who have no or little education level.

Table 5: Results of the Tobit regression analysis for Temporary Migrants

Tobit regression — Number of obs = 70; LR chi2(4) = 43.90; Prob > chi2 = 0.0000; Log likelihood = 47.150696; Pseudo R2 = -0.8710

llrt	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lmpcea	.0797987	.0572654	1.39	0.168	-.0345353	.1941328
lcogcrim	-.0407693	.0186168	-2.19	0.032	-.0779388	-.0035997
lperofworker	-.0562323	.0188719	-2.98	0.004	-.0939112	-.0185534
dummy_r	-.1690998	.0445138	-3.80	0.000	-.2579745	-.0802251
_cons	3.789162	.4804261	7.89	0.000	2.82996	4.748364
/sigma	.1190486	.0101924			.0986988	.1393983

Source: Authors calculation from 2011Census data.

Llrt = log (literacy rate of temporary migrant), lmpcea = log (Average MPCE), lcogcrim = log (cognizable crime rate), lperofworker = log (percentage of worker), dummy r = rural dummy.

On the other hand, the law and order situation is an important determinant of the incoming literate temporary migrants. This is evidenced by the strong negative effect of the crime rate on literate temporary migrants. Where situations are hostile literate people may not opt for temporary migration. Similarly, if there is a high proportion of the working population, it acts as a break in the flow of literate migrants. Fewer people come from rural areas in the form of literate temporary migrants. As argued by Banerjee and Duflo (2019), people migrate only when the condition is really inhospitable for them. Contrary to the standard arguments migration is not only a simple benefit gain calculation even if it is temporary.

Table 6: Results of the Marginal effects for Temporary Migrants

```
Conditional marginal effects                      Number of obs    =         70
Model VCE     : OIM

Expression    : E(llrt|llrt>0), predict(e(0,.))
dy/dx w.r.t. : lmpcea lcogcrim lperofworker dummy_r
at            : lmpcea          =     7.642937 (mean)
                lcogcrim        =    -1.425443 (mean)
                lperofworker    =      3.63284 (mean)
                dummy_r         =           .5 (mean)
```

	Delta-method dy/dx	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lmpcea	.0797987	.0572654	1.39	0.163	-.0324394	.1920368
lcogcrim	-.0407693	.0186168	-2.19	0.029	-.0772575	-.0042811
lperofworker	-.0562323	.0188719	-2.98	0.003	-.0932204	-.0192441
dummy_r	-.1690998	.0445138	-3.80	0.000	-.2563453	-.0818543

Source: Authors calculation from 2011Census data.

The quantitative result of the relationship is given by the marginal effect (Table-6). We find that a one percent change in cognizable crime reduces the possibility of skilled temporary migrants by 4.1%. Similarly, there is a reduction of the possibility of skilled migrants by 5.6% if there is a one percent rise in the percentage of the working population. This implies that there is some effect of the change in these variables on the possibility of literate temporary migrants. The effect is most of the locational dummy (16%). The effect of change in MPCE is statistically insignificant. In all the marginal effects merely quantifies what we see qualitatively.

Now we come to the analysis of the literacy of Semi-permanent migrants. Semi-permanent migrants stand on two islands at the same time. From one perspective, he has not yet fully decided whether to stay there permanently. On the other, they have more or less resolved a migration decision. It is not clear which characteristics will dominate them. The analysis of the data may show light on this regard. We provide the result of our analysis in the table and its marginal effects in table-8.

Now we take the relationship between the literacy rate of Semi-permanent migrants and their various covariates. Per capita consumption is not all related to the possibility of Semi-permanent migrants being literate. Semi-permanent migrants do not give much importance to economic factors.

But the law and order situation is an important determinant of the incoming of literate Semi-permanent migrants. This is clear by the strong negative effect of the crime rate on the literacy of Semi-permanent migrants. Where situations are hostile literate people may not opt for Semi-permanent migration. Similarly, if there is a high proportion of the working population, it acts as a break in the flow of literate migrants. Less people come from rural areas in the form of literate Semi-permanent migrants.

Thus we observed that in our data the temporary feature of the skilled Semi-permanent migrants becomes omnipotent.[12] They are in a more indecisive state than the Permanent migrants. They fall more on the toe of the Temporary migrants. For them the same factor that will be important for the literate Temporary migrant becomes important.

Table 7: Results of the Tobit regression analysis for Semi-permanent Migrants

Tobit regression — Number of obs = 70; LR chi2(4) = 39.20; Prob > chi2 = 0.0000; Log likelihood = 58.333071; Pseudo R2 = -0.5061

llrsp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lmpcea	.0549658	.0488617	1.12	0.265	-.0425898	.1525214
lcogcrim	-.0385685	.015873	-2.43	0.018	-.0702599	-.0068771
lperofworker	-.0456123	.016094	-2.83	0.006	-.077745	-.0134795
dummy_r	-.1321035	.0379437	-3.48	0.001	-.2078606	-.0563463
_cons	4.017792	.4098504	9.80	0.000	3.1995	4.836085
/sigma	.1015082	.0086861			.0841658	.1188505

Source: Authors calculation from 2011Census data.

Llrsp = log (literacy rate of semi-permanent migrant), lmpcea = log (Average MPCE), lcogcrim = log (cognizable crime rate), lperofworker = log (percentage of worker), dummy r = rural dummy.

The marginal effect quantifies the relationship (Table-8). We find that a one percent change in cognizable crime reduces the possibility of skilled Semi-permanentmigrants by 3.9%. There is a reduction of the possibility of skilled migrants by 4.6% if there is a one percent rise in the percentage of the working population. This implies that there is some effect of the change in these

[12]This is evident from our analysis on literate Permanent migrants done later on.

variables on the possibility of literate Semi-permanent migrants. The effect is most of the locational dummy (13%). The effect of change in MPCE is statistically insignificant. In all the marginal effects merely quantifies what we see qualitatively.

Table 8: Results of the Marginal effects for Semi-permanent Migrants

```
Conditional marginal effects                      Number of obs   =         70
Model VCE     : OIM

Expression    : E(llrsp|llrsp>0), predict(e(0,.))
dy/dx w.r.t.  : lmpcea lcogcrim lperofworker dummy_r
at            : lmpcea          =     7.642937 (mean)
                lcogcrim        =    -1.425443 (mean)
                lperofworker    =      3.63284 (mean)
                dummy_r         =           .5 (mean)

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lmpcea |   .0549658   .0488617     1.12   0.261    -.0408015     .150733
    lcogcrim |  -.0385685    .015873    -2.43   0.015     -.069679   -.0074581
lperofworker |  -.0456123    .016094    -2.83   0.005     -.077156   -.0140686
     dummy_r |  -.1321035   .0379437    -3.48   0.000    -.2064718   -.0577351
------------------------------------------------------------------------------
```

Source: Authors calculation from 2011Census data.

For the Permanent workers, we have a new world vista. It is seen that economic motives now become very strong as a driver of literate migrants. This is obvious that seems the decision to Permanent migration is based on a vision of enriched life that has a strong bearing on the consumption expenditure ensured. Hence the relation is positive. For permanent literate migrants, however, the law and order situation is not very vital. He/ She has coped up with the ongoing situation. As Prof. Amartya Sen (2000) argued man has to find out some meaning in the environment, in which he/ she lives. Thus a housewife has to find some solace even when her in-laws are very antagonistic to her freedom and life activities. Similarly, a citizen leaving under a cruel authoritative dictatorship finds out some meaning even in such deplorable conditions. A firm servant has to find some juice in his unending bondedness.

Table 9: Results of the Tobit regression analysis for Permanent Migrants

```
Tobit regression                                  Number of obs     =         70
                                                  LR chi2(4)        =      65.22
                                                  Prob > chi2       =     0.0000
Log likelihood =  14.900699                       Pseudo R2         =     1.8414

------------------------------------------------------------------------------
        llrp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lmpcea |   .4447264   .0914474     4.86   0.000     .2621457    .6273072
    lcogcrim |  -.0291455   .0297325    -0.98   0.331    -.0885083    .0302173
lperofworker |   -.066555    .030151    -2.21   0.031    -.1267534   -.0063566
     dummy_r |  -.2065496   .0710813    -2.91   0.005    -.3484681   -.0646311
       _cons |   1.111037   .7671997     1.45   0.152    -.4207264    2.642801
-------------+----------------------------------------------------------------
      /sigma |   .1901133   .0162747                      .1576198    .2226068
------------------------------------------------------------------------------
```

Source: Authors calculation from 2011Census data.

Llrp = log (literacy rate of permanent migrants), lmpcea = log (Average MPCE), lcogcrim = log (cognizable crime rate), lperofworker = log (percentage of worker), dummy r = rural dummy.

Other factors as they behave in the other regressions. They are positively related with the proportion of workers and with the possibility of the coming from the rural areas.

Table 10: Results of the Marginal effects for Permanent Migrants

```
Conditional marginal effects                      Number of obs     =         70
Model VCE    : OIM

Expression   : E(llrp|llrp>0), predict(e(0,.))
dy/dx w.r.t. : lmpcea lcogcrim lperofworker dummy_r
at           : lmpcea          =     7.642937 (mean)
               lcogcrim        =    -1.425443 (mean)
               lperofworker    =      3.63284 (mean)
               dummy_r         =           .5 (mean)

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lmpcea |   .4447264   .0914474     4.86   0.000     .2654928    .6239601
    lcogcrim |  -.0291455   .0297325    -0.98   0.327    -.0874201    .0291291
lperofworker |   -.066555    .030151    -2.21   0.027    -.1256498   -.0074601
     dummy_r |  -.2065496   .0710813    -2.91   0.004    -.3458665   -.0672327
------------------------------------------------------------------------------
```

Source: Authors calculation from 2011Census data.

The marginal effect quantifies the relationship (Table-10). We find that a one percent change in MPC Eincreases the possibility of skilled semi-permanent migrants by 44%. This is a sizable effect. There is a reduction of the possibility of skilled migrants by 6.7% if there is a one percent rise in the percentage of the working population. This implies that there is some effect of the change in these variables on the possibility of literate Permanent migrants. The effect is most of the locational dummy (21%). The effect of change in the crime rate is statistically insignificant. In all the marginal effects merely quantifies what we see qualitatively.

4.3 Some policy considerations:

This paper is not oriented toward a rigorous analysis of any detailed policy prescriptions. Such an exercise would require a detailed meta-analysis along with the Monte Carlo sensitivity studies. We merely posit some very general observations based on our Tobit analysis.

Our study clearly indicates that there is a negative relationship between a higher percentage of employment and literate migrants. This may indicate that there appears to be less availability of skilled jobs in the employment market. Naturally, when such jobs are in vogue marginalizing the skill jobs, highly skilled migrants will be deterred by it. In order to mitigate the situation, the government must take a policy to open up opportunities for job-oriented skill formation. Such policies would improve both the quality of employment as well as the output.

Maintaining law and order conditions is a crucial way of attracting highly skilled migrants. History has shown how a deteriorating law and order condition has led to a fall of skilled migration. Often even indigenous skilled people are deterring out of place if law and order deteriorated. We have the famous example of "Hitler's gift" where a large number of skilled people moved out of Germany to many countries and especially America. This has led to a blooming of the US economy enabling it to become a world leader.

As argued by Ray, Naaz, Khasnobis and Majumder (2020), there are two poles of migration. On the one hand, there are richly endowed people who migrate for a better living. On the other, there is the poor who are forced by the situation to migrate mostly as a survival strategy. In our analysis, this is reflected in the positivity of the rural dummy. These rural folks move mainly to get a better deal when local conditions are very inhospitable. Another policy prescription is thus to create more jobs in the rural area to prevent out migration.

5. Conclusion:

Migration is an important issue in any discourse of developing economies. In the current years, it has raised many questions that have political and social implications (Banerjee and Duflo, 2019).

The main issues seem around the impact that migration has on the destination economy. On the one hand, it is stressed that migrants bring in numerous ideas and skills that foster development. The USA is a classic example of this. USA has benefited immensely from the skills and technical acumen that the migrants broad into the heart of other countries such as the UK also gain from the human capital that the migrants have bought. However, it is alleged that migrants are displacing domestic workers from the labour market. A lot of tensions has been created in many countries on this issue.

According to Banerjee and Duflo (2019), it is the quality of incoming migrants that determines the strength of these two opposite factors. If more skilled migrants come lure of income opportunities then income generation will definitely rise. On the other hand the flow of low-skilled or semi-skilled migrants may create pressure in the local labour market digressing wage and income opportunities.

In the present paper, we thus try to understand the nature of migrants as indexed by literacy rate. We divided them into three categories- Temporary, Semi-permanent and Permanent. It is seen that the flow of skilled Temporary and Semi-permanent migrants are determined not so by immediate economic consideration such as income but by the Law and Order condition of the destination. If Law and Order condition is bad such type of skilled migrant hesitates to migrate. Even if economic conditions are lucrative. For skilled Permanent migrants, however, Law and Order make a little issue as they have coped with the situation. For them, more important is the economic perspective. Seems they have little chance to revert back their decisions. Other factors have the same for both. If there is more percentage of the working population, there is little scope for further employment. The flow of migrants is thinner. More skilled migrants come from the urban area than the rural area for all types of migrants.

In essence, the message of the short essay is very simple. If a region has to draw more skilled migrants, the Law and Order situation have to be increasing. Only this can attract more skillful migrants resulting in the influx of more human capability and hence growth and development.

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Appendix

Table A1: State wise Distribution of Migrant Types

states	Total /Rural /Urban	Temporary Migrants	Semi-permanent Migrants	Permanent Migrants	Migrants Duration not stated	Row Sum
Andaman & Nicobar Islands	**Total**	8.43	20.96	64.76	5.85	100
	Rural	8.49	19.74	66.79	4.98	100
	Urban	8.33	23.14	61.13	7.40	100
Andhra Pradesh	**Total**	3.30	13.47	55.51	27.72	100
	Rural	3.12	12.39	59.26	25.23	100
	Urban	3.55	15.02	50.13	31.30	100
Arunachal Pradesh	**Total**	5.29	19.49	55.00	20.21	100
	Rural	5.64	17.53	53.13	23.70	100
	Urban	4.65	23.06	58.39	13.89	100
Assam	**Total**	2.76	12.06	61.69	23.49	100
	Rural	2.64	11.76	61.58	24.01	100
	Urban	3.18	13.24	62.10	21.47	100
Bihar	**Total**	1.88	10.98	72.44	14.70	100
	Rural	1.72	10.78	73.74	13.76	100
	Urban	2.83	12.19	64.79	20.19	100
Chandigarh	**Total**	4.91	17.74	70.49	6.86	100
	Rural	10.26	27.04	59.34	3.36	100
	Urban	4.75	17.46	70.82	6.97	100
Chhattisgarh	**Total**	4.19	15.34	75.28	5.18	100
	Rural	3.97	14.09	77.60	4.35	100
	Urban	4.67	18.00	70.39	6.94	100
Dadra and Nagar Haveli	**Total**	13.13	32.10	44.70	10.07	100
	Rural	14.84	27.74	44.90	12.52	100
	Urban	12.27	34.28	44.60	8.85	100
Daman and Diu	**Total**	15.27	36.03	43.94	4.76	100
	Rural	8.76	23.91	59.76	7.57	100
	Urban	16.39	38.12	41.21	4.28	100
Delhi	**Total**	3.93	15.51	74.40	6.15	100
	Rural	4.91	19.82	69.43	5.83	100
	Urban	3.91	15.41	74.52	6.16	100
Goa	**Total**	6.87	16.34	63.35	13.43	100
	Rural	6.22	14.30	64.92	14.56	100
	Urban	7.28	17.61	62.39	12.73	100
Gujarat	**Total**	4.66	16.17	67.68	11.49	100
	Rural	4.80	14.11	71.47	9.62	100
	Urban	4.52	18.13	64.08	13.26	100

Haryana	**Total**	4.91	14.94	69.58	10.56	100
	Rural	5.29	12.71	74.25	7.75	100
	Urban	4.51	17.35	64.55	13.59	100
Himachal Pradesh	**Total**	5.25	15.84	72.21	6.70	100
	Rural	4.95	14.36	73.91	6.78	100
	Urban	6.84	23.68	63.20	6.27	100
Jammu and Kashmir	**Total**	5.03	12.56	61.90	20.51	100
	Rural	5.39	11.91	65.44	17.26	100
	Urban	4.37	13.76	55.32	26.55	100
Jharkhand	**Total**	2.65	13.94	76.23	7.17	100
	Rural	2.30	13.20	78.20	6.30	100
	Urban	3.38	15.51	72.12	8.99	100
Karnataka	**Total**	4.62	16.12	58.49	20.77	100
	Rural	4.23	14.00	62.93	18.84	100
	Urban	5.11	18.85	52.79	23.24	100
Kerala	**Total**	4.68	15.06	64.05	16.21	100
	Rural	4.28	14.21	66.09	15.42	100
	Urban	5.17	16.10	61.56	17.17	100
Lakshadweep	**Total**	26.22	35.53	27.07	11.19	100
	Rural	23.65	39.55	30.28	6.51	100
	Urban	26.89	34.47	26.22	12.42	100
Madhya Pradesh	**Total**	3.87	14.41	72.58	9.15	100
	Rural	3.66	13.59	74.94	7.81	100
	Urban	4.28	15.99	67.97	11.76	100
Maharashtra	**Total**	5.32	16.23	65.46	12.99	100
	Rural	5.45	14.24	65.79	14.52	100
	Urban	5.20	18.32	65.10	11.38	100
Manipur	**Total**	3.15	12.75	55.67	28.44	100
	Rural	3.17	12.57	54.61	29.65	100
	Urban	3.11	13.07	57.56	26.26	100
Meghalaya	**Total**	3.80	12.96	47.49	35.75	100
	Rural	3.30	11.08	44.28	41.34	100
	Urban	5.08	17.84	55.81	21.26	100
Mizoram	**Total**	4.49	16.85	61.34	17.32	100
	Rural	5.79	16.39	58.08	19.74	100
	Urban	3.79	17.09	63.09	16.03	100
Nagaland	**Total**	8.09	21.28	57.66	12.97	100
	Rural	10.00	22.54	51.48	15.98	100
	Urban	6.17	20.01	63.85	9.96	100
Odisha	**Total**	3.47	13.49	64.49	18.55	100
	Rural	3.10	12.27	65.44	19.19	100
	Urban	4.74	17.70	61.22	16.35	100

Odisha	**Total**	3.47	13.49	64.49	18.55	100
	Rural	3.10	12.27	65.44	19.19	100
	Urban	4.74	17.70	61.22	16.35	100
Puducherry	**Total**	4.80	17.26	66.03	11.91	100
	Rural	4.16	15.84	65.37	14.62	100
	Urban	5.11	17.95	66.36	10.58	100
Punjab	**Total**	3.85	11.67	63.26	21.22	100
	Rural	3.78	10.35	65.27	20.59	100
	Urban	3.93	13.44	60.56	22.07	100
Rajasthan	**Total**	4.39	14.49	73.44	7.68	100
	Rural	4.44	13.88	75.75	5.93	100
	Urban	4.26	16.04	67.58	12.12	100
Sikkim	**Total**	7.59	19.26	58.98	14.17	100
	Rural	8.49	18.54	59.57	13.40	100
	Urban	6.07	20.48	57.97	15.48	100
Tamil Nadu	**Total**	4.38	15.99	58.89	20.75	100
	Rural	3.83	13.80	60.08	22.28	100
	Urban	4.86	17.89	57.84	19.41	100
Tripura	**Total**	4.45	11.11	68.15	16.29	100
	Rural	4.92	10.65	65.99	18.43	100
	Urban	3.46	12.08	72.60	11.86	100
Uttar Pradesh	**Total**	2.64	11.13	68.73	17.50	100
	Rural	2.18	10.08	72.98	14.76	100
	Urban	3.76	13.71	58.34	24.20	100
Uttaranchal	**Total**	5.81	17.11	66.61	10.47	100
	Rural	5.74	15.40	69.16	9.71	100
	Urban	5.94	19.97	62.35	11.74	100
West Bengal	**Total**	2.69	11.65	69.69	15.97	100
	Rural	2.44	11.42	69.68	16.46	100
	Urban	3.13	12.06	69.70	15.11	100
ALL INDIA	**Total**	3.86	14.02	66.16	15.96	100
	Rural	3.52	12.56	68.74	15.18	100
	Urban	4.39	16.30	62.13	17.18	100

Source: Authors calculation from 2011Census data.

TableA2: State-wise Literacy Rate According to Migrant Types

States	Total /Rural /Urban	Literacy Rate of Temporary Migrants	Literacy Rate of Semi-Permanent Migrants	Literacy Rate of Permanent Migrants
Andaman and Nicobar Islands	**Total**	75.27	78.18	78.01
	Rural	73.49	75.43	75.97
	Urban	78.50	82.35	81.99
Andhra Pradesh	**Total**	61.93	66.86	56.57
	Rural	56.24	61.07	45.68
	Urban	69.11	73.73	75.09
Arunachal Pradesh	**Total**	54.29	64.85	59.44
	Rural	48.94	59.33	48.30
	Urban	66.06	72.47	77.82
Assam	**Total**	63.13	69.40	60.06
	Rural	59.11	65.94	53.80
	Urban	76.02	81.30	84.05
Bihar	**Total**	54.02	51.77	36.76
	Rural	49.81	47.95	32.05
	Urban	68.99	71.50	68.16
Chandigarh	**Total**	71.95	77.19	80.44
	Rural	67.00	70.00	73.50
	Urban	72.27	77.53	80.61
Chhattisgarh	**Total**	64.29	72.85	50.85
	Rural	59.76	69.62	40.10
	Urban	72.44	78.19	75.92
Dadra and Nagar Haveli	**Total**	73.83	77.95	70.66
	Rural	76.26	77.44	39.35
	Urban	72.37	78.16	86.42
Daman and Diu	**Total**	71.00	76.95	45.98
	Rural	63.62	67.69	80.71
	Urban	71.68	77.95	86.63
Delhi	**Total**	69.29	75.30	77.64
	Rural	62.81	71.03	67.82
	Urban	69.49	75.44	77.87
Goa	**Total**	64.34	64.51	85.32
	Rural	59.95	57.88	82.99
	Urban	66.66	67.83	86.82
Gujarat	**Total**	60.24	67.38	67.99
	Rural	53.96	60.11	53.46
	Urban	66.56	72.75	83.37

Haryana	**Total**	54.67	71.58	58.21
	Rural	45.65	69.40	43.65
	Urban	66.08	73.31	76.27
Himachal Pradesh	**Total**	71.50	81.43	68.49
	Rural	70.53	81.62	65.46
	Urban	75.22	80.80	87.22
Jammu and Kashmir	**Total**	46.21	64.22	47.61
	Rural	39.29	58.80	37.62
	Urban	62.10	72.96	69.62
Jharkhand	**Total**	62.44	63.82	44.26
	Rural	56.37	56.60	30.69
	Urban	71.05	76.63	74.92
Karnataka	**Total**	63.73	70.49	65.80
	Rural	54.91	62.30	54.89
	Urban	73.09	78.31	82.48
Kerala	**Total**	63.43	64.03	91.55
	Rural	58.80	59.48	90.58
	Urban	68.11	68.95	92.82
Lakshadweep	**Total**	86.05	85.47	91.36
	Rural	84.00	85.73	90.68
	Urban	86.53	85.39	91.57
Madhya Pradesh	**Total**	53.50	62.57	48.44
	Rural	45.38	54.79	36.15
	Urban	67.00	75.47	74.88
Maharashtra	**Total**	59.35	68.92	75.72
	Rural	51.66	62.80	67.06
	Urban	67.77	73.90	84.88
Manipur	**Total**	71.27	73.09	69.41
	Rural	69.50	69.61	65.57
	Urban	74.50	79.09	75.95
Meghalaya	**Total**	61.95	66.61	69.57
	Rural	54.31	58.37	62.22
	Urban	74.83	79.89	84.69
Mizoram	**Total**	73.45	80.65	90.99
	Rural	61.52	67.71	80.09
	Urban	83.20	87.27	96.35
Nagaland	**Total**	75.17	78.79	80.71
	Rural	76.81	77.81	74.92
	Urban	72.50	79.90	85.38
Odisha	**Total**	66.60	74.35	57.34
	Rural	61.72	70.87	50.59
	Urban	77.54	82.62	82.06

Puducherry	**Total**	64.85	67.10	81.54
	Rural	53.03	56.15	74.49
	Urban	69.60	71.86	84.96
Punjab	**Total**	58.35	66.07	65.21
	Rural	52.89	62.19	56.75
	Urban	65.41	70.09	77.44
Rajasthan	**Total**	52.51	58.02	38.82
	Rural	47.25	51.32	27.86
	Urban	66.42	72.76	70.00
Sikkim	**Total**	75.43	78.12	70.76
	Rural	74.38	76.11	63.52
	Urban	77.91	81.20	83.34
Tamil Nadu	**Total**	68.05	71.92	73.95
	Rural	61.76	65.76	63.26
	Urban	72.36	76.07	83.62
Tripura	**Total**	59.92	86.70	81.68
	Rural	54.31	85.69	77.51
	Urban	76.42	88.57	89.52
Uttar Pradesh	**Total**	56.56	62.84	40.84
	Rural	50.25	58.51	31.66
	Urban	65.52	70.62	68.89
Uttaranchal	**Total**	68.45	77.64	62.98
	Rural	66.84	77.57	54.31
	Urban	71.06	77.74	79.08
West Bengal	**Total**	61.78	70.10	66.28
	Rural	57.57	67.66	58.15
	Urban	67.56	74.18	80.62
ALL INDIA	**Total**	60.56	67.08	59.26
	Rural	53.89	61.06	47.52
	Urban	68.92	74.33	79.60

Source: Authors calculation from 2011Census data.

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Ground Water Usage Scenario in View of Upcoming Fresh Water Crisis in India

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Abstract

India is facing an unprecedented stress on its fresh water resources arising from declining per capita availability of water resources and for changing sectoral allocation of water demand. Therefore, the most challenging tasks for the policymakers are to tackle the shrinking of per capita availability of fresh water and to manage optimal sectoral allocation of water resources. This study highlights the sectoral sharing out of ground water- in agriculture, and in industry and domestic uses, in India. The study further explores state-wise and regional efficacy of ground water use, and determines empirically the factors affecting the total volume of ground water use,with special implication on agricultural sector, so as to manage ground water in an improved way for future benefits. The study comes to the conclusion that water resource management is very crucial for India to combat with upcoming fresh water scarcity and conflict, and therefore, more rigorous policy implementations are of the urgent needs.

Keywords: Water usage, Water scarcity and conflict, Water resource management, Ground water, Surface water.

JEL Codes: Q1, Q25, Q28, Q56, C1.

I. Introduction

In a time of imminent water crisis situation worldwide, efficient water use management is an absolute necessity. Irrigated agriculture and sustainable agricultural growth are continuously being threatened due to growing scarcity of fresh water resources in India. Fresh water is the naturally occurring water that is not brackish, and is suitable for utilization if clean and processed. Hence, ground water is treated as fresh water resources. Water shortages compromise the nation's ability to sustain economic growth, and thereby, call for intra and inter regional conflicts with having negative consequences. But water is a crucial input for agriculture; nearly having a determining effect on the eventual yield. In India's Ultimate Irrigation Potential (UIP) of 139.9 million hectares, 46 percent is from ground water. Of all the ground water extracted annually, 90 percent is used in agriculture (Gulati *et al.,* 2019).

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Irrigation plays a crucial role in increasing the crop productivity, and thereby, profitability of the farmers and ground water alone irrigates 62 percent of the net irrigated area. With an annual ground water draft of 253 billion cubic metre (BCM), India is now the largest ground water user in the world (Gulati *et al.*, 2019). And this large increase in ground water use has been at the cost of negative externality associated with continuous ground water depletion in large areas. Since the power supply to agriculture is heavily subsidized, particularly in the states like Punjab, Rajasthan, Tamil Nadu and Maharashtra, the actual cost of ground water extraction is not felt by the farmers.This attitude often restricts the farmers to realize the scarce value of ground water, which in turn leads to inefficient management of this crucial resource. Due to some flexibility like private ownership of ground water extraction (like tube wells) followed by electricity subsidies/free energy supply across the country, massive development of ground water irrigation in India has taken place. States such as Gujarat and Maharashtra in the western region offer high subsidy for solar pumps. Even for increasing water usage efficiency, high subsidies are given on water sprinklers and drip irrigation systems. Specifically in the north-western states of India like Punjab, Haryana, Delhi and Rajasthan, more ground water is being extracted than the amount that is replenishable in a year, indicating the country's shrinking water resources on per capita basis.

According to Gulati e*t al.* (2019), India accounts for 18 percent of the world's population, but only 4 percent of the world's fresh water resources. Distribution of water resources across the vast expanse of India is also uneven. The increasing demand for water resources with its burgeoning population and diminishing quality are of major concerns in India in recent times. Additional requirement of water for serving nation's spiralling industrial and agricultural growth have led to a situation where the consumption of water has increased rapidly, but the supply of fresh water has remained more or less static. Around 85 percent of rural water supply and 45 per cent of urban water supply are met through the ground water resource. Since a significant amount of water demand is met by ground water, so the ground water tables in most of the areas are getting down at an alarming rate per year. With the increasing population and urbanization, the sectoral pressure on ground water in particular is going to increase further in the future. Of the 16 percent of administrative blocks assessed in the country by Central Ground Water Board (CGWB) come under overexploited; utilization is much higher for Punjab (76 percent) and Haryana (54 percent) (CGWB, 2017). Further, in the western side, mainly in Rajasthan and Gujarat, the scanty rainfall and arid climate make ground water recharge very limited, and thereby, add stress on the already overexploited ground water resource. As per Organisation for Economic Co-operation and Development (OECD) environmental outlook 2050 (2012), India is predicted to face severe water constraints by 2050. Hence, it seems imperative to analyze sustainable use of ground water resources and its management in India at sub-national level with special emphasis on agricultural sector.

2. Review of Literature and Objectives of the Study

In an endeavour to insight into the arena of ground water development and projected fresh water crisis (mainly due to agricultural activities), research works are very scarce. Srivastava *et al*. (2015) assessed the unsustainable ground water use in Punjab agriculture using unit-level cost of cultivation survey data. The authors found that large farmers were the more efficient in using ground water resources as compared to the small farmers with less land holdings. The study also revealed that ground water supply augmentation and demand reduction measures with special emphasis on water use efficiency might be a help to curtail non-productive use of ground water resources. The status of ground and surface water use in agriculture, challenges and possible options to increase water use efficiency in India were studied by Dhawan (2017). Potential, challenges and management of ground water resources were also studied by Saha and Ray (2019) in the Indian context. The authors found that high dependence on ground water resources was responsible for a stressed condition in various parts of the country. Understanding of the aquifer systems and management of ground water resources might be a help for environmentally sustainable development. India's depleting ground water resources was also studied by Chindarkar and Grafton (2019). The authors cited that under the Jyotigram Yojana (JGY) scheme in Gujarat, a rationed electricity supply was provided to the farmers and an unrationed power supply to the non-agricultural users in view of increasing ground water storage. By using district-level data of Gujarat during 1996-2011 and through an econometric analysis, the authors found that ground water storage continued to decrease with JGY. Further, the impact of ground water depletion on agricultural production in India was studied by Bhattarai *et al.* (2021). The authors used a district-level panel regression to understand how ground water depletion affected staple grain production in India, for the period 2004-2013. The study revealed a negative impact of ground water depletion on crop production in India. The study further explored that in the states like Haryana and Punjab where most of the foodgrains are produced in India, the reduction or removal of energy subsidies did not encourage the farmers to switch to planting less water-intensive crops.

However, no such study has been undertaken so far related to the changing pattern of ground water use in India, and focusing on estimating efficacy of ground water use at sub-national levels with special emphasis on food grains production, for the last two decades, in view of India' s shrinking fresh water resources. After the study of Amarasinghe *et al.* (2008) on India's water supply and demand from 2025-2050 with respect to the business-as-usual scenario and issues, the seen and unseen facts of India's water crisis due to unsustainable consumption have been discussed in the study of Matto (2019) and Nathan (2021). But more precise study showing

accountability of agricultural sector on upcoming fresh water scarcity and disputes is of a burgeoning need. Even empirical study to determine the key factors affecting the total volume of ground water use to combat with water scarcity might be an important research agenda. Therefore, the present study has three main objectives which are as follows:

1. to observe the pattern of groundwater use across regions in India for the last two decades,
2. to examine the efficacy of ground water use in Indian agriculture across states and regions for the last two decades, and
3. to determine the factors affecting the ground water use for better management of water resources in future, with special emphasis on agricultural sector.

3. Methodology

The study uses secondary data for analysis, the sources of which are listed below.

- Water resources - Central Ground Water Board, Ministry of Jal Shakti, Department of Water Resources, River Development & Ganga Rejuvenation, GoI; National Water Information Centre, GoI; Central Water Commission, Ministry of Jal Shakti, Department of Water Resources, River Development & Ganga Rejuvenation, GoI.
- Temperature and rainfall - Annual summary 2017, National Climate Centre, Climate Service Division, India; India Meteorological Department, Ministry of Earth Sciences, GoI.
- Agricultural land area - Ministry of Agriculture and Farmers Welfare, GoI.
- Agricultural production - Ministry of Agriculture and Farmer's Welfare, GoI.
- State-wise rural population - Office of the Register General and Census Commissioner, Ministry of Home Affairs, GoI.

The data were collected for the five time points - 2004, 2009, 2011, 2013 and 2017, as per availability of the data. Since the study shows the changing pattern and efficacy of the ground water use at the state and regional levels, so the entire economy is divided into five regions - North, South, East, West and Central. Pictorial representations have been made to show the changing water use pattern and regional efficacy of ground water use for the last two decades in India. Regression analysis is done to determine the factors affecting the total volume of ground water use. Descriptive statistics are used to explain the variables in the regression analysis. The explanatory variables are agricultural land area, average rainfall, average temperature, agricultural production, rural population and efficacy of surface water use in food grains production of each state. Though topography and geology determine the availability of ground water; those are beyond the control of human beings. Yet the efficacy of surface water use is important as an

explanatory variable because the two main sources of water - ground and surface are close substitute of each other to meet the total water demand for different uses. The descriptive statistics of the independent variables used in the regression analysis is presented in Table 1.

Table 1: Descriptive Statistics of the Explanatory Variables

Variable	**Description**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Agricultural Land Area	Agricultural land area is measured in '000 hectare.	2398.276	3464.125	15.00	14332.00
Average Rainfall	Average rainfall is measured in millimeter.	1438.23	999.1308	140.53	4748.9
Average Temperature	Average temperature in summer and average temperature in winter have been taken into account, and then grand average is obtained. The measurement unit is Celsius.	24.0169	7.266344	13.45	54.4

Agricultural Production	Agricultural production is measured in '000 tones.	27196.07	47580.97	0.00	229548.90
Rural Population	Rural population is in '000 number.	196.0345	137.718	15.00	417.00
Efficacy of Surface Water Use in Food Grains Production	Calculated in terms of net change of surface water flow (subtracting total change in outflow of surface water from total change in inflow, in BCM) for per unit of food grains production (in million tones).	-.1584483	.6904502	-1.893	2.201

Source: Done by authors

The dependent variable in the regression analysis is the total volume of ground water use (in BCM), the mean of which is 8.57. Some statistical tests have been performed to confirm the study results after the regression analysis.

4. Results and Discussion

4.1. Pattern of Ground Water Use

In view of addressing the first objective, regional analysis of ground water use in agriculture for irrigation, and in industry & domestic purposes has been done. Average ground water use of each region for the five time points are presented in Table 2.

Table 2: Regional Analysis of Ground Water Use for Irrigation and Industrial & Domestic Purposes (in BCM)

Sl. No.	Region	State	Year				
			2004	2009	2011	2013	2017
1	Northern	Delhi, Haryana, Jammu & Kashmir, Uttar Pradesh, Punjab, Bihar, Uttarakhand, Himachal Pradesh	11.99 (0.82)	12.87 (0.93)	13.40 (1.02)	13.43 (1.21)	12.44 (1.37)
2	Central	Chhattisgarh, Madhya Pradesh	9.19 (0.76)	9.87 (0.93)	10.45 (0.99)	10.85 (1.03)	10.70 (1.09)
3	Eastern	Jharkhand, West Bengal, Odisha, Sikkim, Tripura, Nagaland, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram	1.77 (0.25)	1.83 (0.26)	1.62 (0.29)	1.80 (0.31)	1.72 (0.36)
4	Western	Rajasthan, Gujarat, Goa, Maharashtra	9.09 (0.82)	10.18 (0.94)	10.01 (0.97)	10.51 (1.06)	10.70 (0.98)
5	Southern	Andhra Pradesh, Tamil Nadu, Kerala, Karnataka	10.55 (0.99)	9.41 (1.47)	9.06 (1.36)	9.30 (1.35)	9.65 (1.53)

Source: Done by authors

Notes: Agricultural activities do not take place in Delhi.

Figure in parenthesis indicates ground water use for industrial & domestic purposes.

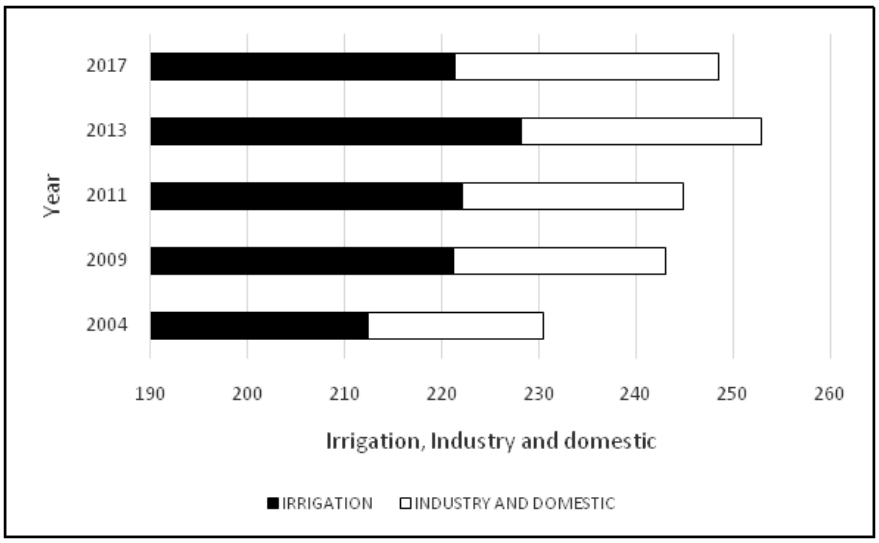
It is evident from Table 2 that northern region has remained in the highest position in terms of ground water use during the assessment period and eastern region ranks lowest among all the regions.Though ground water use was increased in the northern region over the period 2004-2013, a significant drop in ground water consumption was observed in 2017, by 7 percent from 2013 level, which was due to a moderate and timely rainfall, and reclamation of ponds and lakes happening in the several northern states of the country at that time. In the eastern region, ground water consumption was at its lowest level in 2011. Mostly the eastern states use surface water for the existence of several perennial rivers and their tributaries there. Further, in the western region, ground water use was perceived slowly increasing over the entire study period; while the southern region perceived a downfall of its use up to 2011, and after that it started increasing. Perhaps the

existence of periodic rivers in those regions escalated the use of ground water. In the central region, ground water use slowly increased, reached its peak in 2013, and then started falling although it was not very significant. In the later phase, all these regions perceived increasing demand for ground water because of massive population growth, and thereby, increase in food demand.

Further, on account of groundwater use in industry and domestic purposes, southern region took the lead in the assessment period, while the eastern region experienced the lowest ground water use. However, over the years in all the regions ground water consumption has been increased for industrial and domestic uses as a consequence of population growth, urbanization, and industrialization.

The segregation of ground water use - for irrigation and for industrial & domestic purposes in the last two decades at all India level is presented in Figure 1.

Figure 1: Use of Ground Water at All India Level (in BCM)



Source: Done by authors

4.2. Efficacy of Ground Water Use in Food Grains Production

Assessment of the efficacy of ground water use is important so as to ensure environmental sustainability. In the study, efficacy of ground water use in food grains production is measured by the ground water use in agriculture (in BCM) for per unit of food grains production (in million tones). The state-wise and regional discrepancy of this efficacy is tested to detect whether the regions using ground water is at safe level. The term 'efficacy' is used in the study to denote the ability to produce the desired or intended result regarding ground water use. Table 3 represents the calculated figures of the state-wise efficacy of ground water use over the five time points. Consequently, the average use of ground water in per unit of food grains production over the assessment period for each state has been calculated and ranking of the states (from highest to lowest) has been done according to their efficacy levels. The states possessing higher average values represents lower levels of efficacy and vice versa.

Table 3: State-wise Analysis of the Efficacy of Ground Water Use (in BCM) for Food Grains Production

Rank	State	Year					Average
		2004	2009	2011	2013	2017	
21	Andhra Pradesh	1.036	0.824	0.717	0.726	1.229	0.906
2	Arunachal Pradesh	0.003	0.006	0.005	0.005	0.000	0.004
18	Assam	1.340	1.190	0.613	0.797	0.356	0.859
20	Bihar	1.219	0.964	0.730	0.803	0.633	0.869
12	Chattisgarh	0.460	0.628	0.499	0.495	0.668	0.550
9	Goa	0.256	0.127	0.076	0.147	0.186	0.158
25	Gujarat	1.995	2.071	1.211	1.341	1.675	1.658
15	Haryana	0.694	0.762	0.688	0.784	0.712	0.728
8	Himachal Pradesh	0.055	0.226	0.165	0.105	0.134	0.137
6	Jammu & Kashmir	0.067	0.114	0.126	0.112	0.127	0.109
10	Jharkhand	0.303	0.544	0.314	0.147	0.133	0.288
16	Karnataka	0.929	0.822	0.710	0.718	0.796	0.795
27	Kerala	2.712	2.128	2.272	2.302	2.329	2.348

19	Madhya Pradesh	1.140	1.040	0.857	0.781	0.521	0.868
24	Maharastra	1.351	1.264	1.287	1.151	1.140	1.239
3	Manipur	0.004	0.010	0.005	0.008	0.000	0.005
5	Meghalaya	0.000	0.006	0.006	0.025	0.083	0.024
1	Mizoram	0.000	0.000	0.000	0.000	0.000	0.000
1	Nagaland	0.000	0.000	0.000	0.000	0.000	0.000
11	Odisha	0.436	0.459	0.594	0.495	0.738	0.544
23	Punjab	1.181	1.260	1.204	1.155	1.090	1.178
17	Rajasthan	0.954	1.041	0.674	0.770	0.744	0.836
4	Sikkim	0.000	0.025	0.030	0.000	0.000	0.011
26	Tamil Nadu	2.715	1.958	1.297	1.478	1.219	1.733
7	Tripura	0.144	0.139	0.127	0.127	0.023	0.112
22	Uttar Pradesh	1.199	1.065	0.969	0.966	0.796	1.00
13	Uttarakhand	0.761	0.562	0.594	0.473	0.683	0.614
14	West Bengal	0.675	0.642	0.608	0.635	0.642	0.640

Source: Done by authors

Note: The data for Mizoram, Nagaland have been considered as zero due to the negligible use of ground water resources.

Table 3 lights on the facts that Kerala is having the lowest efficacy of ground water use in food grains production, while the north eastern states like Arunachal Pradesh, Manipur, Mizoram, Meghalaya, Nagaland and Sikkim possess the high efficacy level. In reality, north eastern states experience adequate rainfalls every year and cropping is done there mostly using surface water as because of the existence of several perennial rivers and their tributaries. In Delhi, absence of agricultural activities makes ground water consumption zero in food grains production. Over the years the states like Assam, Bihar, Madhya Pradesh, Maharashtra, Tamil Nadu, Jharkhand, Tripura and Uttar Pradesh have shown an observable increase in the efficacy of ground water use for food grains production. In West Bengal, this efficacy level has remained more or less static through out the assessment period. However, in Jammu-Kashmir, efficacy in ground water use has been slowly declined over time. In Uttarakhand, Andhra Pradesh, Goa and Karnataka though the efficacy of ground water use was increasing in the initial and mid phases of the assessment period, it again started falling in the later phase. In Odisha, the drastic fall in efficacy of ground

water use was perceived in 2017. Report of the Dynamic Ground Water Resources of India, 2017, had marked the states like Punjab, Haryana, Rajasthan Uttarakhand, and some parts of Madhya Pradesh, Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Bihar, Chattisgarh, Odisha and West Bengal as over exploited and sometimes critical or semi-critical in terms of ground water use which our study strongly supports. In a vast country like India the two dominant factors controlling ground water flow - topography and geology vary abruptly. Further, frequent earthquakes due to global warming and climate change have brought the changes in water level due to aquifer deformation. Chemical, physical and biological content of water, which define water quality, also have been changed over time by the process of economic growth and development. Therefore, quantity and quality of ground water, distance and elevation of the source, and topography of the surrounding area are the factos responsible for the varied level of ground water use across states in India.

After the state-wise analysis of the efficacy of ground water use in food grains production, regional analysis is done and presented in Table 4. This analysis takes the average of ground water consumption of all the states in a particular region in each time point.

Table 4: Regional Analysis of the Efficacy of Ground Water Use (in BCM) for Food Grains Production

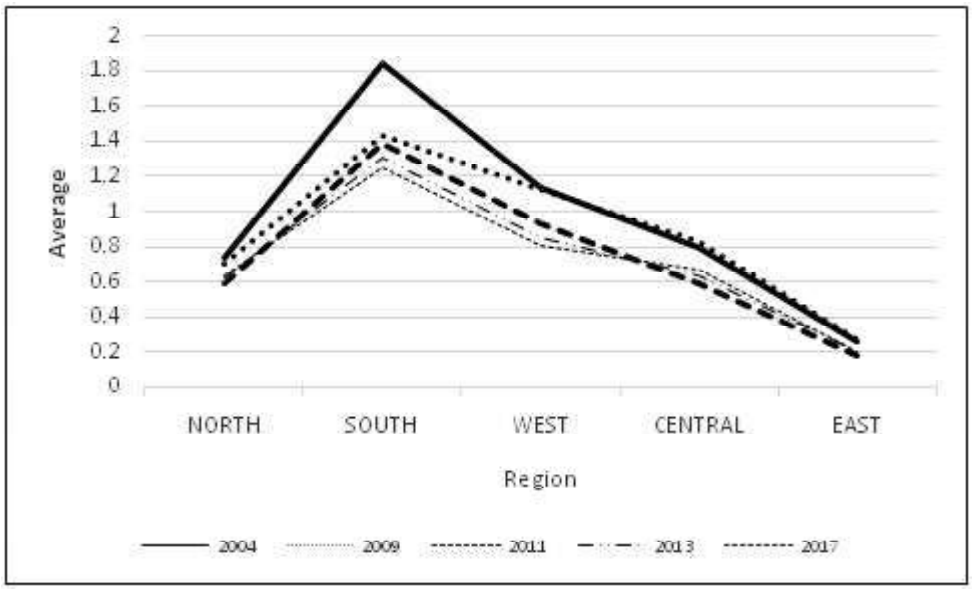
Sl. No.	Region	State	Year				
			2004	2009	2011	2013	2017
1	Northern	Haryana, Jammu &Kashmir,Uttar Pradesh, Punjab, Bihar, Uttarakhand, Himachal Pradesh	0.739	0.707	0.639	0.628	0.596
2	Southern	Andhra Pradesh, Tamil Nadu, Kerala, Karnataka	1.848	1.433	1.249	1.306	1.393
3	Western	Rajasthan, Gujarat, Goa, Maharashtra	1.139	1.125	0.812	0.852	0.936
4	Central	Chhattisgarh, Madhya Pradesh	0.800	0.834	0.678	0.638	0.594

Sl. No.	Region	State	Year				
			2004	2009	2011	2013	2017
5	Eastern	Jharkhand, West Bengal, Odisha, Sikkim, Tripura, Nagaland, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram	0.264	0.274	0.209	0.203	0.179

Source: Done by authors

The regional trends of the efficacy of ground water use are presented in Figure 2.

Figure 2:Regional Trends of the Efficacy of Ground Water Use (in BCM)



Source: Done by authors

Figure 2 represents that in terms of the efficacy of groundwater use; eastern region consumed the lowest levels of ground water for per unit of food grains production over the assessment period, while the southern region consumed the highest levels of ground water followed by western, central and northern regions, respectively.

4.3. Determinants of Ground Water Use

In view of the third objective, factors affecting the ground water use have been determined through a regression analysis in favour of 29 states of India for the year 2017, depending upon the data availability and after data mining to minimize the biases. The regression equation for the study is

$$\textit{Total volume of ground water use}_i = \alpha + \beta_1 \textit{ Agricultural land area} + \beta_2 \textit{ Average rainfall} + \beta_3 \textit{ Average temperature} + \beta_4 \textit{ Agricultural production} + \beta_5 \textit{ Rural population} + \beta_6 \textit{ Efficacy of surface water use in food grains production} + \varepsilon_i$$

where *Total volume of ground water use* is the dependent variable

α is the intercept of the model

β_i's is are the coefficients of the independent variables; i = 1,….,6

ε is the random error which is assumed to be independently, identically and normally distributed

The estimated regression result is presented in Table 5.

Table 5: Estimated Regression Result

Variables	**Coefficient**	**VIF**
Constant	0.1301314 (2.17936)	-
Agricultural Land Area	0.0014209 (0.0007049)**	4.96
Average Rainfall	-0.0020972 (0.0009788)**	1.29
Average Temperature	0.1355582 (0.0598372)**	1.15
Agricultural Production	0.0000835 (0.0000263)***	4.42
Rural Population	0.0129897 (0.0078618)	1.97
Efficacy of Surface Water Use in Food Grains Production	0.1618317 (0.871061)	1.07

Number of observations	=	29	
	F (6, 22)	=	108.52
	Prob > F	=	0.0000
	R-squared	=	0.8193
	Root MSE	=	5.3695
Mean VIF 2.48			
(Figures in parenthesis indicate standard error)			
***denotes significance at 1 percent level			
**denotes significance at 5 percent level			

Source: Done by authors

In the model, robust estimator has been used to deal with the problem of heteroscedasticity. The R2 value for this cross-section data is 0.8193. R2 measures the goodness-of-fit for a linear regression model. The model shows that about 82 percent of the variation in the data of outcome variable is due to the variations in the data of independent variables collectively. The value of F-statistic is 108.52 and the P-value associated with it is 0.000, which indicates that in overall the regression result statistically significantly predicts the outcome variable. In addition, the Variance Inflation Factor (VIF) of the independent variables in the model has been estimated and the mean VIF is found as 2.48 (within the critical value of 10), which indicates that the model does not suffer from any severe multicollinearity problem; the explanatory variables are not highly correlated with one or more of the other explanatory variables.

In the model, all the coefficients of the explanatory variables have expected signs. The results show that total volume of ground water use increases with the increase in agricultural land area, average temperature, agricultural production, rural population and efficacy of surface water use; and decreases with the increase in average rainfall. It is expected that with the increase in agricultural land area and agricultural production, the demand for ground water will increase to irrigate the field. Increase in rural population forces more people to join the agricultural activities, and so the demand for ground water use increases. Increase in average temperature evaporates surface water fast and raises the demand for ground water use. Further, augmented efficacy of surface water use boosts the demand for ground water to meet the total water requirement in cropping. On the contrary, adequate rainfall helps in raising total surface water inflow, and therefore, the use of ground water decreases. The estimation results show that agricultural land

area, average rainfall and average temperature are statistically significant at 5 percent level, and agricultural production is statistically significant at 1percent level. Table 6 shows the result of Ramsey RESET test to verify whether any important variable determining the total ground water use has been omitted.

Table 6: Result of Ramsey RESET Test

Ramsey RESET test using powers of the fitted values of total volume of ground water use Ho: model has no omitted variables F (3, 19) = 5.93 Prob > F = 0.0050

Source: Done by authors

The test result (Prob > F = 0.0050) indicates that the model has no omitted variable bias.

4.4. Significance of Water Resource Management

Since water is one of the most fundamental resources necessary for sustenance and central to socio-economic development, proper utilization of this resource is very crucial. However, the ever growing population and economy, combined with the impact of drastic climate change, are making water resources scarce and posing threats in many parts of the country. We are witnessing severe damage to livelihoods, human health and ecosystems, and eventually the water scarcity is expected to become a leading cause of national political conflict in near future, and the prognosis for India is no different. Severe scarcity of water during droughts affects agriculture and farmers' welfare.The loss in agricultural output causes acute agrarian distress. India's fresh water crisis is actually due to less utilization of rain water, more use of surface and ground water resources in agricultural activities and in industry & domestic purposes, but not because of coping ability with rapid industrialization and urbanization, etc. The main issue arises from the drastic climate change characterized by ever increasing temperature and decreasing rainfall nationwide.

India receives an average of 4,000 BCM of precipitation every year (World Resource Institute, 2015). However, only a small part of it is used in India's surface and ground water bodies due to a dearth of storage procedure, lack of adequate infrastructure and inappropriate water management. Further, India's annual rainfall is received in a short span of four months (June to September), which often results in run offs during monsoon and calls for irrigation investments for rest of the year. But population in India is likely to be 1.6 billion by 2050, which is going to create a large demand for water, food and energy. This will also call for infrastructure expansion and improved resource utilization. Rice, wheat and sugarcane constitute 90 percent of India's crop production and are the most water consuming crops. Rice being an important export crop,

consumes as much as 3,500 litres of water for a kilogram of grain produced (World Resource Institute, 2015). Ground water resources are in fact being depleted due to unsustainable extraction levels that exceed natural recharge rates.

Government of India, therefore, put explicit emphasis on ensuring the efficacy of the use of water resources. Since most of the demand for fresh water usage comes from agricultural sector, so government announced an umbrella scheme for better monitoring and implementation of irrigation projects. Although, this scarcity issue was addressed nationally, there was a vast discrepancy in the movement of various states in India.The CGWB was setup to develop and disseminate technologies; for monitoring and implementing policies; for scientific sustainable development and management of ground water resources including exploitation, assessment, conservation, augmentation and protection from pollution based on the strategy related to ensuring economic and ecological efficiency and equality. But still several regions in the country are facing acute water stress chronically although the central and state government policies have been put forward with varying schemes to promote irrigation and water use efficiencies. The over enthusiasm of some of the state governments regarding utilization of water resources had resulted in distorting water prices; around 39 percent of the wells showed a decline in ground water level CGWB (2011).

Given the fact that availability and demand for water resources in India show a sizeable variation across regions with inefficient and inequitable use of water, initiative has been taken for overall development of ground water use. But still there exists a wide regional variability. Over-dependence on ground water beyond a sustainable level use often results in significant decline in the ground water table, which has happened especially in the northwest of India. The CGWB (2017) has categorized 16.2 percent of the blocks as 'over-exploited' and additional 14 percent as either at 'critical' or 'semi-critical' stage with most of the overexploited blocks in that region. The unsustainable ground water use necessitates demand management and supply augmentation measures to improve water use efficiency, especially in the agriculture sector. On the contrary, in the eastern region where ground water utilization is on a limited scale, the policies offer greater scope for harnessing the benefits of ground water for cropping.

Further, one more reason behind the water stress situation in a large part of India is the short of water resources management, rather than physical absence of water resources. This means that management, particularly in irrigated fields which accounts for majority of India's fresh water consumption, requires special attention. The amount of rainfall varies widely and spatially, and therefore, importance of construction of dams and rainwater harvesting cannot be ignored in a country like India. The Accelerated Irrigation Benefits Programme (AIBP) was launched during 1996-97 in India as a Central Assistance Programme to speed up the execution of large irrigation

projects and to handle the old ones which were facing financial crunch in functioning. AIBP took part in expansion, restoration and reconstruction of the large, medium, and even small irrigation projects to facilitate agricultural production, but it faced excessive cost burden (Comptroller and Audit General of India, 2018). The challenge was to tackle the rising gap between irrigation potential created by the system agencies, and actually utilized by the farmers. Given the fact that the scarcity of fresh water may severely impact environment and human lives; overuse and misuse of this resource should be properly taken care of. We need to make sure of using fresh water resources judiciously to ensure sustainable development. Under the current schemes of project implementation of the government, focus should be more on creation of the potential. In future, emphasis should be more on utilization of created potential. Hence it is of absolute necessity to enforce proper management of all types of natural resources, especially management of crucial renewable resources like water to achieve the global goal. Even in the report of Asian Development Bank (ADB, 2016), strengthening of water security in Asia and the Pacific was the main concern for water development based upon the water challenges faced by Asia and the Pacific.

5. Conclusions

The study analyzes sectoral allocation of ground water use - in agriculture, and for industrial purposes and domestic consumption over the last two decades in India, which is rare in the Indian context. The study also points out the efficacy of the states and regions in terms of ground water use to deal with the issue of upcoming fresh water scarcity as predicted for India. The determinants or key factors responsible for ground water depletion in India came out from the study has serious policy implications.The study comes to the conclusion that the efficacy of ground water use varies significantly across states and regions of the country. Therefore, the water use efficiency must be improved and more rigorous studies at sub-national level are important for policy implementation. It is not only indispensable to restrict the overuse of water resources in agriculture (especially by making best use of the available technologies and resources), but per capita domestic consumption and industrial requirements should also be taken care of. Sincere attention should also be on the scientifically planned water usage strategies and drafting of water management plans to combat with water scarcity and conflicts.

Though the study has serious policy implications, the study may be extended for state-wise and regional efficacy analyses of ground water use in industrial and domestic purposes in India, alike the use in agricultural sector. Incorporation of surface water might also be useful to get the complete picture. Further, expansion of time horizon or inclusion of more determinants for the total volume of ground water use might help validating the study results.

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Distributional Pattern of Solid Waste Generation in Burdwan Municipality

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Abstract

This study attempts to identify sources and distributional pattern of solid waste generation in Burdwan Municipality. The paper investigates major source of waste generation in terms of locations (residential and non-residential premises, administrative area like ward). This study examines the classification of solid waste and identifies the largest contributor in solid waste generation in Burdwan Municipality. This study observes bio-degradable waste is the maximum among all municipal solid waste (MSW) generation in Burdwan town. Commercial places generate more MSW than institutions while the top contributors from residential premises are low-income group (LIG) households. The paper examines distributional pattern of solid waste generation in household levels at wards. The paper also observes the distributional pattern of basic municipal infrastructure related to MSW management. There is mismatch between MSW generation and available infrastructure due to uneven distribution of resources and poor management practices.

Key Words: *Burdwan Municipality, Distributional Pattern, Municipal Solid Waste (MSW), Dumping, RPs and NRPs, Municipal Infrastructure*

JELClassifications: Q530, R21, R22

I. Introduction

India has emerged as the fastest growing economy[3] in the world in the twenty first century. Urbanization rapidly increases in India with economic growth. India being an economic front runner its consumption level has increased with changing lifestyle that generates huge waste

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[3]KausikBasu (2015), the Former Chief Economist of the World Bank, said that India is leading the World's growth chart……. the global economy is shifting and Indian economy is ready to escalate its economic activity...,(See,the Times of India, June 11, 2015, p 1&6).

including bulk amount of solid waste[4], which is a threat to environment and natural resources. Bulk quantity of solid waste generation may create certain obstacle towards sustainable development. In this context, it is required to manage scientifically all types of wastes for sustainable urban development. An urgent need is to change paradigm in solid waste management (SWM) system to achieve sustainable development goal (SDG), which certainly focuses on (a) reduction of elements of municipal solid waste for less environmental stress and minimization of resource depletion, and (b) improvement of human welfare promoting public health and/or minimization of economic losses due to ill health associated to municipal waste and its pollution.Waste could be generated at residential (household level) and non-residential (such as institutions, market and/or commercial places etc.) premises. Municipal Solid Wastes could be controlled and managed efficiently with proper knowledge of its source or origin. In this context, it is necessary to understand the distributional pattern of waste generation in civic life in a specific urban area for deep understandings. In this regard, this study has considered Burdwan Municipalityof West Bengal in India. Burdwan has certain unique characteristics that are discussed later.

This paper aims to identify the sources of waste generation and its distribution across Burdwan Municipality. To understand the SWM practice this study also investigates the process of solid waste generation, its collection, transportation, dumping and available infrastructure. This study assesses the current practice in SWM in Burdwan Municipality and attempts to identify the organisational functioning and major constraints, if any, for achieving its efficiencyin Burdwan Municipality.

The paper is organised as the following: Section 2 provides literature review on municipal solid waste management practice in brief. Section 3 describes background of Burdwan Municipality. Section 4 describes data and methodology. Section 5 discusses results and finally, section 6 concludes with remarks.

2. Literature Review

Waste is no longer useful in daily civic life and such items or materials are thrown away from individuals or households and other economic agents. Truly, stuffs are refused after derived utility from it. Refuse is primarily solid waste that is discarded from either residential or commercial sites

[4]Wastes are any discarded or abandoned materials. Wastes can be solid and semi-solid or materials containing gas. Sources of municipal waste are households, construction and demolition debris, sanitation residues, hazardous waste from industries; and hospital waste which is generated during the diagnosis, treatment or immunization, etc.

(Gourlay, 1992). Domestic, workplace, street cleaning, hospitals, and other institutions are common sources of refuse. Heavy manufacturing waste is collected, processed, and disposed of by firms or other contractors in the industry (Akhilesh & Avlokita, 2020; Balasubramanian, 2018). Due to the failure of municipal governments to collect garbage, city people dump it in open spaces and peri-urban areas, posing health risks and polluting the environment (Coad, 2006; Gupta et al., 2015). The city fathers are responsible for rubbish collection. Uncollected garbage poses a significant challenge to cities, particularly in developing countries (Thomas-Hope, 1998). Tanaka (1999) claims that today's waste management is all about trash reduction and recycling. Items deemed useless are processed and returned to the market; this practice is encouraged because it aids waste management. Solid waste management is becoming increasingly challenging in developing countries (Johannessen, 1999; Seng et al., 2018), particularly Zimbabwe, and requires long-term and sustainable solutions. According to UN-Habitat (2006), only about 20% of urban solid waste is correctly collected and disposed of. Communities have been empowered to manage waste in their areas through Community Based Organizations (CBOs) in an effort to solve the problem of refuse. Social, economic, and political considerations all have an impact on refuse collection. Rapid urbanization, resulting from a major flight of people to cities, has put a strain on certain municipalities' resources due to trash collection and waste management. According to UN-Habitat research from 2006, solid waste management consumes 20% to 40% of municipal revenue in poor nations. In metropolitan regions, refuse collection is sporadic, with the majority of it going uncollected, particularly in high-density neighbourhoods. Third-world cities lack the financial resources to purchase up-to-date garbage collecting equipment. The equipment and staff required for waste collection are frequently insufficient, and in many cases, old and outmoded. Municipalities do charge for garbage pickup; however, the fees are relatively low, and in some cases do not even cover the operational costs. Domestic garbage, such as food waste, weeding waste, garden waste, hedge cutting, and undesired household goods such as plastics, rubber, old clothes, and papers, is the largest source of refuse. Batteries, used lights, abandoned furniture, and books are examples of other household garbage. Miraftab (2004) conducted a similar study on waste collection in Cape Town, interviewing city authorities and obtaining waste statistics from the city council, and found that the majority of refuse created in metropolitan areas comes from families. People generate waste at schools, hospitals, institutions of higher learning, bus stations, and even companies as they gather for functions. Indiscriminate waste still accumulates on the streets despite the availability of sweepers, who seem overwhelmed by the rate at which waste accumulates.

Solid waste management is necessitated for pollution free environmental (Mazzanti&Zoboli, 2008). Due to rapid increase of particular urban population solid waste management practice is also important (Vij, 2012). Urbanization and industrialization lead to change lifestyles and behavior that affects waste composition from mainly organic to synthetic material that last longer such as plastics and other packaging material (Idris et al., 2004). E-waste that existed before was generated as much as 20-50 metric tons a year (UNEP, 2006). Appropriate policies are needed considering environmental, social and economic aspects (Aye &Widjaya, 2006). The drivers of sustainable waste management were clarified by Agamuthu et al. (2009), which include human, economic, institutional and environment aspect. Asian countries had also given attention in building the national legal frameworks, managing institutional, technology, operational and financial aspects, and creating public awareness and participation (Shekdar, 2009; Burntley, 2003). The problem is the product of rapid unplanned urbanization, high population growth rate (Dutta et al, 2016) and due to improper management various problem occurred to inhabitants, in order to carried out any suitable measures for improvements of the MSWM and reduce the waste management related problem of the municipality (Ghosh et al, 2017).

From above literature review it is observed that most of the advanced Municipalor Corporation is use proper Solid Waste Management system. The waste management system should be dynamic and continuous based on new insights and experiences (Klundert et al, 2001). Now different conceptual framework is coming, not only collection of garbage and also follow the different solid waste management process to get green and clean city. However, negligible study has focused on Burdwan Municipality and no paper has also highlighted on distributional pattern of waste generation. It is difficult to maintain cleanliness of the city without proper knowledge on the distribution of sources of municipal wastes. In this context, this study attempts to understand the distributional pattern of generation of MSW in Burdwan Municipality.

3. Background of Burdwan

Burdwan has a long history and the city owes its historical importance to being the head quarters of the Maharajas of Burdwan under the British rule. It was the head quarter of Burdwan province duringthe British period. The Burdwan Municipality was established in the year 1865. Burdwan Medical College and Hospital plays an important role during outbreak of the plague epidemic. Burdwan is the store house of food grains of Bengal. Now, it is the head quarter of Burdwan (East) district, West Bengal, India. Burdwan is the essential town that connects the rest of India. At present population under Burdwan Municipality is around 3.2 lakhs and it has 35 administrative wards for providing municipal services. One important role of municipality is to collect waste or garbage and maintain cleanliness of the city. The Chairman, Commissioner,

Sanitary Inspector and other labour are involved in this work. For smooth functioning it is required to know the major sources of waste generation places and premises such as households in residential premises, and non-residential premises like hotels, hospital and nursing homes, commercial market places, institutions, and industrial sector. Burdwan is the hub of medical care centres and medical services since pre-independence period. Medical waste is huge in Burdwan and need proper scientific management techniques to control medical wastes.

Traditional thinking of municipality was collection of garbage and clean local area for caring the health of local people. As any kind of waste creates health problem[5] and in India, large number of the illness come out because of vulnerable waste management system and practice. A typical and traditional waste management system is poor which display irregular municipal services and low amount of waste collection coverages, and open dumping etc. in Burdwan Municipality.

Rapid urbanization with fast economic growth also changes the solid waste generation and its characteristics which dictate to upgrade the solid waste management system in terms of waste quality, quantity and compositions. In brief the paper presents an overview on generation of MSW and its distribution which truly help to the municipal authority to manage MSW in time with appropriate tools and techniques.

4. Data and Methodology

This study mainly uses secondary data which are collected from Burdwan Municipality. Most of the data are available in the form of reports/documents. This paper uses several data which are taken from Burdwan Municipality for the year 2019. MSW is measured in gramme (gm) for household level otherwise in Kilogramme (Kg) and Metric Ton (MT). Burdwan Municipality has 35 wards, around 3.2 lakhs population, 71.6 thousand households, 1571 non-residential premises (NRP) including 330 commercial establishments (see details in Appendix). Basic statistical tools and/or techniques are used for the study purpose. Tabular and graphical presentations are used for basic analysis purpose.

5. Results and discussion

This section analyses the results focusing on distribution of sources of solid waste in terms of (i) locations or premises and their sub-categories, (ii) administrative units like municipal wards and household level, and (iii) distribution of associated available infrastructural facilities in Burdwan Municipality.

[5]Unmanageable solid waste becomes a major environmental and public health problem in urban areas (Ogawa, 2000).

A: Preliminary observations on broad distribution of location-wise waste

Initially the paper presents the different type of MSW (Table 1) and overviews the key sources of waste generation (Table 2). Classification of municipal solid waste helps to identify the major characteristics of waste and its nature, and next to identify its sources. MSW could be controlled and managed efficiently with proper knowledge of waste classification and its source or origin.

MSW are classified into several groups such as biodegradable, plastic, metal, glass, wood, leather and rubber, cloth, paper, E-waste, medical waste and rubbish (soil, ash, etc.). Table 1 describes type-wise solid waste in Burdwan Municipality in 2019. As per classifications, major municipal solid wastes are plastics and package materials, papers, rubber and leather, wood, metals, glass, cloths, electrical and electronic wastes, rubbish, and bio-degradable wastes. Among all waste class, biodegradable waste is in the top rank, it is nearly 83% of total solid waste. Cloth and plastic wastes are in second and third rank contributing 4.67% and 3.55%, respectively. Figure in Table 1 indicates that bio-degradable waste is the largest amount of solid waste in Burdwan municipality and hence, it is required to identify its source.

Table 1: Type-wise Solid Waste in Burdwan Municipality in 2019

Classification	Amount (kg)	Percent (%)
Biodegradable waste	3634.8	83.09
Plastic, synthetic packing material	155.2	3.55
Leather, Rubber	69.4	1.59
Wood	48.4	1.11
Metals	36.06	0.82
Glass	30.08	0.69
Cloths cut pieces	204.1	4.67
Paper cut board	67.7	1.55
Medical waste	4.9	0.11
Electrical waste	37.2	0.85
Soil, ash, rubbish	86.6	1.98
Total	***4374.5***	***100***

Source: Author's Calculation from the database of Burdwan Municipality, 2019

Waste Generation in Burdwan Municipality

MSW could be controlled and managed efficiently with proper knowledge of its source or origin. Waste generation can be categorized into residential and non-residential premises, spatial waste generations, and street sweeping, etc. However; available information suggests that aggregate waste in Burdwan Municipality is mainly generated in residential premises (RP) and non-residential premises (NRP), which includes market and commercial places that might generate large amount of bio-degradable waste. Table 2 demonstrates the distribution of location-wise daily waste generation in Burdwan Municipality. Total 130.1 metric tons of solid waste is generated per day in Burdwan Municipality. Main sources of municipal solid waste generation are commercial establishments and household residential premises.

Residential premises (RP): Households generate around 63.2 metric tons waste per day in the residential premises of Burdwan Municipality (Table 2). Household premises generate 44.3 MT/day wet waste which is 2.3 times more than that of dry waste.

Table 2: Source-wise Distribution of Waste Generation per day in Burdwan Municipality in 2019

Type of Premises	Total Waste (MT/day)	Wet Waste (MT/day)	Dry Waste (MT/day)
RPs (HH)	63.2	44.3	18.9
NRPs	66.9	44.1	22.8
Total	130.1	88.4	41.7

Sources: Burdwan Municipality, 2019.

Note: MT/day denotes metric ton per day.

Non-residential premises (NRP): Educational institutions, commercial places and public place, etc. are considered as non-residential premises which generate around 66.9 metric tons of solid waste every day. Nearly 67% is wet waste and remaining 33% is dry waste in NRPs.

From Table 2 it is noted that wet waste is generated nearly same amount (around 44 MT/day) in both (RP and NRP) premises while dry waste is more in NRPs (22.8 MT/day) compared to RPs (18.9 MT/day). Following it we observe that 1571 NRPs of Burdwan Municipality generate daily 66.9 metric tons solid waste (Table 3).

Table 3: Distribution of Category-wise NRPs and their Waste Generation in Burdwan Municipality in 2019

Category of NRP	No. of NRPs	Total waste generated by the NRP of the entire city per day (kg)	Total wet waste generated by the NRP of the entire city per day (kg)	Total dry waste generated by the NRP of the entire city per day (kg)
Educational Institute	40	320	232	88
Commercial places	1095	65043	42924	22119
Public places	2	21.2	9.2	12
Medical Centres	129	657.9	477.3	180.6
Tourist Places	305	854	488	366
Total	1571	66896.1	44130.5	22765.6

Sources: Burdwan Municipality, 2019

Table 3 shows distribution of category-wise NRPs and their total waste generation in Burdwan Municipality. Total waste from non-residential premises (NRPs) of the municipality is generated from five sectors such as Educational Institute, Commercial Places, Public Places, Medical Centres and Tourist Places. Total number of NRPs is 1571 in Burdwan Municipality area and among them commercial place is maximum number of 1095, followed by Tourist places (305) and medical centres (129) and educational institutions (40). Commercial places are around 70% of total number of NRPs in Burdwan municipality and generate around 97% of total waste generated in NRPs. Medical centres also generate 0.658 MT/day of medical waste, of which 27.45% is dry waste and rest 72.55% is wet medical waste.

B: Distributional Pattern of Generation of Municipal Solid Waste in RPs

Residential premises (RPs) of Burdwan Municipality generate nearly 63.2 ton total solid waste daily across administrative 35 wards. Around one and half ton of solid waste is generated in each ward daily in Burdwan Municipality. There is a wide range of variation in waste generation across wards. Amount of waste generation varies from minimum of 0.9 ton to maximum of 3.3 ton within 35 wards of Burdwan Municipality. On an average each ward generates 1.806 MT solid waste per day in residential area of Burdwan Municipality. It is compared with state and national levels to judge the position of Burdwan Municipality in daily waste generation. Detail discussion on it is given in separate section in later part of the paper. Amount of waste generation depends on the characteristics of household and community and/or their social behaviour. One of the important

sources of solid waste is the residents of Burdwan Municipality. Hence, we try to understand the distribution pattern of solid waste generation at household and individual level. Total generated waste of households is distributed among 3 categories or groups[6] like High-Income Group (HIG), Middle-Income Group (MIG), Low-Income Group (LIG) and Slum. Table 4 shows household category-wise waste generation in residential premises in Burdwan Municipality in 2019. Around 757 grams (0.757kg) waste per capita is generated per day in Burdwan Municipality. However, it is noted that per capita waste generation is more in low-income group (LIG) and high-income group (HIG) while it is least in the Slum (Table 4). It is also observed that HIG and LIG create large amount of wet waste, however, LIG[7] generates more dry waste than HIG.

Table4: Household Category-wiseWaste generation in Burdwan Municipality in 2019

Category of household	Waste per capita per day (grams)	Wet waste per capita per day (grams)	Dry waste per capita per day (grams)
HIG	213.8	149.6	64.2
MIG	184.9	130.1	54.8
LIG	215.8	149.7	66.1
Slum	142.5	100.7	41.9
Average	*757.0*	*530.1*	*226.9*

Sources: Burdwan Municipality, 2019

To capture the variation of waste generation this paper analyses its distribution across wards, individual citizen and household levels. This study analyses the distributional pattern of solid waste generation in wards as well as at household and/or individual levels in RPs.

Administrative Ward-wise Distributional Pattern of Solid Waste Generation

First this study attempts to find the distribution of solid waste generated in municipal administrative wards. Municipal authority collects solid waste[8] regularly and reports daily total

[6]Following municipal tax payment resident households are divided into 4 categories such as High income (HIG), Middle income (MIG), and Low-income group (LIG) and Slum.

[7]Low-income households normally buy cheap and low-priced goods which are poor in quality that might be created waste more compared to HIG. High-income households purchase high-priced and quality goods that generates less waste.

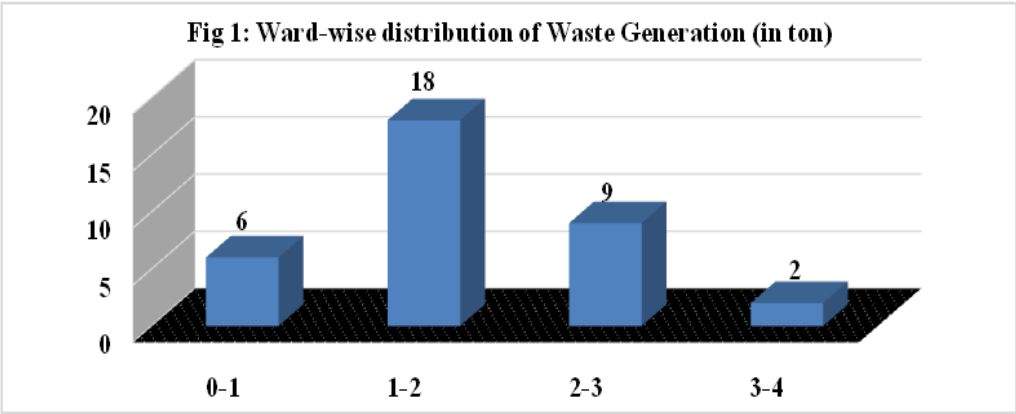
[8]This study is based on daily solid waste in ton and it reports in ton or in Kg as per contextual requirement. It is noted that 'ton' is converted to Kilogram (i.e., Kg) to grams (i.e.g) for individual and household levels.

solid waste which is measured in ton. Table 5 shows the distribution of solid waste which is generated in wards daily in Burdwan Municipality in 2019. The range of generated solid waste is 0.9 - 3.3 ton and it is divided into four classes like less than 1, 1-1.99, 2-2.99, and 3 and above. Now, Table 5 displays number of wards or frequency distribution of wards that generates solid waste in Burdwan Municipality in 2019. It is clear from Table 5 that six wards generate less than one-ton solid waste, while eighteen wards (around 51%) generate it more than one ton but less than two tons daily. Only two wards generate more than three tons solid waste daily. Now, Fig 1 shows the distribution of solid waste generation in Burdwan Municipality in 2019.

Table 5: Ward-wise distribution of Waste Generation in 2019

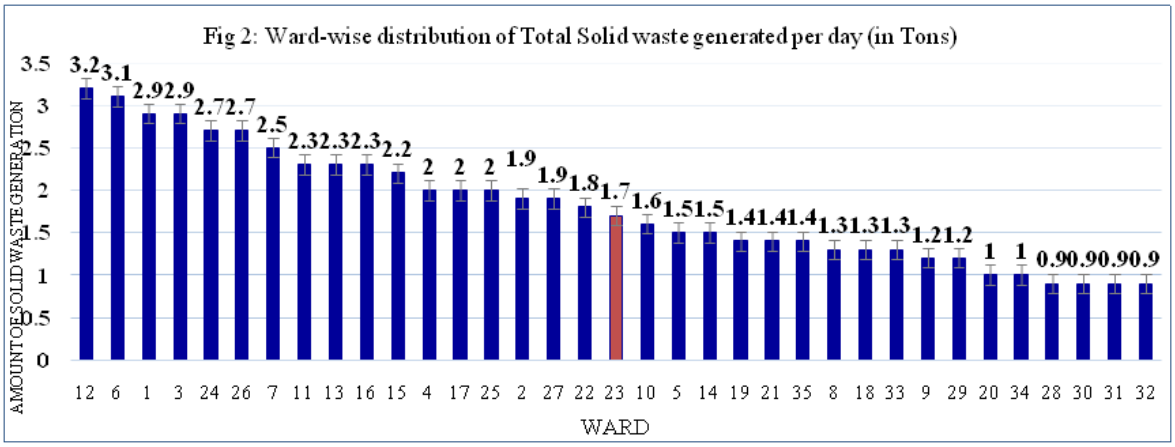
Waste Generation (in tons)	Number of Wards
Less than 1	6
1-1.99	18
2-2.99	9
3 and above	2
Total	35

Source: Author's Calculation from the database of Burdwan Municipality, 2019



Source: Author's Calculation from the database of Burdwan Municipality, 2019

From Table 5 and Fig 1, it is clear that maximum (18) wards belong to the class 1 - 2 ton of distribution of solid waste generation in Burdwan municipality. Alternatively, arranging descending order of amount of solid waste generated in wards the median amount of waste is 1.7 ton in ward 23 (see Fig 2).



Source: Author's Calculation from the database of Burdwan Municipality, 2019

Now, total 63.2 ton solid waste is decomposed into 19.1 ton of dry and 44.1 ton of wet wastes across wards of Burdwan Municipality. Table 6 displays the distribution of dry and wet waste generated in Burdwan Municipality. It is noted that 80% wards generate 0.3 -0.9 ton dry waste, while nearly 49% wards generate 1-2 ton wet waste in Burdwan Municipality in 2019.

Table 6: Ward-wise distribution of Dry and Wet Waste Generation (in ton)in 2019

Dry Waste	Number of Wards		Wet Waste	Number of Wards
0- 0.3	2		0-1	15
0.3-0.9	28		1-2	17
0.9-1.2	5		2 - 3	3
Total	35		Total	35

Source: Author's Calculation from the database of Burdwan Municipality, 2019

From above Table 6 it is observed that average amount of wastes is generated in maximum wards while minimum and large wastes are generated in few wards only. Overall ward-wise waste generation follows normal distribution.

Distributional Pattern of Generation of Solid Waste at Household level

Following statistical techniques, we have classified waste generation per household and per capita level (Table 7 and Table 8). Amount of waste generation is directly associated with its size in

terms of population and density and/or economic activities. The bulk amount of waste generation (more than 0.9 kg) per household are found in two wards; moderate amount of waste generation (0.829-0.879 kg) per household are found in thirteen wards; mild amount of waste generation (0.779-0.829 kg) per household are found in six wards only (Table 7).

Table 7: Ward-wise distribution of Waste Generation per Household (in kg) in 2019

Waste Generation per Household (in kg)	Number of Wards
0.779-0.829	6
0.829-0.879	13
0.879-0.929	5
0.929-0.979	9
0.979-1.029	2
Total	35

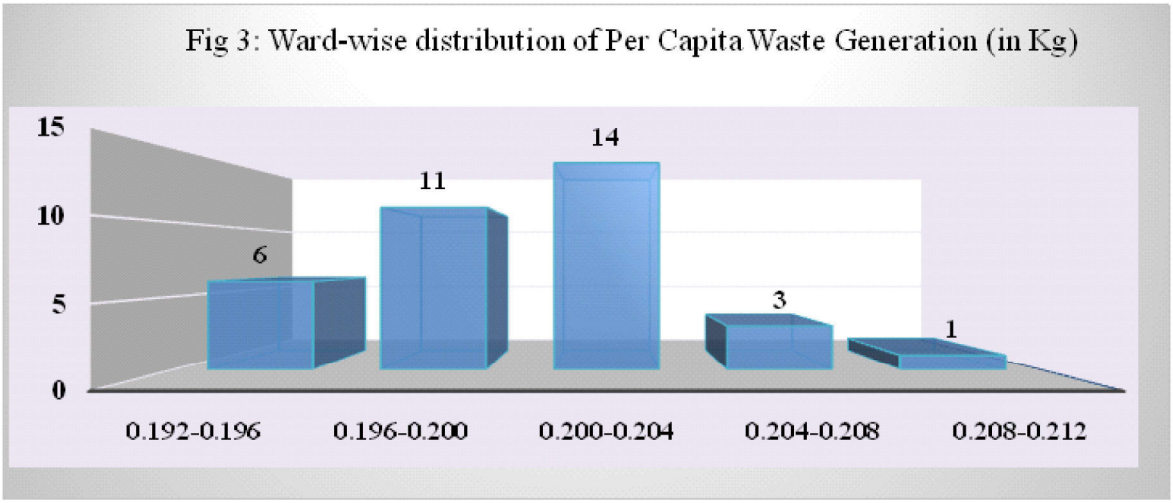
Source: Author's Calculation from the database of Burdwan Municipality, 2019

Per capita Waste reflects the contribution of individual citizen in waste generation in municipal area. Individual citizen of Burdwan municipality creates around 200 grams waste per day. The bulk amount of per capita waste (more than 0.208 kg) generation is found in one ward; moderate amount of per capita waste (0.2 - 0.204 kg) generation are found in fourteen wards; mild amount of per capita waste (less than 0.196 kg) generation is found in six wards only (Table 8 and Fig 3).

Table 8: Ward-wise distribution of Waste per Capita Generation (in kg)in 2019

Per Capita Waste Generation (in kg)	Frequency
0.192-0.196	6
0.196-0.200	11
0.200-0.204	14
0.204-0.208	3
0.208-0.212	1
Total	35

Source: Author's Calculation from the database of Burdwan Municipality, 2019



Source: Author's Calculation from the database of Burdwan Municipality, 2019

The analysis on the distributional pattern of waste generation helps the municipal authority to identify actual locations with high and low amount of garbage. It would be helpful for municipal authorities to collect and clean the garbage optimally with appropriate allocation of resources (like man and machines) in time.

The above said Ward-wise distribution of municipal waste generation is helpful for municipal authorities to control/manage it and keep city clean using appropriate infrastructure manage system for MSW.

C: Distributional pattern of Infrastructure associated with municipal solid waste management

Municipal solid waste management crucially depends on population[9] and available municipal infrastructure like dustbins, vat or/and garbage points, vehicles, etc. Quality of urban life crucially depends on its infrastructure particularly solid waste management related infrastructure such as dustbins, vats or garbage points, open dumping spots, or garbage vans, build up drainage system, and waste transport system like tricycle vans, light vehicles or heavy vehicles, etc. Each municipal administrative ward has at least one concrete dustbin; however, question arises related to its maintenance and garbage clearance in regular intervals. Apart from it, here we consider and discuss only garbage points like vats and tricycle vans which is kept as garbage point in wards and managing the generated solid waste daily.

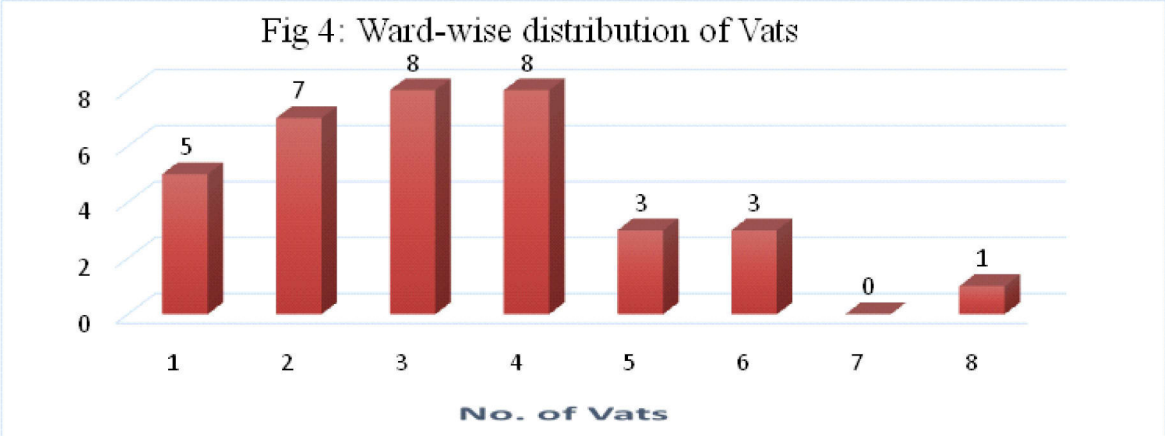
[9]See population distribution in Appendix

Dustbins and Vats: Garbage dumping points and/or dustbins and vats are the most important municipal infrastructure where households and/or individuals dump their generated solid wastes. Recently most of the dustbins are replaced by vats and mobile vans in several wards and slowly mechanisation is also introduced partially in Burdwan Municipality. On an average 3 to 4 vats are required in each ward of Burdwan Municipality, however, in reality it varies widely from 1 to 8 vats. So, distribution of vats in wards is not proper. It is observed that, one third wards have 1 to 2 vats only, and 3 to 4 vats are available in sixteen wards or nearly fifty percent wards have 3 to 4 vats. Numbers of 5 to 6 vats are available in six wards and the highest number of available vats is 8 in one ward only (Table 9 and Fig 4). There is no rationality behind the distribution of vats in Burdwan Municipality.

Table 9: Ward-wise distribution of Vatsin 2019

Number of Vats	Frequency
1	5
2	7
3	8
4	8
5	3
6	3
7	0
8	1
Total	35

Source: Author's Calculation from the database of Burdwan Municipality, 2019



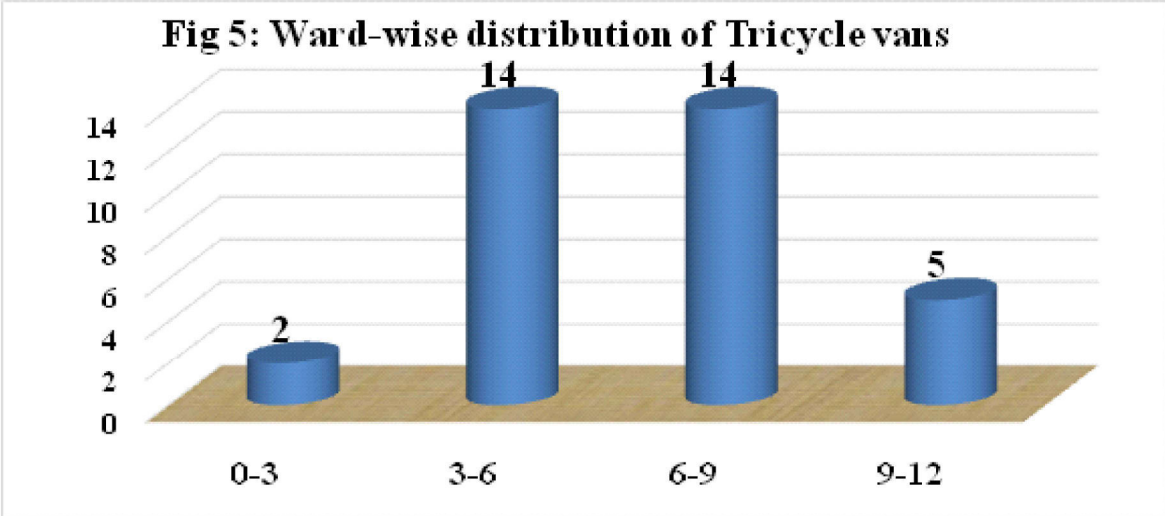
Source: Author's Calculation from the database of Burdwan Municipality, 2019

Tricycle Vans: Tricycle van is the bare minimum vehicle which is required to carry municipal solid waste from one location to other locations or from small to larger garbage points/vats. Tricycle van is available ward wise for collection of solid wastes and maintains cleanliness of the city. In Burdwan Municipality, it is found that 80% wards have 3-9 Tricycle vans. Only less than 3 and more than 9 Tricycle vans are available in 2 and 5 wards, respectively in Burdwan Municipality (Table 10 and Fig 5).

Table 10: Ward-wise distribution of Tricycle vansin 2019

Number of Tricycle vans	Frequency
0-3	2
3-6	14
6-9	14
9-12	5
Total	35

Source: Author's Calculation from the database of Burdwan Municipality, 2019



Source: Author's Calculation from the database of Burdwan Municipality, 2019

Around 20 - 30 workers are available in major (twenty-seven) wards, in which population is also nearly moderate or within median class. More than forty workers are available in one ward only.

Table 11: Ward-wise distribution of Workersin 2019

Number of Workers	Frequency
10-20	5
20-30	27
30-40	2
40-50	1
Total	35

Source: Author's Calculation from the database of Burdwan Municipality, 2019

Discussion

Now here we discuss about the waste management system of Burdwan Municipality. Figure 1 shows the frequency distribution which suggests 2 wards are generating more than 3 MT waste per day and wards are identified such as ward No.6 and ward No.12 from Figure 2. Similarly, we have also identified 6 wards (ward No. 20, 34, 28, 30, 31 and 32) generating the least amount of waste (less than and equal to one MT per day).

So, few wards generate huge amount of solid waste while these wards have moderate or low population. Some wards generate low amount of solid wastes due to proper management with available infrastructure like dustbins, vats and try cycle vans. Most of the wards have moderate population, worker per ward, vats, try cycle vans, etc. In this context the regression analysis indicates that generation of solid wastes in wards are directly associated with population, number of households, and municipal infrastructure, however, municipal management is insignificant (see, Table A.2 in Appendix). A depth and rigorous statistical analysis will help to understand the variation of waste generation. We should cover it separately, however, continuing our discussion it is important to know the relative position of Burdwan Municipality comparing State and National level.

A Comparative Analysis

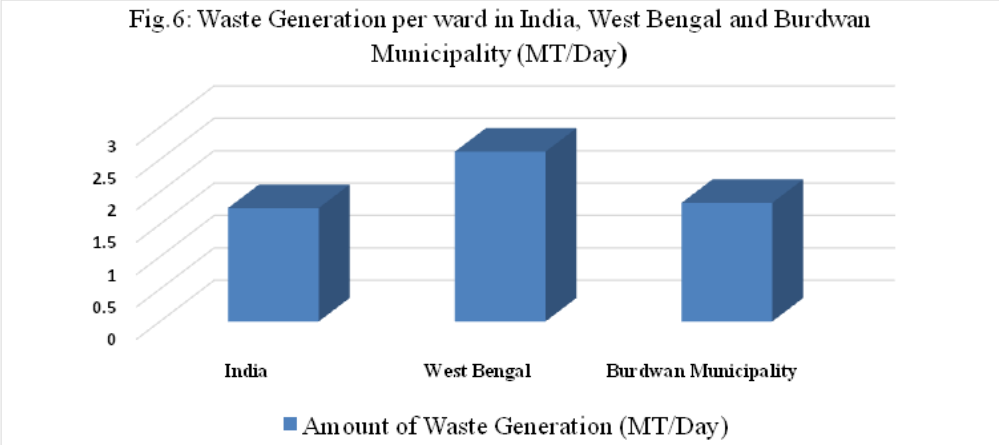
Now, we discuss about relative position of Burdwan Municipality comparing with State and National level. Daily ward average waste generation is used for a comparative analysis. In other words, daily ward average waste generation in Burdwan Municipality is how far away from that of India and West Bengal. There are 84475, 2938 and 35 wards in India, West Bengal and Burdwan Municipality, respectively (see Table 12).

Table 12: Amount of waste generation and number of wards in India, West Bengal and Burdwan Municipality in 2019

Items	Amount of Waste Generation (MT/Day)	No of Wards	Waste Generation per ward (MT/Day)	No of Wards in Burdwan Municipality (<)	No of Wards in Burdwan Municipality (>)
India	147614	84475	1.75	18	17
West Bengal	7700	2938	2.62	29	6
Burdwan Municipality	63.1	35	1.80	19	16

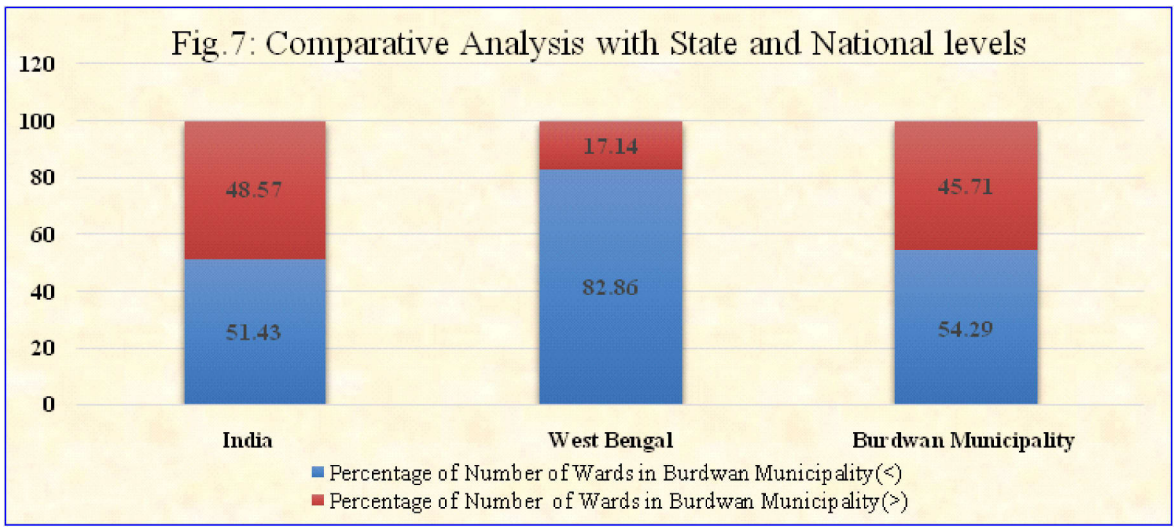
Source: MoHUA, 2020 and Author's computation

Table 12 shows that wastes are generated in India, West Bengal and Burdwan Municipality respectively amount of 147614, 7700 and 63.1 MT per day. Waste generation per ward in India, West Bengal and Burdwan Municipality are respectively 1.75, 2.62 and 1.80 Metric ton per day (Table 12 and see, Fig 6). Burdwan Municipality generates waste 1.80 MT/day per ward which is below State (2.62 MT/day/ward) and above India (1.75 MT/day/ward).



Sosurce : MoHUA, 2020 and Author's Computation

Table 12 also provides that number of wards of Burdwan Municipality are below and above State and National average (waste generation per ward). It is noted that 18 and 29 wards of Burdwan Municipality generate less than National and State average, while 17 and 6 wards are above National and State average. 19 wards generate less than average waste in Burdwan Municipality and 16 wards are greater than average waste generation in this Municipality[10].A comparative analysis of waste generation between Burdwan Municipality,India and West Bengal, and it is clearly observed that 51.43% and 82.86% wards of Burdwan Municipality are below the respective averages of India and West Bengal (see Fig 7).



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[10]Commercial places are situated in some wards that generate huge amount of solid waste while these wards have moderate or low population.

6. Conclusion

The paper has examined the distributional pattern of solid waste generation in Burdwan Municipality and identifies residential and non-residential premises as major source points of waste generation. This study also observes the classification wise solid waste generation. Biodegradable waste is the largest contributor in solid waste generation in Burdwan Municipality. This study observes the contribution of LIG and HIG households generate more municipal solidwaste compared to others in RPs and commercial places generate more MSW than institutions, etc. The paper examines solid waste distributional pattern in wards, household and per capita levels. The paper also investigates the distribution of basic municipal infrastructure related to SWM which is poor. Following West Bengal Municipal Act 2016, Burdwan Municipality has taken certain technical measurement for solid waste management system partially and need to improve effective governance with adequate staff and machineries.

Certain efforts are required to raise public awareness, education, and discipline civic life for attaining minimum waste. All resident should be aware about their municipal services and must participate and cooperate with the municipality authority. Without cooperation of responsible citizens, the waste management systems will never be implemented. Burdwan Municipality has adopted certain plan for waste management for residents; however, Municipal authority should take different plans and actions for different shopping malls, commercial establishments and market places for their waste generation. Municipality should adopt different policies and should be more active for their management system along with participation of all stakeholders otherwise it will be difficult to attain the clean smart city and/or Swachh Bharat.

The waste management system of Burdwan Municipality may achieve a sustainable and long-term solution for proper waste management if several actions should be implemented at all level such as technical, financial, social and institutional levels. This is our next research agenda.

From the above discussion, it is clear that the waste management system in Burdwan Municipal area is usually moderate. Local administrative advancement, infrastructural progress and financial investment may prospect better outcome from this waste management system.

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Appendix

Table A.1:Ward-Wise Population and Its Distribution in Burdwan Municipality

Ward	Population	Household	Slum Household	Slum Population
1	14476	3080	261	1305
2	9527	2066	319	1595
3	14645	3038	449	2245
4	10105	2136	460	2300
5	7243	1530	900	4500
6	15350	3538	520	2600
7	12372	2732	268	1340
8	6675	1668	36	180
9	5916	1392	249	1245
10	8183	2039	344	1720
11	11535	2812	415	2075
12	16050	3970	118	590
13	11343	2689	310	1550
14	7537	1834	341	1705
15	10708	2575	185	925
16	11353	2609	269	1345
17	10194	2326	651	3255
18	6697	1574	129	645
19	7050	1573	634	3170
20	5185	1060	24	120
21	7005	1488	201	1005
22	8880	1991	683	3415
23	8378	1978	493	2465
24	13270	3192	480	2400
25	9883	2335	293	1465
26	13381	2847	630	3150
27	9361	1988	180	900
28	4436	943	50	250
29	6062	1400	40	200

30	4527	1053	0	0
31	4235	891	93	465
32	4446	1031	83	415
33	6374	1397	378	1890
34	5162	1196	110	550
35	6721	1647	260	1300

Sources: Burdwan Municipality, 2019

Table A.2: Estimated OLS Results of Waste generation in Burdwan Municipality

Variables	M1	M2	M3	M4	M5
Constant	-13.838 (-26.533)	-10.763 (-18.535)	1.424 (7.525)	1.454 (2.510)	.949 (2.809)
No of Population	3.988*** (30.016)				
No of Household		3.833*** (21.688)			
No of Population in Slum			0.001** (2.440)		
Municipal labour force				0.014 (0.614)	
Infrastructure					0.123** (2.662)
R^2	0.965	0.934	0.153	0.011	0.177
Adj,R^2	0.964	0.932	0.127	0.019	0.152
N	35	35	35	35	35

Note: figures in parenthesis are t-values. '***' and '**' denote level of significance at 1% and 5%, respectively.

Source: Author's Calculation; Data Source: Burdwan Municipality, 2019.

Growth of Food Processing Sector in North-eastern Region: Evidence from the State of Assam

Hemanta Das[a] & N. B. Singh[b]

Abstract

This study aims to analyse the status of the food processing sector in the northeast especially considering the state of Assam, and hence, makes a comparative analysis of the food processing sector of Assam and India as a whole. In the earlier section of the study, it explains growth of food processing unit in Assam and India, and found that growth rate of the food processing unit in Assam is comparatively lower than overall India. It, then, present trend of different parameters related to performance of food processing sector like gross value of output per Food Processing Unit (FPU), value added per FPU, profit per FPU, and found that Assam is lagging behind the aggregate India in these parameters. Besides, study finds that the contribution of the Assam's food processing sector to aggregate India has been declining over the year, though seen growth in the food processing unit. This imply that the performance of the sector in the state not impressive and it is not improving. The sector is mainly labour-intensive in the state, although adoption of modern technology is important for higher productivity.

Keywords: Food processing, Nascent stage, diversification, Post-harvestwastage, Value addition, Horticulture.

JEL Classifications: L60, P47, P59, R11

I. Introduction :

The problems like income disparity between cultivators and non-agricultural workers, rural poverty and unemployment, rural-urban migration etc., are growing and becoming a matter of serious concern for a developing country like India. In the country, wherein the number of households engaged in agriculture was 119 million in 2011, it is increasingly realised that high agricultural growth and enhancement of incomes are essential for the welfare of this elephantine size population and to ensure inclusive development of the economy (GOI, 2017). Therefore, the

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focus has now shifted to the income approach, i.e., productivity improvement, resource use efficiency, cropping intensity, crop diversification towards high-value crops, and adding value to agricultural products.

Policymakers are suggesting for development of the food processing sector as it can play a crucial role in increasing value addition to agricultural products, improving farm income and revitalising agrarian growth. The sector establishes a strong backward and forwards linkage as it serves as a link between industry and agriculture. On the one hand, the sector is more raw material incentive and intimately dependent on the agriculture sector, which provides their raw material, and on the other hand, development of this sector possesses a greater possibility to positively affect the farm sector by reducing post-harvest wastage, enhancing farm gate prices, reducing transaction cost (Proctor & Berdegué, 2016). Apart from this, the development of the food processing sector can also promote agricultural diversification towards high-value crops and the commercialisation of farming, and also would create newer jobs as the industry is more labour-intensive than other industries (Sarkar & Karan, 2005). Hence, the growth in the food processing sector will enhance growth in the farm sector. Besides, growth in food processing sector will make significant contribution in food security and diet of population by reducing wastage of food crops.

Over the year, the food processing sector emerged as an important one and considered as sunrise sector of the Indian economy. In the last five years (2014-15 to 2018-19), the sector has been growing at around 10% Average Annual Growth Rate (AAGR) as compared to around 3.11% in agriculture at 2011-12 prices (GOI, 2021a). The total value added by the food processing industry reached 2.24 lakh crores in 2018-19 from 1.30 lakh crores in 2012-13 at 2011-12 prices(GOI, 2022). The sector's growth potential is rising with increase in demand for ready-to-eat processed foods due rapid urbanisation, rising middle-income groups, changing dietary habits and increasing health consciousness of people (Proctor & Berdegué, 2016). However, the sector is at a nascent stage and processed less than 10 percent of total agriculture produce of the country (Dhanya et al., 2020).

India is the second largest producer of agriculture product which is raw materials for the food processing sector and holds the potential to capture the growing demand by developing the sector. According to GOI (2021b), India produces more than one billion tons of agriculturally produced, with 284.83 million tonnes of food grains, 25.23 million tonnes of pulses and 259.60 million tonnes of cereals (rice, wheat, maise, millets, etc.), 31.31 million tonnes oilseeds, 311 million tonnes horticulture product, and more than 400 million tonnes other crops comprised sugarcane, cotton, jute, tea, coffee, tobacco, etc. However, a huge quantity of agricultural

production is deplete from the food chain in the form of post-harvest loss as the Indian food processing sector is at a nascent stage, processed less than 10 percent of the total agricultural produce of the country (Dhanya et al., 2020). As per the report of Jha et al (2015), nearly 4.65-5.99% of cereals, 4.58-15.88% of fruits & vegetables, 6.36-8.41% pulses are losses in India and overall nearly 40% of perishables crops goes waste. Post-harvest losses in India were estimated to be INR 926.51 billion (USD 15.19 billion) in FY2014, representing a significant loss of national wealth.

The north-eastern part of India also possesses huge scope for develop the food processing sector. In the region, agriculture sector's contribution in the State Domestic Product (SDP) ranges from 19 to 37 percent in the states (Rais et al., 2014). Uniquely diverse and suitable agro-climatic conditions in the region offer enormous opportunities to raise foodgrain production as well as horticultural production. Besides, the region is endowed with quality workforce in the form unemployment educated youths and possess potential to engage these workforces for the development of the sector. However, despite these distinct advantages in the north-east, the food processing sector has not grown at par with the rest of the country, and the region's potential has not been tapped.

In the region, Assam is the major contributor to the region's total agricultural produce. The state produced 54.67 lakh tonnes foodgrains and 99.08 lakh tonnes horticulture crops in 2019-20 (GOA, 2021). However, a huge post-harvest loss is becoming a matter of concern in the state, reducing marketable surplus and restraining the growth of the agricultural sector. The estimated loss in horticultural produce is 5 to 30 percent which estimated to be more than 8000 crore rupees per annum (GOA, 2022). Hence, the state has the basic requirements for developing the food processing sector.

2. Literature Review

Food processing that adds value to agricultural produce is seen as a strategy to promote agricultural growth and rural-led employment-oriented economic development (Desai & Namboodiri, 1992). It is assumed that the development of the sectors will increase the potentiality of export earnings, restructure the domestic industry and help address dietary issues.However, food processing in India is very low compared to the international average, although the country holds second place in agricultural production worldwide, after China. There is a wide gap between food production and the processing of items in India. This is due to tough challenges that the sector faces in the form of lack of adequate government support, quality of raw materials, inadequate infrastructure, inaccessibility to the latest technology, lack of skilled manpower, lack of credit facility etc., (Negi, 2015).

There are various factors which determine the growth of food processing sector and identification of these factors is important in order to formulate appropriate policy for growth of the sector. In a study, Desai & Namboodiri (1992)analysed the development and financial performance of the food-processing industries considering selected sub-sectors namely foodgrains milling, edible oilseeds processing, sugar factories and dairy products.The study found that modern processing technology, well infrastructure, and access to institutional finance are the important determinant of the sector's development and suggested to encourage public and private investment, especially in rural areas. In another study, Singh et al (2012) examined performance and growth trends of the food processing industry in India and identified that low awareness among consumers about the nutritious benefit of processed foods, low price elasticity for processed food products; underdeveloped distribution network; inefficient marketing infrastructure; streamlining of food laws; low level of R&D are the challenges that facing by the sector. Similarly, Rais et al. (2013)provided a detailed analysis of the food processing industry and found that there is a wide gap between the quantity of agricultural produce and the processing of items. They found that due to a lack of skilled manpower and low adoption of modern science & technology, the industry failed to work at its potential and suggested for government support to strengthen S&T capability, infrastructure and skill set in order to develop the food processing industry. Similarly, Shukla (2019) found that a fragmented and lengthy supply chain, inadequate infrastructure, lack of skilled manpower, low adherence to quality standards are the major challenges faced by this sector. He added that the development of value-added agri-business is the only practical and sustainable way ahead, and if we are not able to develop this sector, we will miss out on a golden opportunity to bring the rural workforce into the mainstream. Further, Shelly & Kaur (2015) analysed the contribution of Foreign Direct Invest (FDI) in the growth of the Indian food processing sector and found that FDI significantly contributed to the development of the sector. They suggested that policy should focus on supporting this sector and attracting more FDI to develop the country as a food processing hub and connect it to the foreign production network.

Apart from this, investigation of the efficiency and productivity dimension of the food processing sector also important as it reveals the strength and weakness of the sector. Researchers like Baliyan et al. (2015) examine total factor productivity change in the Indian food processing sector during the pre-liberalisation and post-liberalisation periods. Their study found that the overall TFP change in the food processing industry increased from the pre-liberalisation period to the post-liberalisation period. However, they found that the lack of modern technologies and limited resource utilisation are the main constraints in the growth path of the Indian food processing industry. Bhandari & Vipin (2016)attempted to measure the performance and some technical aspects of the food processing industry during 2000- 2015.They found that vegetable oils &

products and beer & alcohol industries are functioning efficiently, but the sugar, dairy and tea industry has scope to increase efficiency. They revealed that the age of the production unit, R&D intensity, and infrastructural factor has a significant positive impact on the food processing industry's efficiency, but marketing intensity is negative in this regard. Similarly, Shilpa & Amulya (2019) analysed employment and value additionin the industry. They observed that the technical efficiency of the food processing industry in India has increased, but the scale efficiency and total factor productivity have decreased. However, N.P (2019) examined the performance of the unorganised food processing industryand reveal that the industry is unable to realise its full potential. Using Stochastic Frontier Analysis (SFA) on NSS 73rd (2015-16) round unit-level data, the study reveals that the industry is unable to realise its full potential. They found that inefficiency in the enterpriseis mainly due to lack of skilled labour, lack of credit and unavailability of full-time workers.

Moreover, various scholars have appraised the status, prospects and challenges faced by the sector in different regional settings. Dev & Rao (2004) in their study investigated the opportunities and challenges of the processing sector in the state of Andhra Pradesh. Similarly, Ravita (2011) identified the problems and prospects of agro-based industries in Punjab and analysed the growth pattern. G. S. Mehta (2012) examined the impact of agro-processing industries in increasing in come and development prospects and emerging problems in the sector in Uttar Pradesh and suggested measures that to be initiated to develop the agro-industries. In another study by Venkatesh et al. (2017) based on a comprehensive survey conducted in Tamil Nadu, evaluate the role of the processing sector in enhancing farmers' income. The study found that farmers with processing industry linkage could earn about 49 per cent average additional income compared to those not linked.

Few scholars have also investigated different dimensions of the food processing sector in the North-eastern region. Rais et al.(2014) analysed the challenges faced by the food processing sector in the North East region and the impact of the food processing sector on farmers' income. They observed that simple activities like cleaning, sorting and packaging could add value to products and enhance farmers' income by 42.8% per kg. However, they revealed that the food processing sector in the region is highly unorganised and inefficient due to a lack of infrastructure facilities and suggested to improve the infrastructure urgently. Similarly, Raleng & Singh (2021) also analysed the problem and prospects of the sector in the state. They revealed that lack of advanced processing machinery and technologies, unavailability of skilled manpower, inadequate R&D activities, lack of training facilities, inefficient supply chain, unorganized nature of sector, weak marketing support, lack of proper post-harvest infrastructures likewarehouses, cold storage, poor transportation infrastructure are major challenges the sector facing in the state.

Using a social accounting matrix analysis, Das et al. (2013) attempts to evaluate the benefits accrued form the establishment of food processing units by the surrounding villages in Assam. Their study found that people from the nearest village get benefits in the form of output rise, income enhancement, employment opportunity, and consumption increase. Khati & Kim(2020) analysed the drivers of the food processing sector in Assam especially considering the status of the region's human resources and skills development. Using secondary data, they also made a comparison of the performance of the sector of all the north-eastern states and found that Assam is the leading state in terms of output and productivity.

3. Research Gap

It is evident from the above literature that very little research has been conducted on different aspects of the food processing sector in the northeast. The available studies are mostly confined to identifying the scope, prospects and challenges faced by the firms and farmers. It is very important to analyse and identifies the prospects and problems faced by this industry for different regional setting, asthey are vastly different from region to region. But it is also highly pertinent to investigate the performance of the region's food processing industry and compare it with all India aggregate. At the same time, analysis of the contribution of different sub-sectors to the region's food processing industry is considered to be equally important for better insight. Hence, considering the lacuna, the present study is a modest attempt to fill the gap considering the state of Assam, which is the major contributor to the region's total agricultural production. Such analysis will provide an opportunity to enhance the lagging indicators to improve the performance of the food processing industry in the region.

4. Research Questions

In particular, the current paper aims to answer the following research questions:

a) Whether Gross value of output per FPU, Gross value added per FPU, Profit per FPU, Investment per FPU, Outstanding loan per FPU, Capital formation per FPU, Person engaged per FPU and Input-output ratio is higher or lower in Assam than overall India over the period?

b) In different parameters relating to the performance food processing sector, whether the contribution of Assam's food processing sector to India's overall food processing sector increasing or not?

c) Which sub-sector is contributing most to Assam's food processing sector in terms of Number of FPU, Gross output, Capital formation and employment over the period?

5. Objective of the Study

a) To analyse year to year Growth of FPU of Assam vis-à-vis India.

b) To analyse the trend of different parameters relating to food processing sector of Assam vis-à-vis India.

c) To explain the contribution of Assam's food processing sector to India's overall food processing sector in different parameters.

d) To explain the contribution of the sub-sectors to Assam's food processing sector in different parameters.

6. Data and Research Methodology

The current study is based on secondary data. Data was extracted from the Annual Survey of Industries (ASI) catalogue of EPWRF time-series data for the organised food processing sector (3-digit level as per NIC-2008) for a period of twenty years (2000-01 to 2019-20).The required data is available in concorded form, considering 2011-12 as the base year. For analysis, the study considered only six sub-sectors of the food processing sector, namely "processing and preserving of fruit and vegetables (NIC-103)","manufacture of vegetable and animal oils and fat (NIC-104)", "manufacture of dairy products (NIC-105)", "manufacture of grain mill products, starches and starch products (NIC-106)", "manufacture of other food products (NIC-107)" and "manufacture of beverages (NIC-110)".The collected data has been analysed with the help of table and diagram.

7. Analysis and findings

7.1. Growth trend of the food processing unit of Assam and India

A developed food processing sector and its strong linkage with the farm sector is important for reducing post-harvest wastage and sustainable growth of the agriculture sector(Varshney & Ghosh, 2013). Therefore,the Ministry of Food Processing Industries, Government of India is extending various incentives to makethe food processing sector a vibrant one. In this section, we analysed the growth trend of the food processing unit of Assam and India during 2000-2001 to 2019-2020. Table 1, expresses that the number of food processing units increased from 868 and 23,171 in 2000-2001 to 1,573 and 39,586 in 2019-2020 in Assam and India,respectively. However, the year-wise growth rate of the food processing unit is not consistent for both Assam and India; sometimes, it is highly positive and sometimes, even negative. The highest growth rate (16.39%) in number of FPU in Assam was seen in 2010-2011 followed by 14.63% in 2008-2009. India's highest growth rate was seen in 2010-2011, which was 30.95%. The Compound Annual Growth rate of the food processing unit in Assam and India is 2.86% and 3.18%,

respectively, from 2000-2001 to 2019-20. It shows signs of expansion of the sector in Assam and Aggregate India. However, the compound annual growth is lower in Assam compared to aggregate India, and it implies slow growth of the sector in the state.

Table 1: Year-wise number of FPU and growth rate (2000-2001 to 2019-2020)

Year	Number of Food processing unit		Year to Year Growth rate (%)	
	Assam	**India**	**Assam**	**India**
2000-2001	868	23171	N/A	N/A
2001-2002	804	22646	-7.37	-2.27
2002-2003	834	23027	3.73	1.68
2003-2004	855	23002	2.52	-0.11
2004-2005	897	24479	4.91	6.42
2005-2006	942	24806	5.02	1.34
2006-2007	910	24800	-3.40	-0.02
2007-2008	875	25247	-3.85	1.80
2008-2009	1003	26231	14.63	3.90
2009-2010	1007	26429	0.40	0.75
2010-2011	1172	34610	16.39	30.95
2011-2012	1207	35589	2.99	2.83
2012-2013	1248	35699	3.40	0.31
2013-2014	1287	36016	3.13	0.89
2014-2015	1310	37130	1.79	3.09
2015-2016	1347	37718	2.82	1.58
2016-2017	1402	38049	4.08	0.88
2017-2018	1463	38454	4.35	1.06
2018-2019	1563	38813	6.84	0.93
2019-2020	1573	39586	0.64	1.99
CAGR (%)	**2.86**	**3.18**		

Source: Researcher's calculation based on ASI data

7.2. Performance of the food processing sector of Assam and aggregate India

The gross value of output, gross value added, profit, and input-output ratio - are the parameters which explain the performance of the food processing sector. Therefore, this section tried to explore the trend of these parameters over the years for Assam and India and compare the performance of the sector. Besides, we also tried to explain the trend of other parameters like investment, credit access (outstanding loan), capital formation, and person engaged or labour employed, which are vital determinants of the performance of an enterprise. In the figures (see Figure 1), we have shown the trend of different parameters of the food processing sector of Assam vis-à-vis India.

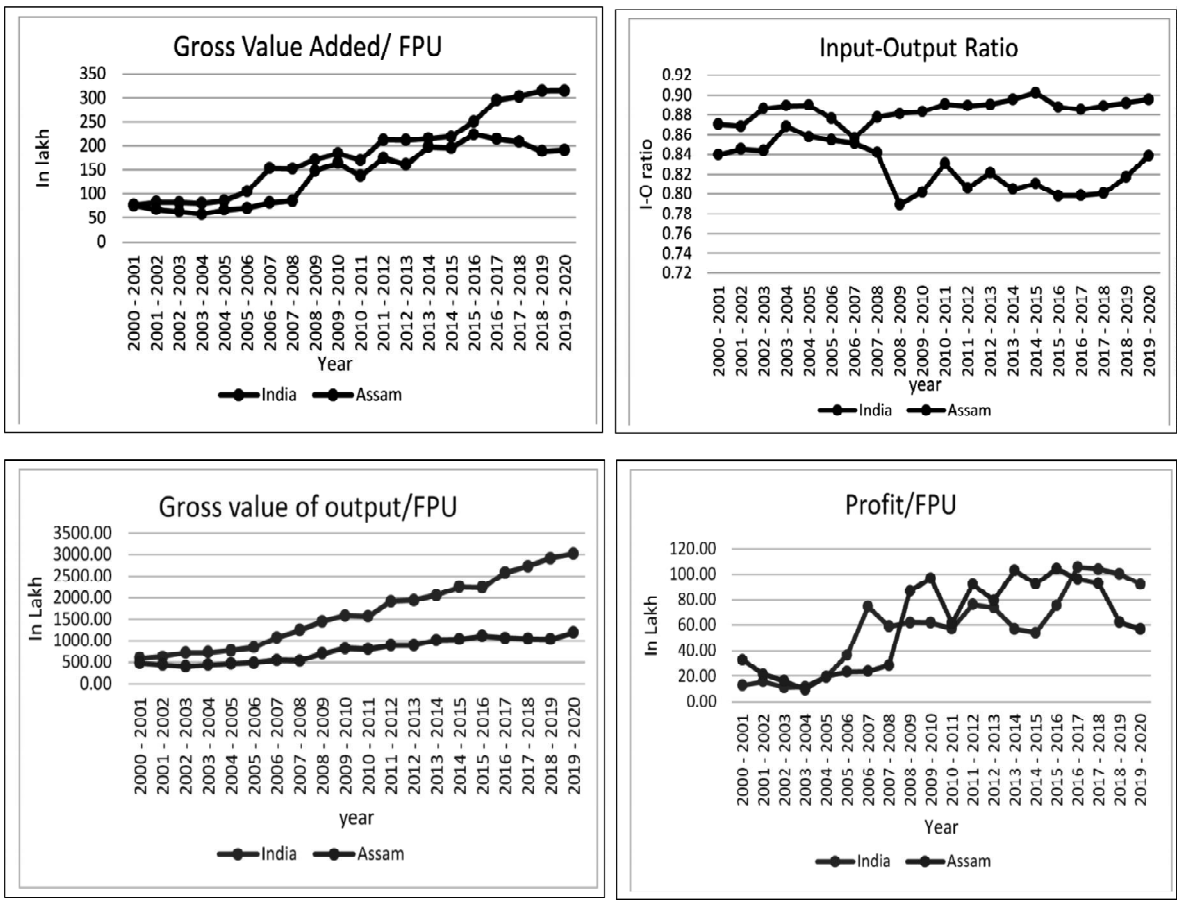

Figure 1: Trend of different parameters relating to food processing sector of Assam vis-à-vis India
Source: Prepared by Researcher using estimate from ASI data

[1]Input/output,where input comprise raw material & fuelconsumed, and gross value of output considered as output

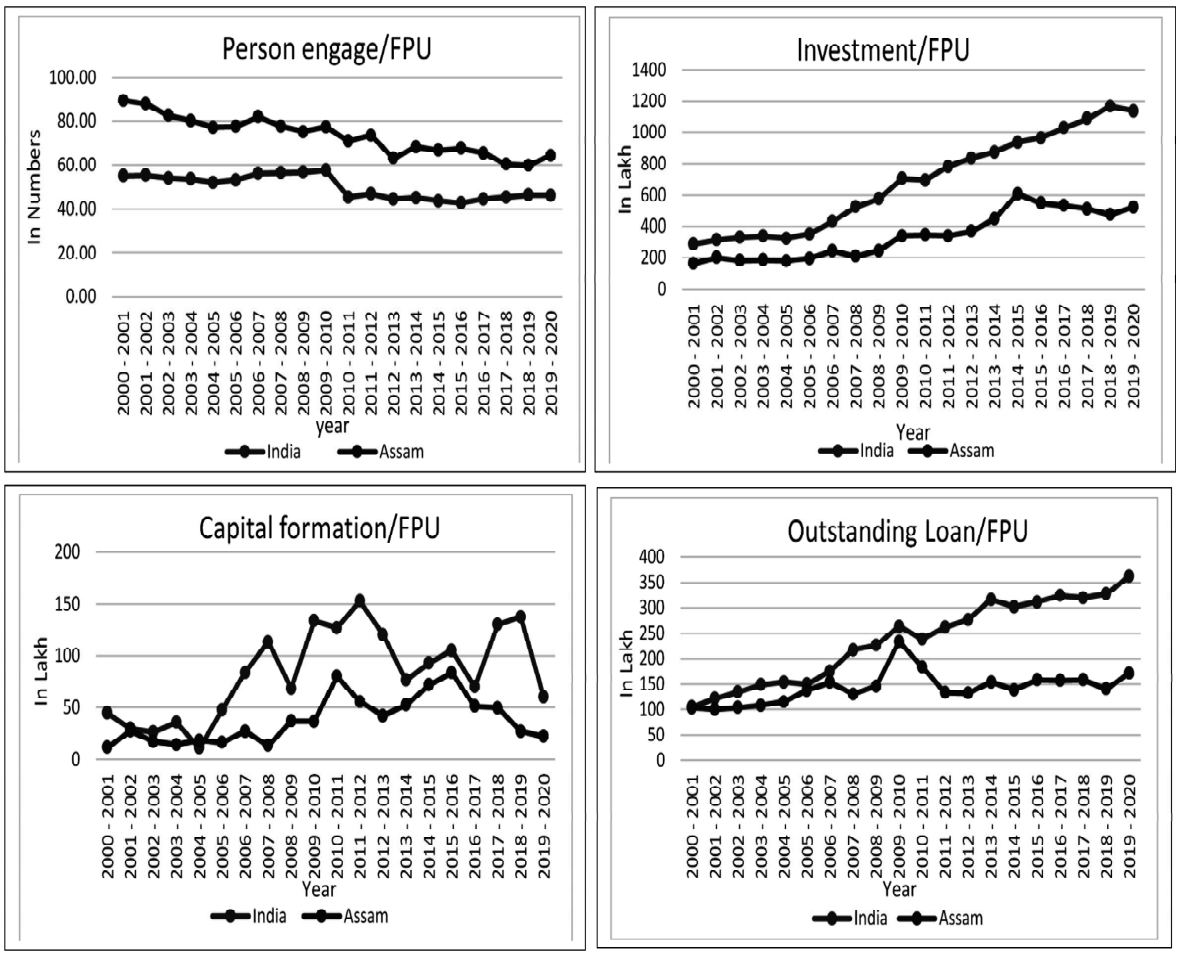

Figure 1: Continued

Figure 1 shows that the value of gross output per FPU is increasing in both Assam and India over the period. However, the trend line shows that the value of gross output per FPU in Assam is much lower than aggregate India, and this difference has increased each year. Similarly,value added per FPU is consistently growing in both Assam and India, and value added per FPU in Assam is comparatively lower than aggregate India. Here, we have seen that this difference has not increased in each year; only from 2016-2017, the difference started widening. On the other hand, in the profit and input-output ratio, we have seen exceptional. The trend line of profit per FPU shows that it is higher for Assam than India in most of the years, except the years 2005-2006, 2006-2007, 2007-2008 and the last four years. Similarly, the trend line of input-out ratio shows that the input-output ratio for FPU in Assam is lower than India, which implies that FPU in

Assam produces higher output at given input or produces a given level output using lower input than Aggregate India.

From Figure 1, it is also observed that Assam's food processing sector is mostly labour-intensive. Capital formation per FPU in Assam was continuously lower than in India over the period; even it was more likely the same up to 2004-2005. In contrast, if we look at labour engagement per FPU, we will see that even though it is declining continuously, it is still higher than aggregate India. Besides, there has been a continuous rise in the gap in the trend line of loans received (or outstanding loans) per FPU in Assam and India. While loans received (or outstanding loans) per FPU are continuously rising for aggregate India, it is more or less stagnant in Assam. In the case of investment also, Assam's food processing sector is lagging behind aggregate India. Even though investment per FPU in Assam increased over the year, it is much lower than in India, and the difference in this has increased during the period.In this regard, researchers may conclude that the performance of the food processing sector in Assam is not impressive and has not improved significantly during the period of the study compared to other states and regions. This could be due to low access to credit, low capital formation and low investment.

7.3. Contribution of Assam's food processing sector to India's overall food processing sector

Table 2 and Figure 2 present the contribution of Assam's food processing sector to India's overall food processing sector in respect of eight parameters, i.e., number of food processing unit, value of gross output, gross value added, profit, capital formation, person engaged, outstanding loan and investment to aggregate India. It shows that the number of food processing unit has slightly increased from 3.75% to 3.97%, the value of gross output has decreased from 2.99% to 1.56%, gross value added has decreased from 3.71% to 2.42%, profit has decreased from 9.70% to 2.45%, capital formation has increased from 0.97% to 1.47%, person engaged has decreased from 6.09% to 5.54%, the outstanding loan has decreased from 3.68% to 1.89% and share of investment has decreased from 2.13% in 2000-2001 to 1.83% in 2019-2020.

Table 2: Contribution of Assam's food processing sector to India's overall food processing sector in different parameters(in %)

Year	NFPU	VGO	GVA	Profit	C F	PE	OL	Investment
2000-2001	3.75	2.99	3.71	9.70	0.97	6.09	3.68	2.13
2001-2002	3.55	2.47	2.91	4.83	3.27	5.63	2.93	2.28
2002-2003	3.62	2.02	2.77	5.19	2.37	5.53	2.79	2.00
2003-2004	3.72	2.23	2.66	3.06	1.49	5.56	2.69	2.04
2004-2005	3.66	2.20	2.83	3.77	6.07	5.43	2.72	2.04

2005-2006	3.80	2.17	2.56	2.42	1.29	5.55	3.49	2.12
2006-2007	3.67	1.88	1.95	1.17	1.20	5.36	3.21	2.08
2007-2008	3.47	1.50	1.94	1.68	0.41	4.77	2.08	1.39
2008-2009	3.82	1.86	3.30	5.35	2.06	5.07	2.46	1.63
2009-2010	3.81	2.00	3.40	5.96	1.05	5.12	3.38	1.84
2010-2011	3.39	1.76	2.73	3.64	2.14	5.28	2.60	1.69
2011-2012	3.39	1.60	2.79	4.10	1.24	5.32	1.73	1.48
2012-2013	3.50	1.62	2.65	3.76	1.22	4.96	1.67	1.55
2013-2014	3.57	1.76	3.29	6.45	2.45	5.40	1.74	1.83
2014-2015	3.53	1.62	3.15	6.04	2.72	5.38	1.62	2.29
2015-2016	3.57	1.78	3.20	4.94	2.84	5.63	1.82	2.03
2016-2017	3.68	1.52	2.67	3.35	2.69	5.42	1.78	1.91
2017-2018	3.80	1.46	2.61	3.40	1.45	5.05	1.89	1.79
2018-2019	4.03	1.43	2.42	2.51	0.80	5.19	1.73	1.64
2019-2020	3.97	1.56	2.42	2.45	1.47	5.54	1.89	1.83
Average	3.67	1.87	2.80	4.19	1.96	5.36	2.40	1.88

Source: Researcher's calculation based on ASI data

Note: NFPU = Number of food processing unit VGO = Value of gross output

CF = Capital Formation PE= Person engaged OL= Outstanding loan

The average contribution in the number of food processing units, the value of gross output, gross value added, profit, capital formation, person engaged, outstanding loan and investment were 3.67%, 1.87%, 2.80%, 4.19%, 1.96%, 5.36%, 2.40% and 1.88%, respectively, for the period from 2000-2001 to 2019-2020. Here, we have seen that the share of Assam's food processing sector in the number of the food processing unit is more or less constant; however, the contribution in gross output, gross value added, and profit declined. This indicates a weakening in the performance of the food processing sector in Assam. However, it is important to note that the share in loans received by the food processing sector of Assam also declined,and it may be the one cause of falling in investment in the sector.

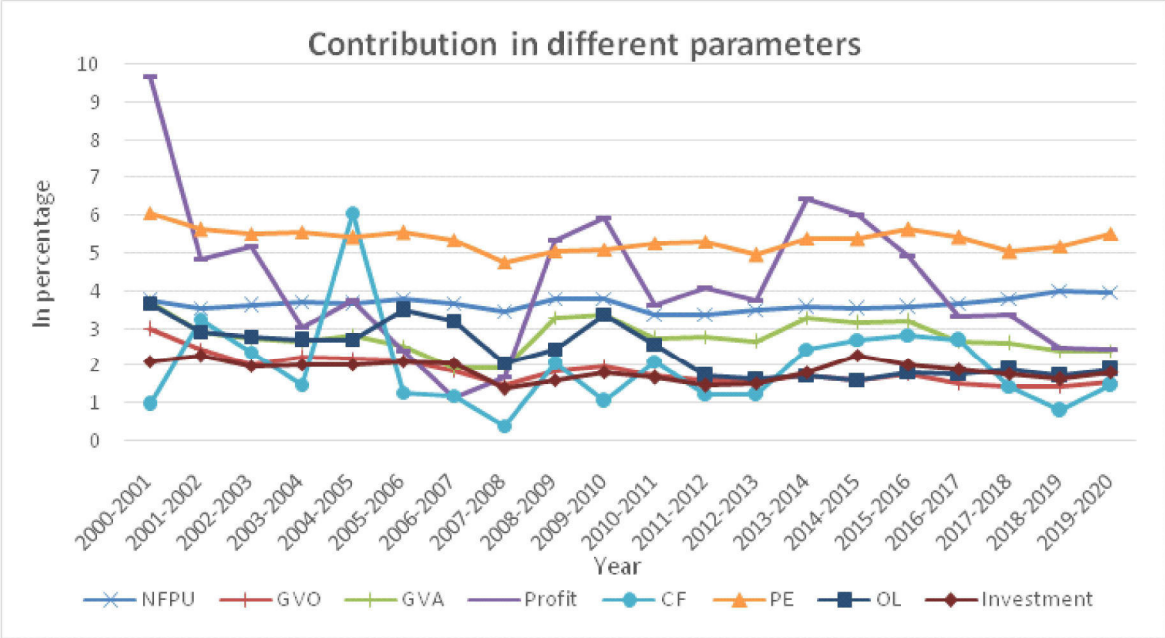

Figure 2 : Trend of contribution of Assam's food processing sector to India's overall food processing sector in different parameters (2000-01 to 2019-20)

Source: Prepared by Researcher using estimate from ASI data

7.4. Contribution of sub-sectors to Assam's food processing sector

Table 3 presents the contribution of the sub-sectors of Assam's food processing sector to the overall sector in the number of food processing unit, value of gross output, capital formation and person engaged (or employment). The table reveals that in number of food processing unit, "manufacture of other food products (NIC-107)" has the highest share in each quinquennial year, i.e., 69.51%, 64.89% and 63.57%, respectively. The "manufacture of grain mill products, starches and starch products (NIC-106)" has the second highest contribution. However, it is seen that while other sub-sectors' contribution has risen over the year, the contribution of "manufacture of other food products (NIC-107)" has fallen."Processing and preserving of fruit and vegetables (NIC-103)" and "manufacture of dairy products (NIC-105)" are the two sub-sector which has the lowest contribution.

Table 3: Sub-sector's share in each parameter to overall food processing sector in Assam over the last three quinquennials ending.

	Number of units & Share to FPS		
Sub-Sectors	**2009-2010**	**2014-2015**	**2019-2020**
NIC-103	6(0.60)	20 (1.53)	38 (2.43)
NIC-104	44 (4.37)	47 (3.59)	53 (3.37)
NIC-105	6 (0.60)	12 (0.92)	15 (0.95)
NIC-106	219 (21.75)	311 (23.74)	333 (21.17)
NIC-107	700 (69.51)	850 (64.89)	1000 (63.57)
NIC-110	32 (3.18)	70 (5.34)	134 (8.52)
FPS	1007 (100)	1310 (100)	1573 (100)

	Value of gross output (In lakh) & Share to FPS		
Sub-Sectors	**2009-2010**	**2014-2015**	**2019-2020**
NIC-103	10307 (1.23)	6303 (0.47)	79957 (4.27)
NIC-104	8878 (1.06)	15536 (1.15)	22655 (1.21)
NIC-105	1047 (0.13)	7186 (0.53)	16586 (0.89)
NIC-106	117446 (14.0)	147769 (10.92)	361075 (19.28)
NIC-107	667668 (79.77)	1112771 (82.26)	1288470 (68.79)
NIC-110	31640 (3.78)	63149 (4.67)	104372 (5.57)
FPS	836986 (100)	1352714 (100)	1873115 (100)

	Capital Formation (In Lakh) & Share to FPS		
Sub-Sectors	**2009-2010**	**2014-2015**	**2019-2020**
NIC-103	1374 (3.71)	926 (0.98)	349 (0.99)
NIC-104	469 (1.26)	210 (0.22)	1845 (5.22)
NIC-105	20 (0.05)	338 (0.36)	325 (0.92)
NIC-106	3269 (8.82)	7836 (8.31)	1164 (3.29)
NIC-107	30470 (82.17)	81592 (86.44)	26226 (74.15)
NIC-110	1478 (3.99)	3483 (3.69)	5461 (15.44)
FPS	37080 (100)	94322 (100)	35370 (100)

	Employment (In Numbers) & Share to FPS		
Sub-Sectors	**2009-2010**	**2014-2015**	**2019-2020**
NIC-103	374 (0.44)	460 (0.53)	1835 (1.81)
NIC-104	471 (0.60)	454 (0.52)	350 (0.35)
NIC-105	231 (0.30)	423 (0.48)	551 (0.54)
NIC-106	2610 (3.35)	2533 (2.90)	4812 (4.75)
NIC-107	72901 (93.45)	80242 (91.73)	91040 (89.88)
NIC-110	1448 (1.86)	3364 (3.85)	2700 (2.67)
FPS	78008 (100)	87476 (100)	101288 (100)

Source: Researcher's calculation based on ASI data

Note: Figures within the parentheses are the contribution percentage to each parameter in corresponding years.

Again,"manufacture of other food products (NIC-107)" and "manufacture of grain mill products, starches and starch products (NIC-106)" has the first and second highest contribution, respectively in gross value of output. Here, only the contribution of "manufacture of other food products (NIC-107)" has fallen, but other sub-sectors contribution has risen over the year. "Manufacture of dairy products (NIC-105)" is the lowest contributor in each quinquennial year.

In the case of capital formation, we have seen a similar trend. The contribution of "manufacture of other food products (NIC-107)" is the highest, followed by the sub-sector "manufacture of grain mill products, starches and starch products (NIC-106)". There is significant growth in capital formation in the sub-sector "manufacture of vegetable and animal oils and fat (NIC-104)" and "manufacture of beverages (NIC-110)". It is seen that there is a drastic fall in share in capital

formation in the sub-sectors "manufacture of grain mill products, starches and starch products (NIC-106)", and "processing and preserving of fruit and vegetables (NIC-103)". Share in capital formation in the "manufacture of grain mill products, starches and starch products (NIC-106)" sub-sector fell from 8.82% in 2009-2010 to 3.29% in 2019-2020 and in "processing and preserving of fruit and vegetables (NIC-103)" fallen from 3.71% in 2009-2010 to 0.99 in 2019-2020. "Manufacture of dairy products (NIC-105)" has the lowest share in capital formation in each quinquennial year.

In employment, the contribution of "manufacture of other food products (NIC-107)" is highest over the year. However, employment in this sub-sector has declined each year. It is also noticeable that in the sub-sectors like "processing and preserving of fruit and vegetables (NIC-103)", "manufacture of vegetable and animal oils and fat (NIC-104)" and "manufacture of grain mill products, starches and starch products (NIC-106)", contribution in employment has risen.

From this analysis, we can say that the sub-sector "manufacture of other food products (NIC-107)" is the highest contributed one, followed by the sub-sector "manufacture of grain mill products, starches and starch products (NIC-106)". And the "processing and preserving of fruit and vegetables (NIC-103)" and "manufacture of dairy products (NIC-105)" sub-sectors are the smaller sub-sectors.

8. Discussion

Considering the leading agriculture-producing state in NER, the study tried to analyse the performance of the food processing sector in Assam in comparison with all India aggregate. The study finds that Assam's food processing unit's growth rate is comparatively lower than overall in India. In Assam, the food processing unit grows at 2.86%, whereas in India, it is at 3.18%. Analysis shows that gross output value per FPU and value added per FPU is significantly lower in Assam than in India. Similarly, profit per FPU in Assam is also seen lower than India in past few years starting from 2016-2017, even it was higher in most of the earlier years. Besides,the study found that the contribution of Assam's food processing sector to aggregate India has been continuously falling over the year, despite significant growth in the number of food processing units in the state.

There are various factors which may be responsible for such low and deteriorating performance of the sector in the state. Low level of credit availability in the state is the one of such factors which are responsible for low and deteriorating performance of the sector. Due to low credit availability, capital formation and investment in the sector is very low and also declining, which in turn weakens the performance of the sector. Dhanya et al. (2020) also mentioned that loan

availability or access to credit is very important for the growth of the food processing sector. Similarly, Singh et al. (2012) and Negi (2015) also revealed that lack of credit, capital, and low investment are the major issues facing the food processing sector.

Besides, there is lack of proper post-harvest infrastructures likewarehouses, cold storage, marketing infrastructure, and transportation infrastructure in the state in particular and region in general, which might be another reason that investors are not getting attracted to invest in the region, and resulting in low investment in the sector in the state as well as in the region. At the same time, insurgency issue in the region also responsible.

It is worth mentioning that the sector in the state is labour-intensive, which was also noted by Rais et al.(2014).The adoption of the labour-intensive method of production by the food processing industry can link to the availability of the huge labour force in the state and cheap wage rates. Labour engagement per FPU in Assam is significantly higher than aggregate India and accounts for an average 5.36% of the overall food processing sector of the country. This result is corroborates with the finding of Khati & Kim (2020). However, due to inadequate R&D activities and lack of training facilities in the state, the labour in the sector may not be skilled enough to work efficiently, which may also be affecting the performance of the sector.

Further, if we say about lower profit realisation by the FPU in Assam than India from 2016-2017 onwards, it can be linked with the implementation of food processing development projects in the country. Intending to double farmers' income by 2022, the Government of India formulated a policy framework in 2016, where they have given utmost importance to increasing value-addition and development of the food processing sector. However, the implementation of the food processing development project is unequal; while it is faster in most of the other parts of the country, it is much slower in the northeast, and probably for this, profit realisation by the FPU in Assam became less compared to aggregate India from 2016-2017 onwards.

It has seen that the "manufacture of other food products (NIC-107)" is the major sub-sector with the highest share in each parameter. Other sub-sectors' contribution to the food processing sector of the state is very less. The"processing and preserving of fruit and vegetables (NIC-103)" and "Manufacture of dairy products (NIC-105)" are the smallest sub-sectors.

9. Conclusion and suggestions

The NER of India has immense potential for developing the food processing sector as the production of horticultural crops is rising due to ongoing agricultural diversification in the region.It realises that the development of the food processing sector can help to achieve sustainable

growth in the agriculture sector since it can positively affect the farm sector by reducing post-harvest wastage, enhancing farm gate prices, reducing transaction costs, and reducing post-harvest wastage. This study has tried to explore the growth trend and the performance of the food processing sector in the NER, mainly focusing on Assam. Compared to aggregate India, Assam's food processing sector is less developed and the sector's performance is not impressive over the period. The contribution of the sector to aggregate India in value gross output has been continuously falling. Low credit availability, low capital formation and investment are the major reason for the sector's low performance. Besides, the lack of proper post-harvest infrastructures like warehouses, cold storage, marketing infrastructure, and transportation infrastructure in the state is also responsible forthe low performance of the sector in the state. Therefore, needed policymakers' attention to createa better and more sustainable entrepreneurial environment in the state for speedy growth in the sector.

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Class-Size Distribution of Cities in India During 1991-2011: An Inter-State Analysis

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Abstract

The number of cities in India and its constituent states has increased during 1991-2011.With economic reforms it is expected that urbanization rate is increasing day by day. Urban places are socially and economically very important. Due to some special amenities or some concentrated natural resources in some places, the urbanization rate has varied among the constituent states in India. As well as, the urban centers are not very well diversified among all the districts of different states. In India, there exists a dramatic variation in urbanization across the states. In our paper we are to examine the distribution to cities/towns among the size-classes in India and its constituent states during 1991-2011. Our estimates reveal that during 1991-2011, the number of towns in India and its constituent states has shown an increasing rate due to rapid industrialization and rural-urban migration. During this period, most of the states namely, Bihar, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Goa, Jharkhand, Himachal Pradesh, Meghalaya, Mizoram, Sikkim and Uttaranchal have greater growth rate than all India level. Among all the states in India, West Bengal has achieved the highest primacy index in the three census years. In 2011 it is found that the variation in the distribution of cities are higher than the all India level in some states namely, Assam, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. We observe that the number of towns among the size-classes have highly diversified in different states but population has not diversified. Interestingly, we note that the diversification of the number of towns among the size-classes are greater compared to that of the population during the period under study as population is mainly concentrated in some developed urbanized places.

Keywords: Urbanisation, Indian cities, Lorenz curve, Rank-size rule

Jel Codes: R12,R23,D3, C5, O4

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I. Introduction :

Urbanisation is a process, where more and more people are living in the urban sector than the rural areas of any economy. In developing countries, urbanisation is mainly accelerated due to increasing population growth in rural areas. Urban places are socially and economically very important. Some special amenities are concentrated in some places, so the urbanization rate has varied among the constituent states in India. Urban areas are associated in different cities and towns. Urban places are interlinked. There exists different type of relationship between separate towns and cities. The urban hierarchy considers that the urban places vary in population sizes and economic functions. As well as, the urban centers are not very well diversified among all districts of different states. In India, the cities have been defined by the Government of India. During the census of 1961, urban centers are classified into two-fold: (i) Statutory towns, i.e. the settlements that were given urban civic status like corporation, municipality and cantonment by the state government and (ii) Non-statutory or Census Towns, i.e. all other places which satisfy the following criteria like minimum population of 5000, at least 75% of male working population engaged in non-agricultural activities and a density of population of at least 400 people per sq. km. So, we can say that city is a relatively permanent and large settlement having a population of diverse skills and characteristics, lacking self-sufficiency in the production of food, usually depending on manufacturing and commerce to satisfy the wants to its inhabitants and providing goods and services for the benefit of areas lying outside it (Siddhartha & Mukherjee, 2019). In urban areas the infrastructure like roads, water supply, power, telecommunication, mass transport, and sanitation are developed.

The Census of India has classified urban areas into six categories on the basis of their population:

Class I towns: More than 1,00,000 populations.

Class II towns: 50,000 to 99,999 populations.

Class III towns: 20,000 to 49,999 populations.

Class IV towns: 10,000 to 19,999 populations.

Class V towns: 5000 to 9,999 populations.

Class VI towns: Less than 5000 populations.

In this paper we will try to focus on the size-class distribution of urban population and urban towns in different states of India during 1991-2011. We will also try to examine the diversification of urban population and towns of different class-sizes in different states in India during the period under study.

Objectives:

So under these circumstances our main objectives of this paper are:

i) To estimate the growth rate of numbers of cities and population of different class-sizes among different states in India during 1991-2011.

ii) To estimate the concentration of the urban population of different class-sizes among different states in India during 1991-2011.

iii) To estimate the distribution of numbers of cities and population of different class-sizes among different states in India during 1991-2011.

Literature Review:

In India urbanisation has increased faster than expected during 2001-2011. This had reversed the declining trend in the growth rate of the urban population during the 1980s and 1990s. For the first time since independence, the absolute increase in the urban population is higher than in the rural population during 2001-2011. This had huge implications for providing infrastructure and other civic amenities in urban areas (Bhagat, 2011).The patterns of urbanisation are very diverse among the states. Delhi, Goa & Mizoram have recorded the significant level of urbanization. In 2011 only 15 states and union-territories have showed the increased population growth (Singh & Singh, 2017). But the urban areas have an important role in the generation of national income of India. Although the populations of India's cities are less than one third of the total population, they command more than three fourths of the country's GDP. Due to different historical reasons India's urban system is 'top-heavy" i.e. population are mainly concentrated in the big cities (Shaban&Kourtit, 2020). The distributions among the class-size cities were highest in 2001 during the time frame of 1951-2001 (Das, 2015). Giri (1998) found that during 1970-80 there was faster population growth in the small & medium urban centres as because of the location shift of various secondary and tertiary sectors. Kumari (2015) examined that the distribution of cities in Indian urban system reveals that class I cities have grown at a higher rate than the small cities. Bhagat (2005) also observed that the area of class I cities had increased as well as new class I cities had emerged the higher growth and larger concentration of urban population in metropolitan area and its peripheries is an important feature of India's urbanisation in the post-globalisation period. Therefore, rural-urban migration not only had occurred towards its peripheries but also other medium and small cities and towns as the absorption capacity of those megacities had decreased. This is known as "urban sprawl" to reduce congestion and crowding diseconomies. Kundu & Saraswati (2012) observed in their study that higher growth and larger concentration of urban population in metropolitan area and its peripheries is an important feature of India's

urbanisation in the post-globalisation period. Therefore, rural-urban migration not only had occurred towards its peripheries but also other medium and small cities and towns as the absorption capacity of those megacities had decreased. Aslany (2018) found that in India the percentage share of the middle-class population is 28.05% of total urban and rural population.

Kundu (2009) has observed that the percentage of the urban population in 5 million plus cities in India is higher than in most other regions of the countries. India had added 91 million urban populations in the last decade, in which 53 million populations had been added by Million-plus cities alone which was 58% of the total urban population. The proportion of urban population living in the Million-plus cities had increased progressively from 18.8% in 1951 to 32.5% in 1991.

Ali (2020) has estimated that Kerala, Nagaland and West Bengal have registered more than 100 percent increase in the number of towns since 2001 census. Cities of the other categories excepting class I cities have shown continuous decrease in the growth rate of percentage distribution of urban population. The concentration of urban population in class I cites are very high. Only four mega cities namely, Mumbai, Kolkata, Delhi, and Chennai contain one-fourth of all class I cities' population. Industrialization, Commercialization, employment opportunities, basic amenities are the main reasons behind the growth of cities. Khadke (2018) has investigated that one of the most urbanised states, the Class I cities are growing at a much faster rate and their contribution to the progress of urbanization is overwhelming in Maharashtra during 1961-201.

Research Gap & Research Questions:

In all these literatures we observed the percentage share of different size classes cities in different states and the idea of diversification of population of different size class cities in some particular states in India. But these studies have not specified the diversification and concentration of population in all these states in India. Also those studies have not discussed about the distribution of towns among the states in India during 1991-2011.

So our main research questions are:

i) What are the growth rates of numbers of cities and population of different class-sizes in different states in India during 1991-2011?

ii) Are the urban population concentrated or diversified among different class-sizes in different states in India during 1991-2011?

iii) How the numbers of cities and population are distributed among different class-sizes in different states in India during 1991-2011?

Methodology:

In our study to fulfill our objectives we had used the following methods of growth rate, concentration and diversification of population for different size class cities in different states in India.

1. Compound Growth Rate:

$$\text{We assume that } Y_t = Y_0 (1 + r)^t$$

Where, Y_t denotes the observations (e.g. GDP/Urbanisation) at time t and r is the compound growth rate.

Taking log in both sides,

$$\ln Y_t = \ln Y_0 + t \ln(1 + r) + e_t$$

$$\ln Y_t = A + Bt + e_t,$$

where, $A = \ln Y_0$, $B = \ln (1 + r)$ and e_t is the error term.

Using the least square method we can estimate the coefficient, B.

Using the coefficient the compound annual growth rate is : $\hat{r} = (e^B - 1) \times 100$

2. Gini-Lorenz Index (The concentration index):

Gini is defined as "the ratio to the mean (average years of schooling) of half of the average over all pairs of the absolute deviations between all possible pairs of people" (Deaton 1997).

$$GI = 1 - \sum p_i (y_i + y_{i-1})$$

where, pi : percentage of population in the i^{th} city size-class, i=1,…..n

y_i : cumulative proportion of population share in the i^{th} group, i=1,…..n

Closer the value of GI to 0, lower the degree of inequality i.e. if the difference between Lorenz curve and egalitarian line coincides with each other then the degree of inequality will become zero i.e. there is full concentration of population. When GI is 1, the inequality will be maximum i.e. there is concentration of population.

3. Rank-size Rule:

If cities are ranked from largest to smallest population, then r ranked city is expected to have a population equal to the top ranked city divided by the rank of that city. If rank size rule fits in a country's urban system, the logarithmic graph will present a straight line. G. K. Zipf (1913) gave the rule that the town's population is derived by dividing the largest city's population by the towns' rank.

The relation between size of the city and rank can be expressed as: $K=Pr \times r^q$,

Where, K=Population of the largest city, r= rank of a city, Pr= population of a city of rank r and q = absolute value of slope of the distribution.

In logarithmic form the relation is:

$$\ln Pr = \ln K - q \ln r.$$

The rank size graphs represent the logarithmic equations. The slope value of the theoretical rank size distribution is the magnitude of forces of diversification divided by the forces of unification.

Here, if the value of q=1, the rank-size distribution follows the Zipf's law. When the slope value is one, it is called balanced case i.e. in an urban system the forces of unification and diversification are equally distributed. If the slope value is more than 0 and less than 1, then there exists the dominance of the force of diversification. It suggests that the population is relatively evenly distributed i.e. population are concentrated in the medium to smaller sized cities compared to the larger cities. If the value of the slope is greater than one, then the population is unevenly distributed, with bigger cities hosting a larger portion of the population compared to smaller and medium sized cities i.e. population are concentrated in some bigger cities.

Estimates:

Number of Total Towns and Growth Rate of Total Towns in India during 1991-2011

Estimates (Table 1) reveals that number of total towns in all over India has increased during 1991-2011. In almost all the states the numbers of total towns have increased during 1991-2011 excepting Pondicherry. The number of towns is highest in Uttar Pradesh followed by Tamil Nadu and West Bengal in 1991, Tamil Nadu followed by Uttar Pradesh and Madhya Pradesh in 2001, Tamil Nadu followed by Uttar Pradesh and West Bengal in 2011. During 1991-2001, some states like, Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala, Uttar Pradesh, West Bengal, Arunachal Pradesh, Lakshadweep and Pondicherry had shown a reduction in the number of total towns. During 2001-11, the number of total towns have increased in almost all states excepting, Goa.

During 1991-2001 and 2001-11 the growth rate in all India level are positive. The growth rate in 2001-11 is greater than the growth rate of 1991-2001. The growth rate of total towns is highest in Goa followed by Andaman & Nicobar Island and Dadra & Nagar Haveli. During this time, Chandigarh attains the lowest growth rate during 1991-2001. During 1991-2001, some states namely, Assam, Haryana, Maharashtra, Orissa, Punjab, Tamil Nadu, Arunachal Pradesh, Goa, Jharkhand, Meghalaya, Sikkim, Tripura, Andaman & Nicobar Island and Delhi have greater growth rate than all-India level. During 2001-11, the growth rate of total number of towns is

highest in Chandigarh followed by Daman & Diu and Kerala. During this period, the growth rate of total number of towns is lowest in Goa. During this period, some states namely, Bihar, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Goa, Jharkhand, Himachal Pradesh, Meghalaya, Mizoram, Sikkim and Uttaranchal have greater growth rate than all India level.

Distribution of Number of Cities in Different Class-sizes in India During 1991-2011: An Inter-State Analysis:

In India, the total number of towns has increased from 1827 in 1901 to 5871 in 2011. Though the number of towns in India is increasing, but from 1961and onwards, the major percentage of population are living in class I cities i.e. more than one lakh population cities. From 1901, among all the class-sizes, the highest percentage of urban population living in class I cities and it is increasing. From 1961, above 50% of urban population is living in the class I cities and in 2011, 77% of urban population is living in those cities. On the other hand, if we consider the other five class-sizes then there is a huge decrease in percentage of population living in classes: II, III, IV, V and VI respectively from 11.29% in 1901 to 6.57% in 2011, from 15.64% to 8.55%, from 20.83% to 4.91% , from 20.14% to 2.59% and 6.10% to 0.34%. Thus we observe that the % of population in India has varied in different size-classes during 1901-2011 (Table 2).

We are to examine the distribution to cities/towns among the size-classes in India and its constituent states during 1991-2011. Our estimates reveal that during 1991-2011, the number of towns in India and its constituent states has shown an increasing rate due to rapid industrialization and rural-urban migration. During this time period, at the all-India level class I cities have shown an increase in numbers from 300 to 463, class II cities from 345 to 470, class III cities from 947 to 1366, class IV cities from 1167 to1667 and class V cities from 740 to 1739. Butclass VI cities have shown a slight decrease in number from 197 in 1991 to 194 in 2001 and then an increase to 420 in 2011.

Our estimates (Tables 3-5) reveal that at the all-India level among all the size-class cities class IV has obtained the highest position in the years of 1991and 2001. In 2011, Class IV has failed to achieve that position and lost its position to Class V. The lowest positions were taken by class VI cities at the all-India level during 1991-2011.

The shares of number of city-sizes are very much diversified among the states in India during 1991-2011. Here we are going to consider only major states as the other states and union territories do not have all class-sizes cities. In our study to measure the concentration and diversification the number of towns of Jharkhand and Chhattisgarh will be added to Bihar and Madhya Pradesh respectively. Among the size-classes, class III has achieved the highest position

in the states of (i) Andhra Pradesh, Bihar, Karnataka, Kerala, Maharashtra, and West Bengal in 1991, (ii) Bihar, Gujarat, Karnataka, Kerala, Maharashtra, and Rajasthanin 2001. The same position for Class III has achieved by all the aforesaid states in 2011 as well, only Uttar Pradesh has entered into that list. Class IV has obtained the highest position in the states of Gujarat, Madhya Pradesh, Haryana, Odisha, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh in 1991. In 2001, the highest position in numbers of cities in different city-sizes has achieved by Class IV in all the states like 1991 excepting Gujarat. On the other hand, only for the states like Gujarat, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh, Class IV city-size has achieved the highest position among all the city-sizes in 2011. In 1991, only Assam is the state for which Class V has achieved the highest position. In 2001, West Bengal has entered into that list. In the states like Assam, West Bengal and Odisha, Class V city-size has achieved the highest position. In almost all the major states Class VI city-size is lowest except Karnataka in 1991. In this period the share of ClassVI city is zero in the states of Assam and Kerala, as there are no Class VI cities. In 2001, Class VI city-size has achieved the highest position in almost all the states excepting Assam and West Bengal. In 2011, Class VI city-size has achieved the highest position in almost all the states excepting Assam, Odisha and West Bengal.

Now, the share of number of towns in class I is highest in (i) Andhra Pradesh (15.02%) followed by West Bengal (14.38%) and Haryana (13.33%) among all the major states in 1991, (ii) Andhra Pradesh (22.54%) followed by Haryana (19.59%) and Bihar (15.32%) in 2001 and (iii) Bihar (16.76%) followed by Kerala (16.40%) and Haryana (13.48%) in 2011. Similarly, the share of number of towns in class II is highest in (i) Tamil Nadu (16.15%) followed by Andhra Pradesh (15.96%) and Bihar (13.27%) in 1991, (ii) Andhra Pradesh (25.43%) followed by Gujarat (14.81%) and Kerala (14.29%) in 2001 and (iii) Andhra Pradesh (23.85%) followed by Bihar (14.45%) and Karnataka(12.62%) in 2011. Also, in class III Andhra Pradesh has achieved this position followed by Kerala and Bihar in 1991, Bihar followed by Rajasthan and Maharashtra in 2001, and Bihar followed by Rajasthan and Kerala in 2011. In class IV, Odisha had achieved the highest share followed by Madhya Pradesh and Rajasthan in 1991. (ii) Tamil Nadu followed by Madhya Pradesh and Odisha in 2001 and (iii) Tamil Nadu followed by Madhya Pradesh and West Bengal in 2011. The share of number of towns in class V is highest in Assam followed by Madhya Pradesh and Uttar Pradesh in 1991, (ii) West Bengal followed by Assam and Tamil Nadu in 2001 and (iii) West Bengal followed by Assam and Odisha in 2011. Class VI city-size is highest in Karnataka in 1991, West Bengal in 2001 and Assam in 2011.

Our estimates reveal that there exists a wide variation in change in size-class cities among the constituent states in India during the period under study. Almost all the states excepting Tamil Nadu and West Bengal have shown a declining trend of the share of number of towns in class I

during 1991-2001. Though no state has shown any decrease in absolute number in class I but the decrease in percentage shares in different states is due to huge increase in absolute numbers of any one or two size-classes. The share of number of towns in class II has increased in the following states, namely, Andhra Pradesh, Assam, Gujarat, Maharashtra, Odisha, Rajasthan and Uttar Pradesh. But a decreasing trend is observed in the states of Andhra Pradesh, Assam, Kerala, Tamil Nadu and West Bengal during 1991-2001. Almost all the states have shown a decreasing trend in class V excepting Andhra Pradesh, Kerala, Punjab, Tamil Nadu and West Bengal during this period. Also, Andhra Pradesh, Bihar, Haryana, Karnataka, Maharashtra, Punjab, Rajasthan and West Bengal have shown a declining trend in the percentage distribution of class VI. Interestingly, we note that Andhra Pradesh has shown a significant decrease in percentage distribution of class III city-size due to an increase in the percentage distribution of class I and class II city-sizes during this period. Bihar has also shown an increase in class III due to decrease in Class IV and Class V. Tamil Nadu has shown a decrease in percentage share of class I due to huge increase in the absolute numbers of Class IV and Class V. Similarly, the percentage share of class I in West Bengal has also shown a decreasing trend due to the increase in absolute number of class V city-sizes. Rajasthan has shown a huge decrease in percentage share of class IV city-size due to absolute fall in class IV city-size and increase in class III city-size.

During 2001-11, most of the states have shown a decrease in the percentage share of number of towns in class I cities in almost all the states excepting Bihar, Kerala, Madhya Pradesh, Rajasthan and Uttar Pradesh. But like 1991-2001, there will be no decrease in absolute numbers of class I cities. West Bengal has shown a remarkable decrease in percentage share of number of towns in class I city-size due to huge increase in the absolute numbers of class V city-size. The percentage of number of towns in class II cities has shown a decreasing trend in all the states excepting Bihar, Haryana, Karnataka and Uttar Pradesh. In class III cities the share of number of towns has shown a reduction in almost all the states excepting Bihar, Haryana, Madhya Pradesh and Uttar Pradesh during this period. Like class III, the percentage of number of towns in class IV cities has also shown a decrease in the rate in almost all the states excepting Andhra Pradesh, Gujarat and West Bengal. The percentage of number of towns in class V cities has shown an increase excepting Madhya Pradesh, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal during 2001-11. Odisha has shown an increase in percentage distribution in class V cities due to increase in absolute numbers of class V cities and decrease in percentage share of class VI cities. The percentage of numbers of town in class VI cities has shown an increase in almost all the states excepting Gujarat and Kerala.

Distribution of Urban Population in Different Class-size Cities in India during 1991-2011: An Inter-State Analysis

We are to examine the percentage distribution of urban population in different size-class cities in India and its constituent states during the period of 1991-2011. Our estimates (Tables 6-8) reveal that at the all-India level the percentage distribution of urban population is highest in Class I cities (69.75% in 1991, 72.49% in 2001 and 77.04% in 2011) followed by class III cities during the period of 1991-2011. On the other hand, class V cities have achieved the lowest position among the size-class cities for the first two periods and VI in third period. The share of urban population in class I cities has increased from 70% in 1991 to 77% in 2011 at the cost of the declining shares of urban population in classes II, III, IV and VI. Thus, we observe that the distribution of urban population among the size-class cities in India is not uniform during the period under study. Though the percentage share of number in class-I cities are decreasing but the percentage share of population in class I cities are increasing.

Wide variations of the percentage distribution of urban population in different class-size cities are observed among the constituent states in India during the period under study. Among the size - classes, Class I has achieved the highest position in all the constituent states during 1991-2011. Class III has achieved the second highest position in the states of (i) Andhra Pradesh, Assam, Bihar, Karnataka, Kerala, Maharashtra, Orissa, Rajasthan, Uttar Pradesh and West Bengal in 1991, (ii) Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Orissa, Rajasthan, Uttar Pradesh and West Bengal in 2001 and (iii) Assam, Bihar Gujarat, Haryana, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal in 2011. Class II city-size is the second highest in the states of (i) Gujarat, Haryana, Madhya Pradesh, Punjab, Tamil Nadu in 1991, (ii) Andhra Pradesh, Gujarat and Punjab in 2001 and (iii) Andhra Pradesh, Karnataka and Punjab in 2011.

We also observe that in case of class I cities, West Bengal has achieved the highest position among the states during first two periods (81.70% in 1991 and 83.54% in 2001) followed by Maharashtra (77.85%) and Andhra Pradesh (66.88%) in 1991, Maharashtra (79.70%) and Gujarat (76.50%) in 2001. Kerala (91.50%) has achieved the highest position followed by Maharashtra (78.27%) and Gujarat(77.20%) in 2011. Among the states, Assam has achieved the lowest position during 1991-2011. In case of class II cities, the highest percentage distribution of urban population is observed in (i) Punjab followed by Bihar and Tamil Nadu in 1991, (ii) Orissa followed by Punjab and Assam in 2001 and (iii) Punjab followed by Orissa and Andhra Pradesh in 2001. The lowest percentage distribution of urban population has achieved in Maharashtra in 1991, West Bengal in 2001 and Kerala in 2011. In class III cities among all the

states Assam has achieved the highest percentage share followed by Rajasthan & Bihar whereas West Bengal has taken the lowest position followed by Maharashtra & Gujarat in 1991. The percentage of population lived in Bihar has highest followed by Rajasthan & Assam which the percentage of population has lowest in West Bengal in 2001. Among the major states, Bihar has achieved the highest rate of urban population percentage rate followed by Rajasthan and Orissa whereas Kerala has the lowest rate of population percentage in 2011.

Among the major states, the percentage share of urban population lived in class IV cities is highest in Orissa followed by Madhya Pradesh and Assam in 1991. The lowest position is achieved by West Bengal. In 2001, Tamil Nadu has obtained the highest position followed by Assam and Orissa in 2001. In 2011, Assam has achieved the highest position followed by Tamil Nadu and Madhya Pradesh. Andhra Pradesh and Kerala have the lowest position in 2001 and 2011 respectively. Also, the percentage share of urban population lived in class V cities is highest in Assam followed by Madhya Pradesh and Uttar Pradesh in 1991, followed by Tamil Nadu and Madhya Pradesh in 2001 and followed by Orissa and West Bengal in 2011. The highest percentage of population lived in class VI cities is in Karnataka in 1991, Assam both in 2001 and 2011.

Let us now examine the pattern of urban population among the states in India according to the size-class during the period of 1991-2011. Among the size-classes, class I has increased the population percentage in all the constituent states excepting Tamil Nadu during 1991-2001, Andhra Pradesh, Assam, Haryana, Maharashtra, Orissa and West Bengal during 2001-2011. But class II has shown a decrease in population percentage in the constituent states excepting Bihar, Gujarat, Haryana, Madhya Pradesh, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal during 1991-2001. Similarly, Class III city-size has shown a decrease in population percentage in most of the states excepting Bihar, Madhya Pradesh, Tamil Nadu and Uttar Pradesh during 1991-2001; Haryana, Madhya Pradesh, Maharashtra and Punjab during 2001-2011. Class IV has also shown a decrease in population percentage like Class II and Class III in almost all the states excepting Tamil Nadu and West Bengal during 1991-2001; Andhra Pradesh, Assam, Gujarat, Karnataka, Maharashtra and West Bengal during 2001-2011. A declining trend is observed in most of the states excepting Andhra Pradesh, Kerala, Punjab, Tamil Nadu and West Bengal in class V. In class VI the percentage of urban population has also decreased in the constituent states excepting Andhra Pradesh, Gujarat, Haryana, Karnataka, Maharashtra, Punjab and Uttar Pradesh during the period under study.

Class-Size Concentration of Cities in India During 1991-2011: An Inter-State Analysis:

We have already discussed that the Census of India has classified towns into six categories on the

basis of population. Now present study is trying to estimate the concentration index by using the Gini Index of inequality. To estimate the Gini Index the class I cities can be divided into six parts*:-

M6: 100000-199999 Population

M5 : 200000-499999 Population

M4 : 500000-999999 Population

M3 :1000000-1999999 Population

M2:2000000-4999999 Population

M1 :More than 5000000 Population (5000000-19999999)**

Notes: *Census of India, 2011(Circular-38),** The value of M1 is more than 5000000, but to calculate Lorenz curve we require closed group and the highest populated cities' population is 1,83,94,912(Mumbai), so we had taken 1,99,99,999 as the upper limit of M1 class.

Our estimates (Table 9) reveals that at the all India level in 1991 class IV city-size has the highest numbers of cities and class VI city-size has the lowest number of cities. During 1991- 2001, all the city-sizes have shown an increase in their number excepting class VI city. In 2001, class IV city-size has the highest numbers. But in 2011, all the city-sizes have shown a huge increase in their numbers and class V city become the highest in number. Thus cities are not uniform rather concentrated among different city-sizes in different years but there is a tendency of population to concentrate in some city-sizes. The Gini index of size-class concentration in India has increased from 0.742 in 1991 to 0.780 in 2011. This shows that there exists an inequality in size-class distribution of cities in India during the period under study and the inequality has increased over time. As the concentration rate is very high and cities are not uniformly distributed. Mainly for these states the population is highly concentrated in the class I cities. This may happen due to the attractive employment situation and basic amenities of class I cities. Many people of rural areas as well as urban areas are migrated toward those cities. This may be due to employment purpose (for male) or may be due to marriage purpose (for female) as the living conditions of those cities are very much attractive.

Our estimates reveal that the Gini index of size-class concentration in India has increased during 1991-2001 as well as during 2001-11. The Gini index of size-class concentration has increased in almost all the constituent states during 1991-2011, excepting Karnataka, Tamil Nadu and West Bengal. Both in 1991 and 2001, the Gini- concentration index is highest in West Bengal. Orissa

and Bihar have achieved the lowest Gini- concentration indices in 1991 and 2001 respectively. In 2011, this rate is highest in Gujarat and lowest in Assam.

Interestingly, we note that Gini-concentration indices for few states namely, (i) Karnataka, Maharashtra, Tamil Nadu and West Bengal in 1991, (ii) Andhra Pradesh, Gujarat, Karnataka, Maharashtra and West Bengal in 2001, (iii) Gujarat, Karnataka, Maharashtra and West Bengal in 2011, have the higher concentration rate than the all-India level.

City Size Distribution using Zipf Law and Hierarchy among Cities in India during 1991-2011: An Inter-State Analysis

From our previous observations these are observed that, though the cities and towns of different states are diversified among all over the areas of different states but the population are mainly concentrated in specific places. But still now, we have not focused on the relationship between the hierarchy of cities and their population sizes. In order to understand the pattern of distribution of urban cities in an urban system, we focus on rank-size relationship (Table 10). Zipf's law is one of such theories which examine the relationship between the hierarchy of cities and their respective sizes. According to Zipf, size and number of settlement in an urban system are determined by the forces of unification and the forces of diversification. Due to the forces of diversification, the population splits into the larger number of small settlement and this creates a large number of small places each located near resources. Now, when the economy is growing then population tends to be concentrated in a single place where all the needed raw materials are easily accumulated. Force of unification is opposite to force of diversification. Unification leads to the population being concentrated in a few large places i.e. the emergence of small number of large service oriented cities. This force creates a very few large cities. In any urban system, both the forces of diversification and unification work simultaneously and they determine the relationship between size and number of settlements.

The elasticity values make the picture of the urban system more clear. If the coefficient value is less than one, then the force of diversification dominates force of unification and vice-versa. Our estimates reveal that in 1991, three states, namely, Madhya Pradesh, Orissa & Rajasthan have less than unitary elasticity implying that the force of diversification dominates the force of unification. For those states, although the population in class I towns is increasing, the forces of diversification have arisen due to the emergence of large number of smaller towns and cities in the urban system. Among the states, Madhya Pradesh is the state where the force of diversification dominates the force of unification in all the three census years. In all the three years, the force of unification dominates the force of diversification in the states Maharashtra, Uttar Pradesh, Andhra Pradesh, Punjab Kerala, Gujarat, Karnataka, and Haryana i.e. in those states few large cities

dominate the entire urban system. Interestingly, we note that in the years 1991 and 2001,in Assam and West Bengal the force of unification dominates the force of diversification, but in 2011, it becomes just opposite. In Bihar, in 1991 and 2011 the force of unification is active due to the dominance of few large cities. In Orissa, the force of diversification dominates the force of unification in 1991 but in the other two census year the unification is more active than the diversification. In Rajasthan, there was force of diversification among states in 1991 and 2001. On the other hand, the force of unification dominates the force of diversification in the year 2011. Tamil Nadu has shown the opposite urban system, where the force of unification dominates in first two census years, but the force of diversification dominates in the year 2011, i.e. large number of smaller towns and cities are joining in the urban system. Surprisingly, West Bengal which had the highest force of unification in 1991, now has the force of diversification. It may because there is a huge decrease in population share of Class I city. As a result, Class IV, V and VI had shown an improvement in their population share.

R^2 values denote the variation among the distribution of cities. In 1991, the variance in the distribution of cities is highest in Madhya Pradesh (99%) followed by Rajasthan and Orissa. The variance in the distribution of cities is lowest (89%) in Karnataka. The variance in the distribution of cities is highest in Uttar Pradesh (99%) and lowest (81%) in Gujarat in 2001. In 2011, the states Assam, Madhya Pradesh, Orissa, Uttar Pradesh and West Bengal have the highest variance in the distribution of cities (98%) and lowest in Bihar(87%).

In all the years, the variances in the distribution of cities at the all India are less than 95% and it is continuously increasing. In 1991, the states whose percentage of variance in the distribution of cities are greater than the all India variance are Bihar, Haryana, Kerala, Madhya Pradesh, Maharashtra, Orissa and Rajasthan. The variance in the distribution of cities is lower than the all India level in Andhra Pradesh and Gujarat in 2001.

In 2011, the variance in the distribution of cities of Karnataka is same as the variance of all India level. In 2011, the variance in the distribution of cities is higher than the all India level in Assam, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. In Andhra Pradesh, there was 91 percent variance in the distribution of cities in 1991.

The variance in the distribution of cities has decreased in 2001 and it becomes 87% and then in 2011 it became 91%. The variance in the distribution of cities in Assam has increased from 92% to 98% during the period under study. In Bihar it has increased from 94% in 1991 to 96% in 2001, but has decreased to 87% in 2011. On the other hand, in Gujarat it has decreased from 93% in 1991 to 79% in 2011. In Haryana, Madhya Pradesh,Orissa and Punjab the variance in

the distribution of cities is almost same (96%) during the study period. In Karnataka, it is lowest in 1991, 89% only. It is 94% in 2001 and 95% in 2011. In Kerala it has decreased from 97% in 1991 to 96% in 2011. In Maharashtra, the percentage of the variance has decreased from 97% to 94% during the study period. The value of R^2 has decreased from the 97% to 95% in Rajasthan. On the other hand, the variance in the distribution of cities in Uttar Pradesh and West Bengal has increased from 93% to 98% during 1991-2011.

Conclusions:

India's urbanisation is not evenly distributed among all the constituent states. Also urban population is mainly concentrated in class I cities of different states i.e. the force of unification dominates the force of diversification among the constituent states during 1991-2011. Though the numbers of cities are very high in size-classes III, IV and V but the population shares live in those cities are low. In Assam, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal the variance in the distribution of cities are higher than the all India level. The concentration indices were higher in Gujarat, Karnataka, Maharashtra and West Bengal than the all India level during 1991-2011. Thus we observe that size-class concentration is very high and population is not equally distributed among the constituent cities. The Govt. of India should focus on the improvement of medium and small cities and towns so that the burden of population concentration can reduce the highly-populated cities. Otherwise, the attraction of migrated people towards the class I cities will not decrease and the concentration will not reduce.Therefore the policy-maker should give focus on the development in those medium & small cities and towns and socio-economic amenities in rural areas can only reduce the population pressure in class I cities by increasing the urban area.Employment generation, urbanisation and economic growth are interrelated with each other. Industrialisation can improve the three upper said conditions of any economy for their development. So policy makers should concentrate on the industrial development in those small and medium towns in different states in India.

Table 1: Number of Total Towns and Growth Rate of Total Towns during 1991-2011

India/States/ Union Territories	Number of Total Towns			Growth Rate	
	1991	2001	2011	1991-2001	2001-11
India	4689	5161	7933	0.42	1.87
Andhra Pradesh	264	210	353	-0.99	2.26
Assam	93	125	214	1.28	2.34
Bihar	138	130	199	-0.26	1.85
Gujarat	264	242	348	-0.38	1.58
Haryana	94	106	154	0.52	1.62
Karnataka	306	270	347	-0.54	1.09
Kerala	197	159	520	-0.93	5.15
Madhya Pradesh	370	394	476	0.27	0.82
Maharashtra	336	378	534	0.51	1.50
Orissa	124	138	223	0.46	2.08
Punjab	120	157	217	1.17	1.41
Rajasthan	222	222	297	0.00	1.26
TamilNadu	469	832	1097	2.49	1.20
Uttar Pradesh	753	704	915	-0.29	1.14
West Bengal	382	375	909	-0.08	3.85
Arunachal Pradesh	10	17	27	2.30	2.01
Chhattisgarh	95	97	182	0.09	2.73
Goa	14	74	70	7.23	-0.24
Jharkhand	133	152	228	0.58	1.76
Himachal Pradesh	58	57	59	-0.08	0.15
Jammu & Kashmir	74	75	122	0.06	2.11
Manipur	31	33	51	0.27	1.89
Meghalaya	12	16	22	1.25	1.38
Mizoram	22	22	23	0.00	0.19
Nagaland	9	9	26	0.00	4.61
Sikkim	8	9	9	0.51	0.00
Tripura	18	23	42	1.06	2.62
Uttaranchal	-	86	115	-	1.26
Andaman & Nicobar Island	1	3	5	4.77	2.22
Chandigarh	5	1	6	-6.99	7.78
Dadra & Nagar Haveli	1	2	6	3.01	4.77
Daman & Diu	2	2	8	0.00	6.02
Delhi	32	62	113	2.87	2.61
Lakshadweep	4	3	6	-1.25	3.01
Pondicherry	11	6	10	-2.63	2.22

Source: Census of India, Author's own calculation

Table 2: Size-class Percentage Distribution of Urban Population in India during 1901-2011

Census Year		Percentage of Urban Population						
	Number of Towns	Class I	Class II	Class III	Class IV	Class V	Class VI	Total
1901	1827	26.00	11.29	15.64	20.83	20.14	6.10	100
1911	1815	27.48	10.51	16.40	19.73	19.31	6.57	100
1921	1949	29.70	10.39	15.92	18.29	18.67	7.03	100
1931	2072	31.20	11.65	16.80	18.00	17.14	5.21	100
1941	2250	38.23	11.42	16.35	15.78	15.08	3.14	100
1951	2843	44.63	9.96	15.72	13.63	12.97	3.09	100
1961	2365	51.42	11.23	16.94	12.77	6.87	0.77	100
1971	2590	57.24	10.92	16.01	10.94	4.45	0.44	100
1981	3378	60.37	11.63	14.33	9.54	3.58	0.50	100
1991	3698	65.20	10.95	13.19	7.77	2.60	0.29	100
2001	4368	68.67	9.67	12.23	6.84	2.36	0.23	100
2011	5871	77.00	6.57	8.55	4.91	2.59	0.34	100

Source: Census of India, Author's own calculation

Table 3: Size-class Percentage Distribution of Number of Towns in India in1991 : An Inter-State Analysis

States	**I**	**II**	**III**	**IV**	**V**	**VI**	Total
India	8.12	9.33	25.62	31.57	20.02	5.33	100
Andhra Pradesh	15.02	15.96	42.72	18.31	6.57	1.41	100
Assam	4.35	4.35	21.74	30.43	39.13	0	100
Bihar	8.06	13.27	37.44	25.12	13.74	2.37	100
Gujarat	9.33	12	22.22	32.89	19.56	4	100
Haryana	13.33	10	18.89	33.33	22.22	2.22	100
Karnataka	8.27	6.69	32.28	27.56	15.75	9.45	100
Kerala	12.84	8.26	42.20	31.19	5.50	0	100
Madhya Pradesh	5.31	6.70	15.94	40.88	30.02	1.15	100
Maharashtra	9.31	9.66	35.52	28.62	13.79	3.10	100
Odisha	5.88	8.40	21.85	42.86	18.49	2.52	100

Contd.....

Contd.....

Punjab	8.33	15	20.83	36.68	13.33	5.83	100
Rajasthan	6.51	9.30	33.20	40.47	10.23	0.47	100
Tamil Nadu	9.62	16.15	27.31	30.77	13.46	2.69	100
Uttar Pradesh	5.98	6.41	18.38	33.62	29.91	5.70	100
West Bengal	14.38	11.25	28.75	20.63	21.25	3.75	100

Source: Census of India, Author's own calculation

Table 4: Size-class Percentage Distribution of Number of Towns in India in 2001 : An Inter-State Analysis

States	I	II	III	IV	V	VI	Total
India	8.99	9.17	26.33	30.75	20.32	4.44	100
Andhra Pradesh	22.54	25.43	26.01	13.29	11.56	1.16	100
Assam	6.36	6.36	20	28.18	31.82	7.27	100
Bihar	15.32	12.90	52.12	16.13	2.42	1.11	100
Gujarat	14.81	14.81	32.28	23.28	7.94	6.88	100
Haryana	19.59	6.19	24.74	32.99	15.46	1.03	100
Karnataka	10.30	11.59	42.06	22.32	11.59	2.15	100
Kerala	14.29	14.29	35.71	26.53	9.18	0	100
Madhya Pradesh	7.07	7.05	24.18	38.32	21.74	1.63	100
Maharashtra	9.80	11.24	36.60	26.51	13.54	2.31	100
Odisha	6.06	10.61	25	35.61	18.18	4.54	100
Punjab	8.92	11.47	22.93	34.39	18.47	3.82	100
Rajasthan	9.26	12.04	41.67	27.31	7.87	1.85	100
Tamil Nadu	4.34	6.74	18.11	42.22	26.95	1.65	100
Uttar Pradesh	8.06	7.76	25.97	37.31	19.55	1.34	100
West Bengal	11.30	6.69	17.99	20.50	34.73	8.79	100

Source : Census of India, Author's own calculation

Table 5: Size-class Percentage Distribution of Number of Towns in India in 2011: An Inter-State Analysis

States	I	II	III	IV	V	VI	Total
India	7.56	7.67	22.30	27.22	28.39	6.86	100
Andhra Pradesh	17.69	23.85	23.85	17.31	15.38	1.92	100
Assam	3.73	4.23	12.70	23.81	41.80	13.76	100
Bihar	16.76	14.45	41.62	8.67	15.61	2.89	100
Gujarat	10.79	10.43	26.62	28.06	17.63	6.47	100
Haryana	13.48	6.38	29.08	21.99	24.82	4.26	100
Karnataka	8.41	12.62	31.39	21.68	22.33	3.56	100
Kerala	16.40	4.76	34.40	22.22	22.02	0.20	100
Madhya Pradesh	7.73	6.79	24.82	37.47	20.84	2.34	100
Maharashtra	7.39	9.78	31.34	24.95	21.36	5.19	100
Odisha	4.17	6.94	17.59	22.22	35.65	13.43	100
Punjab	8.10	10.95	22.38	29.05	22.38	7.14	100
Rajasthan	10.79	9.35	35.97	26.62	14.03	3.24	100
Tamil Nadu	3.92	5.51	17.26	38.68	30.60	4.04	100
Uttar Pradesh	8.16	7.77	27.59	31.61	22.67	2.20	100
West Bengal	4.55	3.61	8.95	20.72	50.71	11.46	100

Source: Census of India, Author's own calculation

Table 6: Size-class Percentage Distribution of Population in India in 1991: An Inter-State Analysis

States	I	II	III	IV	V	VI	Total
India	69.75	7.67	9.38	5.65	1.91	5.65	100
Andhra Pradesh	66.88	12.60	16.53	3.30	0.64	0.05	100
Assam	37.56	11.65	25.61	16.67	8.51	-	100
Bihar	52.62	17.58	20.80	7.03	1.79	0.18	100
Gujarat	66.43	12.73	10.52	7.69	2.42	0.21	100
Haryana	58.54	15.11	11.95	10.43	3.75	0.23	100
Karnataka	64.60	7.35	17.68	7.73	2.09	0.55	100
Kerala	66.34	7.22	19.08	6.78	0.58	-	100
Madhya Pradesh	50.39	13.94	12.82	16.15	6.58	0.13	100
Maharashtra	77.85	6.49	10.39	4.13	1.03	0.11	100
Orissa	44.43	14.65	19.73	16.97	3.94	0.28	100
Punjab	54.36	19.79	12.89	10.46	2.03	0.47	100
Rajasthan	50.10	13.67	21.31	13.08	1.82	0.02	100
Tamil Nadu	65.96	15.21	11.19	6.11	1.38	0.15	100
Uttar Pradesh	55.99	11.45	13.94	12.25	5.86	0.50	100
West Bengal	81.70	6.58	7.66	2.59	1.35	0.11	100

Source : Census of India, Author's own calculation

Table 7: Size-class Percentage Distribution of Population in India in 2001: An Inter-State Analysis

States	I	II	III	IV	V	VI	Total
India	72.49	7.05	8.91	4.93	1.69	4.93	100
Andhra Pradesh	75.31	13.95	8.35	1.69	0.68	0.04	100
Assam	44.34	14.37	18.56	13.74	8.44	0.54	100
Bihar	59.31	13.66	23.57	3.23	0.23	-	100
Gujarat	76.50	9.67	9.47	3.55	0.67	0.14	100
Haryana	72.57	5.78	11.89	7.65	2.03	0.07	100
Karnataka	67.20	9.63	17.28	4.68	1.07	0.13	100
Kerala	68.82	11.32	14.05	4.98	0.82	-	100
Madhya Pradesh	55.77	12.00	15.95	12.13	4.01	0.15	100
Maharashtra	79.70	6.66	9.42	3.31	0.84	0.07	100
Orissa	48.41	17.12	18.20	12.65	3.17	0.45	100
Punjab	58.39	16.45	12.50	9.82	2.52	0.33	100
Rajasthan	57.23	13.94	20.80	6.92	1.00	0.11	100
Tamil Nadu	56.35	11.64	12.21	14.37	5.26	0.17	100
Uttar Pradesh	62.16	9.95	14.40	10.39	2.97	0.13	100
West Bengal	83.54	4.34	5.96	3.14	2.59	0.43	100

Source : Census of India, Author's own calculation

Table 8: Size-class Percentage Distribution of Population in India in 2011: An Inter-State Analysis

States	I	II	III	IV	V	VI	Total
India	77.04	4.91	6.55	4.55	4.91	2.01	100
Andhra Pradesh	74.96	14.39	6.92	2.37	0.97	0.07	100
Assam	42.67	11.29	16.48	14.53	12.63	2.40	100
Bihar	62.12	13.56	20.54	2.04	1.57	0.17	100
Gujarat	77.20	7.72	8.89	4.66	1.39	0.15	100
Haryana	71.53	6.60	13.55	5.20	2.86	0.27	100
Karnataka	76.47	11.65	4.62	4.74	2.31	0.20	100
Kerala	91.50	1.49	4.52	1.65	0.85	-	100
Madhya Pradesh	61.52	6.99	15.99	11.61	3.66	0.23	100
Maharashtra	78.27	6.69	9.81	9.50	1.51	0.20	100
Orissa	47.80	15.24	17.33	10.22	7.64	1.76	100
Punjab	59.34	16.24	12.95	8.65	2.20	0.63	100
Rajasthan	63.11	10.33	18.31	6.89	1.75	0.22	100
Tamil Nadu	60.70	8.85	11.55	12.80	5.69	0.41	100
Uttar Pradesh	65.27	9.56	14.24	7.86	2.91	0.15	100
West Bengal	74.52	4.84	5.86	6.09	7.59	1.11	100

Source : Census of India, Author's own calculation

Table 9: Concentration Index in India during 1991-2011: An Inter-State Analysis

India/States	1991	2001	2011
Gini Index			
India	0.742	0.754	0.780
Andhra Pradesh	0.643	0.767	0.759
Assam	0.597	0.617	0.634
Bihar	0.631	0.549	0.649
Gujarat	0.735	0.757	0.830
Haryana	0.636	0.679	0.699
Karnataka	0.813	0.791	0.797
Kerala	0.653	0.662	0.777
Madhya Pradesh	0.657	0.644	0.706
Maharashtra	0.807	0.800	0.835
Orissa	0.526	0.641	0.695
Punjab	0.687	0.699	0.689
Rajasthan	0.609	0.659	0.698
Tamil Nadu	0.796	0.744	0.761
Uttar Pradesh	0.703	0.712	0.728
West Bengal	0.831	0.851	0.815

Source : Census of India, Author's own calculation

Table 10 : Rank-Size Parameters: 1991-2011

	Elasticity			R^2		
	1991	2001	2011	1991	2001	2011
India	-1.045	-1.066	-1.035	0.934	0.941	0.944
Andhra Pradesh	-1.234	-1.197	-1.234	0.909	0.877	0.909
Assam	-1.108	-1.018	-0.971	0.918	0.957	0.979
Bihar	-1.046	-0.938	-1.104	0.939	0.956	0.865
Gujarat	-1.109	-1.298	-1.325	0.927	0.810	0.952
Haryana	-1.12	-1.152	-1.280	0.960	0.953	0.957
Karnataka	-1.077	-1.044	-1.134	0.889	0.941	0.945
Kerala	-1.056	-1.180	-1.77	0.971	0.969	0.962
Madhya Pradesh	-0.955	-0.952	-0.991	0.987	0.976	0.982
Maharashtra	-1.224	-1.174	-1.87	0.968	0.962	0.943
Orissa	-0.979	-1.056	-1.099	0.966	0.955	0.978
Punjab	-1.115	-1.117	-1.117	0.949	0.957	0.957
Rajasthan	-0.915	-0.996	-1.073	0.970	0.947	0.952
Tamil Nadu	-1.023	-0.918	-0.918	0.927	0.973	0.973
Uttar Pradesh	-1.032	-1.020	-1.078	0.932	0.987	0.976
West Bengal	-1.226	-1.256	-0.984	0.927	0.977	0.982

Source : Census of India, Author's own calculation

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Socio-economic Impact of Rainwater Harvesting on Farming Economy: A Study from Purulia District of West Bengal

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Abstract

The erratic nature of rainfall has threatened the livelihood related to farming to a great extent specially in the arid regions. Purulia district, one of the arid regions of West Bengal suffers from acute water crisis in the dry seasons. Government constructed rainwater harvesting structures to combat the problem and ensure increase in yield and sustainable intensification of agriculture. A sample of 720 households was surveyed to investigate the impact of these projects on agricultural production, livelihood and consequently upon standard of living. Regression analysis is employed to analyze the data.The results reveal that water from RWH structure have profound impact on agriculture and livelihood diversification in the region. However, the coverage of RWH is quite low, only 27.27 percent of the farming population have access to the canal water from RWH source.Proper irrigation facilities have enabled the farmers of the region to foster other crops apart from paddy and potato which were not previously produced. Production per bigha of paddy has also increased after the inception of RWH projects. Thus, the rainwater harvesting structures have wider implications for the future prospects of farming in the region and therefore should be encouraged. Designing policy reforms in this regard can support economic growth of the region.

Keywords: Rainwater Harvesting, Farming, Livelihood Diversification, Standard of living

JEL Classification: Q1, P32, Q2, Q25, Q56, Q51

I. Introduction :

Since the last decade, climate change has contributed to the erratic behavior of rainfall pattern resulting in long dry spells sometimes while concentrated rainfall at other times. This has added a component of uncertainty to the occurrence of rainfall and hence to the fate of farming. People desperately wait for the surface water to flow to their fields and improve their options to raise

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crops all through the year. Hence the scourge of water unavailability has become the prime issue of concern in the rural milieu. While its availability has a direct bearing with the well-being of the region, its non-availability acts as a limiting factor to development. In such situations rainwater conservation and storing practices becomes pertinent in encouraging and stabilizing agricultural productivity in dry areas. Water unavailability paired with unpredictable climatic conditions act as major constraints to agricultural productivity keeping the farmers at subsistence level and in perpetuate poverty (Hatibu et al).

In West Bengal almost seventy five percent of cropped area is dependent on rainfall. Out of 5.47 million hectares of net cropped area, 2.09 million hectare area of cultivation is based on irrigation facilities while 3.38 million hectare area of cultivation is rain fed. Water scarcity in Purulia district, one of the arid regions of West Bengal is not a new phenomenon. It has a long history. Village women walking long distances with earthen pots and pitcher to fetch water is a common scene found in the streets of this region. The problem becomes more pronounced when the groundwater level goes down in the dry season. Relentless withdrawal of groundwater ignoring the hydro geological character of the area has further aggravated the problem. Agriculture production has become challenging in these dry areas resulting in poor resource utilisation consequently contributing to low-income earnings. To cope up with the changing situation the farmers have resorted to other non-conventional methods of irrigation (Subedi et al, 2020). It has been increasingly realized that harvesting of monsoon water and providing it during the dry spells can change the agriculture scenario and ecological base of the region which can consequently act as the key factor for environmental improvement. Studies suggest that incentives should be given to farmers to construct rainwater harvesting structures at individual levels (Kumar et al,2017).

Given the socioeconomic and cultural setting of the region, attempts have been made by the government to enhance the physical access to water, increase the recharge of aquifers and introduce water conservation practices through watershed approach. The Rainwater Harvesting structures are set up by the government under the Integrated Watershed Management Programme (IWMP) to cater the water needs and provide irrigation water. Water from these projects flow to the agricultural fields through canals.The implementation of the RWH projects have profound impact on the development of the region. The benefits are manifold. Starting from solving the drinking water problems, the projects help in agricultural irrigation thereby increasing productivity and contributing to increased income. Consequently, improved incomes are converted to better livelihood and standard of living. These RWH structures also facilitated in promoting the ecological and environmental conservation in the region. Moreover, with the advent of modern agricultural technology there is a continuous surge for crop diversification essentially on

economic grounds (Hazara, 2003). Thus, the aim of the study is to assess the overall impact of rainwater harvesting system operating in the district on enhancing agricultural production, changing the cropping pattern, its impact on livelihood diversification and on the perceived standard of living.

Accordingly, the paper is organized as follows: Section 2 deals with study area, data source and sample profile, Section 3 explains the different socioeconomic indicators related to farming, Section 4 presents the analysis of impact of RWH on livelihood diversification, the regression results and discussion, Section 5 assess the impact on perceived standard of living and finally section 6 concludes with policy interventions.

2. Study Area, Data and Sample Profile

2.1 Study Area

With an estimated population of about 29 lakhs as per the 2011 census, Purulia District belong to the category of semi-arid regions of West Bengal. The climate is sub-tropical in nature having high evaporation and low precipitation.Temperature varies in its extremes ranging from 2.8 degrees in winter to 52 degrees in summer. The average annual rainfall received lies between 1100-1400 mm. In spite of getting ample rain in the monsoons, most of the water is wasted in runoff because of undulating terrain making the district prone to drought. Groundwater is unavailable for agriculture as the water table is very low. Water potentiality and availability of a region largely depends upon the geological factors of the region. Presence of hard crystalline rocks just beneath the top soil lowers its retention capacity and acts as a constraint to groundwater development.Therefore, rainwater is an essential input for agriculture in the area. Most of the population is engaged in agriculture as the main means of livelihood but inadequate water supply limits the productive activities of the region thereby inhibiting the development process. There are two growing seasons, the main one from June to October and the second one involving sporadic cultivation of rice from September to February. Common crops grown include paddy, spices, wheat etc. and potato, tomato, onion etc as vegetables.

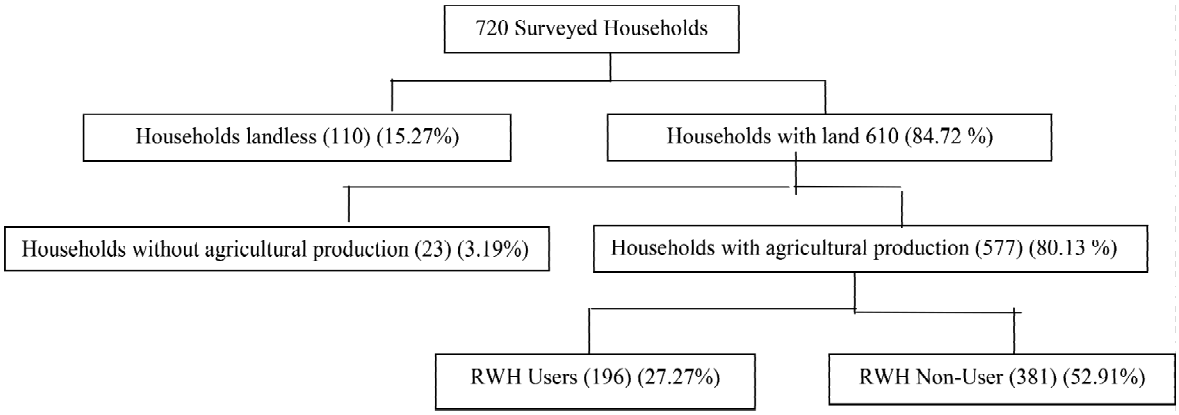
2.2 Data and Sample Profile

To obtain information a survey was carried out in January 2018 in the district using the multistage sampling procedure. A sample of 720 households from 24 watersheds (3 from each block 1 large, 1 medium and 1 small) covering 72 villages (3 villages from each watershed) from 8 blocks (Jhalda-1, Joypur, Baghmundi, Balarampur, Barabazar, Arsha, Raghnathpur, Kashipur) of Purulia district were surveyed. Then from each village 10 households were randomly selected. The sample size ($24\times3\times10 = 720$) is a representative of the people residing in the watershed area

included both user as well as non-user households. The data were obtained at village as well as household level through structured questionnaires.The questionnaire has been designed keeping in mind the objective of the study, covering all the relevant information required for the purpose. Secondary data have been collected from reports and publications of various govt local bodies and organizations like West Bengal State Watershed Development Agency (WBSDA), Soil Conservation and Watershed Development Office etc.

2.3 A snapshot of RWH users and Nonusers

An outline of the households according to the users and nonusers are depicted in the flowchart below. Out of 720 surveyed households, 110 (15.27 percent) households are landless and 610 (84.72 percent) households have lands. Of the lands holding households, only 557 (80.13 percent) households are engaged in agricultural activities. Again, out of the farming households, 196 (27.22 percent) households have access to canal water from RWH source for their fields.



Flow chart showingclassification of households according to RWH User and Non-Users

3. Socio economic indicators of households related to farming

3.1 Socio-economic profile according to RWH water users and non-users

It is evident from table 1 that 24.02 percent of user household head belongs to the productive age group (35-59) years and most of them have education less than matriculation. The user households mostly belong to large families bearing (6-10) members. Primary survey reveals that the region is inhabited by poor people which are also evident from the table. Majority of the sample households have an annual income of less than Rs.50000.

Table 1: Socio-economic characteristics of RWH water users and non-users

Variables	720 households		Total
	RWH Users	RWH Non-Users	
1. Age (No. of Years) of the household head			
Less than 35	8 (1.11)	13 (1.80)	21 (2.91)
(35-59)	173 (24.02)	445 (61.80)	618 (85.83)
60 and above	15 (2.08)	66 (9.16)	81 (11.25)
2. Education (Years of schooling) of the household head			
(1-4)	77 (10.69)	194 (26.94)	271 (37.63)
(5-9)	74 (10.27)	182 (25.00)	256 (35.55)
Matric and above	45 (6.25)	148 (20.55)	193 (26.80)
3. Household Size (No of members)			
(1-5)	49 (6.80)	137 (19.02)	186 (25.83)
(6-10)	144 (20.00)	369 (51.25)	513 (71.25)
(11-15)	3 (0.41)	18 (2.50)	21 (2.91)
4. Annual Household Income (Rupees)			
Less than Rs.50000	89 (12.36)	257 (35.69)	346 (48.05)
Rs. (50000-100000)	82 (11.38)	222 (33.33)	304 (42.22)
Above Rs.100000	25 (3.47)	45 (6.25)	70 (9.72)
Total	196 (27.22)	524 (72.77)	720 (100)

Source: Primary Survey

3.2 Classification according to land holdings and land size

Households (67.86 percent) which do not have access to RWH source use water from other sources like farm ponds, nearby source and pump sets. Sometimes they use pipelines to fetch water to their fields from nearby sources. Table 2 classifies the households according to size of land holdings into 4 broad categories: landless, marginal farmers (less than 2 bighas), small farmers (2-4 bighas) and large farmers (more than 4 bighas). The result shows that 15.28 percent of households are landless and 23.19 are marginal farmers, 34.44 percent are small farmers and 27.08 percent are large farmers. Table 3 further classifies the farmers according to user and non-

user of RWH canal water. It shows only 32.13 percent of landholders have access to water for irrigation.

Table 2: Classification of Households according to their land holdings

Size of Land Holdings (Bigha)	Blockwise								
	Jhalda-1	**Joypur**	**Baghmundi**	**Balarampur**	**Barabazar**	**Arsha**	**Raghunathpur**	**Kashipur**	**Total**
Landless	13 (1.80)	16 (2.22)	11 (1.53)	14 (1.94)	10 (1.39)	12 (1.67)	18 (2.50)	16 (2.22)	110 (15.27)
Less than 2 bighas	17 (2.36)	21 (2.91)	15 (2.08)	22 (3.05)	26 (3.61)	25 (3.47)	18 (2.50)	23 (3.19)	167 (23.19)
(2-4) bighas	37 (5.13)	29 (4.02)	40 (5.55)	25 (3.47)	30 (4.16)	27 (3.75)	29 (4.02)	31 (4.30)	248 (34.44)
More than 4 bighas	23 (3.19)	24 (3.33)	24 (3.33)	29 (4.02)	24 (3.33)	26 (3.61)	25 (3.47)	20 (2.77)	195 (27.08)
Total	77 (10.69)	74 (10.27)	79 (10.97)	76 (10.55)	80 (11.11)	78 (10.83)	72 (10.00)	74 (10.27)	610 (100)

Source: Primary Survey

Table 3: Classification of RWH user and non-user households according to land size

Size of Land Holdings(Bigha)	Total	RWHUSER	NONUSER
Less than 2 bighas	167 (23.19)	57 (9.34)	110 (18.03)
(2-4) bighas	248 (34.44)	75 (12.29)	173 (28.36)
More than 4 bighas	195 (27.08)	64 (10.49)	131 (21.47)
Total	610 (84.72)	196 (32.13)	414 (67.86)

Source: Authors calcuation from primary source

3.3 Total agricultural production before and after installation of RWH

The RWH water reaches to the agricultural fields through canals and diversion channels. The change in total production before and after having access to RWH source of water is presented in Table 4. Thus, this clearly indicates that the coverage of RWH is limited for agricultural irrigation. Thus, after the inception of the projects crop yield has increased as evident from table 4. The figures clearly indicate that almost in all the blocks the production of paddy and other crops increased after the installation of projects, which facilitated irrigation.

Table 4: Total production of user households before and after having access RWH

Blocks	Total Production in K.G. Per Bigha			
	Paddy		Others	
	Before RWH	After RWH	Before RWH	After RWH
Jhalda-1	626.71	723.56	94.14	182.08
Joypur	646.20	750.00	110.06	226.46
Baghmundi	559.60	702.16	118.16	184.28
Balarampur	616.85	727.58	132.44	212.59
Barabazar	612.53	700.88	110.68	169.49
Arsha	606.50	717.09	88.14	146.72
Raghunathpur	646.52	730.70	125.14	184.96
Kashipur	656.39	717.89	129.64	211.07

Source: Primary survey and for before RWH figures ICAR, Purulia

3.4 Cropping pattern

Since the inception of the RWH projects the cropping pattern has changed in the region. The farm households have started to grow new crops which were not previously grown in the area. Primary survey reveals that apart from paddy and potato, vegetables like tomato, onion, spinach, cabbage, cauliflower, lady's finger, brinjal, pumpkin, guard, coriander, carrot, mustard, til, elephant foot yam (ol), colocasia esculanta (kachu) etc. are grown in the area. After household consumption the surplus is sold in the market. Rice and potato are common crops grown in all the eight blocks. After the inception of RWH technology, Kashipur block also started to grow tomato and carrot in Joypur. New crops like spinach, coriander and brinjal were started to be grown in all blocks after introduction of RWH technology. Gourd and pumpkin were not grown earlier but have started to be grow now except in Balarampur and Arsha. Except Arsha and Kashipur block mustard was started to be grown in all blocks.

4. Analysis of impact of RWH on Livelihood Diversification

Since inception of RWH system in the region the farm households started to use water for irrigating their fields. Adequate irrigation facilities enabled the users to increase production yield. The extra income thus generated was diverted into other income generating activities, which eventually contributed to enhance standard of living of the households as well as the region as a whole. Primary survey reveals that the beneficiary households diversified their livelihood sources e.g. startingasmall business. Diversification helps in increasing income of rural people, reduces risk and uncertainty by providing income security, increases status and standard of living. It also helps further to broaden the horizon of knowledge and understanding thereby contributing to overall development of the region preventing the people for urban migration. Hence, we can say that diversification is the key of development through rural economy transformation.

Diversification at the individual household level simply means adding new activities. This can include an agricultural or non-agricultural work for one self, home based work or work at other places. Livelihood diversification could be described as a process by which a household construct an increasingly complex portfolio of activities and assets, in order to survive and improve their standard of living.

It is regarded as reallocation of farm's productive resources such as land, capital, farm's equipment and labour into new activity. These can be new crops or livestock products, value adding activities, provision of services to other farmers and other non-farm activities. Diversifying their income sources positively helps the households to use some of their unused (never used) resources which eventually help them in enhancing their standard of living.

4.1. Diversification Index

To capture the extent of diversification in the region among the households the diversification index was calculated. The inverse of the Herfindahl-Hirschman Index (HHI) was used to measure diversification index. The formulae of HHI = $\sum_{i=1}^{n}(a_i / \sum a_i)^2$, where i ranges from 1 to n and a_i represents the total income earned from the i^{th} sources. Hence the formulae for calculating Diversification Index (DI) is:

Diversification Index (DI) = $1 / \sum_{i=1}^{n}(a_i / \sum a_i)^2$

Table 5(Appendix) presents the values of DI of the households. Higher the value of the diversification index greater the tendency of the people to diversify.

4.1. Data Analysis

To identify major factors affecting livelihood diversification a multiple regression analysis was carried out using equation

$DI_i = a_0 + a_1$ (AGE) + a_2 (EDU) + a_3 (FSIZE)+ a_4 (LHSIZE) + a_5 (ER) + a_6 (RHWUSER) + e_i ----------(1)

Where, DI (Diversification Index) is dependent variable and others are explanatory or independent variables. Those are AGE (age of Household Head), EDU (average years of schooling), FSIZE (number of members in the household), LHSIZE (land size of households), ER (Employment Ratio), Rainwater Harvesting User (RWHUSER).The description of the independent variables and their expected signs are discussed in Table 6.

Table 6: Description of Independent Variables used in the Regression Analysis

Variable	Descriptions of Variables	Type of Measure	Expected Sign
AGE	Age represents the age of head of the household.	Years	-
EDU	Education of the household head is represented by the years of schooling	Years of formal education	+
FSIZE	The total number of members in a household	Numbers of individuals	+
LHSIZE	Land Size represents the size of land holdings of the household.	Area in bighas	+
ER	Ratio of number of non-earning to the number of earning members of a family.	Number of non earning members	-
RWHUSER	Water from RWH source used for irrigation purpose.	Dummy (1 if RWH user, otherwise 0)	+

4.3. Results and Discussion

Table 7 shows the regression results of 610 farming households. Out of 6 explanatory variables in the model, 5 variables i.e., AGE, EDU, ER, FSIZE, RWHUSER were found to be statistically significant. This statistical significance of 5 variables explains the household's diversification on various income sources in Purulia district of West Bengal in India. However only 1 variable i.e., land size was found to be statistically insignificant. The R-squared result of the logistic regression model is 0.500 and probability (LR Statistics) is 0.000. The R-squared results reasonable and satisfactory for the model. So, we can say that our model is a good fit.

Table 7: Regression results of 610 households involved in farm production

Variables	Coefficient	Std. Error	z-Statistic	Prob.
AGE	0.007***	0.003	2.891	0.000
EDU	0.010*	0.006	1.727	0.080
ER	-0.521***	0.022	-24.053	0.000
FSIZE	0.534***	0.023	23.246	0.000
LHSIZE (NS)	0.000	0.000	0.541	0.590
RWHUSED	0.078*	0.043	1.790	0.070
C	0.153	0.183	0.837	0.400
R-squared: 0.500, Mean dependent var: 1.697, F- statistic: 100.618, Prob (F statistic): 0.000, Log likelihood: -438.488, S.E. of regression: 0.499, * Significance at 10 percent, ** Significance at 5 percent, *** Significance at 1 percent, NS – Not Significant				

Source : Authors calculation from Primary Survey

Age (AGE): With increase in age people's interest to diversify their earning sources becomes less and they make themselves confined to one specialized specific job. Hence the extent of diversification is expected to negatively relate with the age of persons. But in our study the coefficient of age is positively related to diversification and is statistically significant.

Education (EDU): A educated person have more potential and willing power for earning more through diversification. Therefore, education level seems to have a positive relation with diversification. Results shows coefficient of education is positively related with diversification and is statistically significant at 10 percent level.

Family Size (FSIZE): The coefficient is positively related with diversification is statistically significant at 1 percent level. Generally, if a household family size is large where number of children and aged people increases than the dependency ratio of a household also increases. This in turn pressurizes the young members of the household to search alternative earning sources so as to increase their earnings. Hence, family size is expected to have a positive relationship with diversification. Thus, the results confirm our expectation.

Employment Ratio (ER): Employment Ratio is defined as the number of non-earning members to the number of earning members of a family. It is assumed to have negative relation with diversification level. The results show negative coefficient and is statistically significant at 1 percent level. Here the regression result supports our expectation.

Land Size (LHSIZE): Larger land size generates more income. Increase in income of households helps to diversify. So, land size is assumed to have a positive relation with diversification. The co-efficient of LHSIZE is positive but insignificant. This indicates that the size of land holding has no impact on diversification.

Rainwater Harvesting User (RWHUSER): Households having access to RWH water source for their fields will have higher yield, which converts to higher income and tend to diversify. Therefore, rainwater harvesting user bears a positive relation with diversification. As hypothesized the coefficient of the RWH user is positive and is statistically significant at 10 percent level.

5. Perceived Status of Living Standard of Households

Diversification enhances household income opportunities the impact of which is reflected on their standard of living. Generally, the standard of living of a household is assessed by number of socio-economic factors such as educational level of the family members, the house type they are residing in, the type of toilet used (sanitary or non-sanitary), the total household income, number of earning members within the household, sources of income etc. To determine the impact of diversification on the perceived standard of living, a logistic regression is applied in our analysis.

In our analysis, we have considered total Per Capita Income (PCI), Toilet Type (TOITYPE), Education level of the head (EDU) and Diversification Index (DI) as the independent variables to explain the perceived standard of living of the households. The dependent variable Standard of Living (LVNSTNDRD) is binary and qualitative in nature taking value 1 when improvement in standard of living is perceived and value 0 when no such improvement is perceived. The description of the variables and their expected signs are discussed in Table 8. The equation of the binary logit regression is

$$(LVNSTNDRD)_i = a_0 + a_1 (PCI) + a_2 (TOITYPE) + a_3 (EDU) + a_4 (DI) + e_i \text{ ---------- (2)}$$

Table 8: Description of the Independent variables used in logistic regression analysis

Variable Name	Definition	Type of Measure	Expected Sign
PCI	Per Capita Income of the household.	Measured in terms of rupees	+
TOITYPE	Type of the toilet system of a household (sanitary/non-sanitary).	Dummy variable taking value 1 for sanitary toilet and 0 for non-sanitary toilet.	+
EDU	Education of the household head	Years of formal education	+
DI	Diversification Index	Value of the index	+

5.1 Factors affecting the Perceived Standard of living of the farming community

Per Capita Income (PCI)

PCI is the per capita income. The extra income enables the households to fulfill the other amenities of life, thereby raising the living standard. Hence it is expected that after meeting the subsistence requirement, any increase in household income will have a positive impact on standard of living.

Toilet Type (TOITYPE)

TOITYPE denotes the toilet system available in the households. Toilet may be of two types: sanitary (with water supply) and non-sanitary (without water supply). Existence of the type toilet in a household reflects the education and awareness level. A household having a sanitary toilet within its premises is a indicator of good health and hygiene which further reflects healthy status of living.

Diversification Index (DI)

DI is Diversification Index. It is hypothesized that diversification index positively increases the income level which further enhances the living conditions. So, diversification index is expected to be positively related to standard of living.

Education (EDU)

EDU denotes the education level of the household head. Education is an important factor affecting the level of living standard. Education increases income and consciousness of people and thus is assumed to bear a positive relationship with standard of living.

5.2 Results of the logit regression and explanation

Table 9 shows the results of logistic regression. Out of four explanatory variables in the model, three variables i.e. DI, EDU, HHINC were found to be statistically significant at 1 percent level. The McFadden R-squared result of the logistic regression model is 0.241 and probability (LR Statistics) is 0.000. Results reveals that the coefficients of Per Capita Income (PCI), Diversification Index (DI) and Education (EDU) are positive and highly significant in influencing the standard of living of households. Thus, the results confirm our expectation. However, the variable toilet type is negatively related to standard of living and also not statistically significant.

Table 9: Results of the logit regression

Variable	Coefficient	Std. Error	z-Statistic	Prob.
DI	1.364***	0.175	7.787	0.000
EDU	0.140***	0.033	4.258	0.000
PCI	0.000***	0.000	5.993	0.000
TOITYPE	-0.052 (NS)	0.218	-0.238	0.811
C	-5.322***	0.565	-9.427	0.000
McFaddenR-squared: 0.241, Mean dependent var: 0.385, LR statistic: 196.337, Prob(LR statistic): 0.000, Log likelihood: -308.441, S.E. of regression: 0.408 , * Significance at 10 percent, ** Significance at 5 percent, *** Significance at 1 percent, NS – Not Significant				

6. Conclusion and Policy Implications

It is evident from the results that water from RWH structure have profound impact on agriculture and livelihood diversification in the region. However, the coverage of RWH is quite low in the region, only 27.27 percent of the farming population uses the water from RWH source. The results also reveals that the cropping pattern has changed to a considerable extent after the availability of irrigation facilities from the RWH source. Many crops which were not grown previously in the area are grown now. Proper irrigation has enabled the people of the region to cultivate other crops apart from paddy and potato which were previously produced. The crops grown now are tomato, onion, spinach, cabbage, cauliflower, lady's finger, brinjal, pumpkin, guard, coriander, carrot, mustard, til, elephant foot yam (ol), Colocasiaesculanta (kachu) etc.

Production per bigha of paddy has increased after the inception of RWH projects. The increased income has enabled the users to divert their income sources. Diverting the increased income into other avenues of employment eventually improved the standard of living. The results further show

that diversification of income sources, education level and household income significantly influenced the perceived standard of living.

Thus, the rainwater harvesting structures have wider implications for the future prospects of farming and therefore should be encouraged and constructed keeping in mind the erratic nature of climate. Kumar et al (2008) showed that improving the water situation along with improved access and use of water, with improved water environment through investments in water infrastructure, creating institutional capabilities in water sector and making policy reforms can support economic growth of the country. There is a need for a holistic approach where our national and state policies can complement each other. The central government's initiative should operate like a joint collaborative arrangement with the stakeholders. However, this is a gigantic task as the stakeholders need to be convinced on the efficacy and benefits of the venture and be involved. Global trend indicates infrastructure financing through community participation to achieve sustainable infrastructural development is always good for that society.

A massive awareness building program for the various stakeholders can be carried out. It is required to send message to all the villagers that every drop of rain that falls on their field, habitation and village should not go waste. Monsoon should be harvested. This can be done by setting up new rainwater conservation structures such as digging up ponds. There is a need for careful planning and management of water resources to cater the water demands.

Appendix

Table 5: Diversification Index of sample households

HH Nos.	Jhalda-1	Joypur	Baghmundi	Balarampur	Barabazar	Arsha	Kashipur	Raghunathpur
1	1.68	1.00	1.97	1.00	1.00	1.00	1.00	1.96
2	1.00	1.80	1.00	1.00	1.98	2.39	1.92	1.00
3	1.47	2.90	1.97	1.00	1.97	1.96	1.98	1.00
4	1.86	2.43	1.00	1.88	1.00	1.00	1.00	1.00
5	1.00	1.00	1.90	1.00	1.00	1.00	1.99	1.84
6	1.00	2.62	1.00	1.00	2.92	1.87	1.00	2.78
7	2.89	2.00	1.99	1.96	2.00	2.95	1.74	1.00
8	1.00	2.80	1.98	1.00	1.60	1.00	1.00	1.93
9	1.52	2.69	1.00	2.43	2.69	1.75	1.87	1.00
0	1.00	1.97	2.69	2.71	2.92	2.99	1.90	1.00
11	1.98	1.57	1.00	1.00	1.00	1.81	1.00	1.97
12	1.00	1.00	2.00	1.83	1.00	1.00	1.99	1.99
13	1.80	1.99	1.00	1.90	1.00	1.00	2.58	2.00
14	1.00	2.59	1.00	2.65	1.79	2.84	1.00	1.00
15	2.91	1.88	1.90	1.88	1.00	1.00	1.47	2.00
16	1.80	1.92	1.00	1.00	1.00	2.00	1.00	1.00
17	1.00	1.00	1.00	1.87	1.94	1.00	2.75	1.97
18	1.00	1.74	1.34	2.67	1.00	2.74	1.88	1.00
19	2.65	2.50	1.00	1.64	2.71	1.00	1.47	1.92
20	1.92	1.73	1.00	1.00	1.98	1.00	1.96	1.00
21	1.00	1.99	1.00	1.00	2.47	2.62	2.74	1.88

HH Nos.	Jhalda-1	Joypur	Baghmundi	Balarampur	Barabazar	Arsha	Kashipur	Raghunathpur
22	1.32	1.72	1.00	1.92	2.00	1.00	1.00	1.82
23	1.00	1.98	1.00	1.86	1.90	1.87	1.00	1.00
24	1.00	1.00	1.00	1.97	1.00	1.00	2.00	1.00
25	1.00	1.73	1.96	1.00	1.73	2.79	3.00	2.91
26	1.80	2.73	1.98	1.99	2.92	2.59	2.00	1.00
27	2.85	2.78	1.99	1.92	1.99	1.00	3.63	1.00
28	2.60	1.00	1.00	1.90	2.00	1.00	2.92	1.99
29	1.00	1.88	1.85	1.00	1.68	1.00	1.50	1.00
30	2.47	1.97	1.98	1.97	1.97	1.00	2.79	1.63
31	1.00	1.00	1.00	1.00	1.83	1.73	1.00	1.00
32	1.99	2.63	1.00	1.97	1.00	1.00	1.86	1.84
33	1.00	1.57	1.00	1.97	1.77	1.00	3.88	1.00
34	1.72	1.00	1.92	1.00	2.27	1.51	1.93	1.69
35	2.79	1.77	1.99	1.98	1.98	1.91	2.77	1.00
36	1.73	2.51	1.00	1.99	1.78	1.00	1.00	2.45
37	1.75	1.69	1.00	1.00	1.00	1.97	1.95	1.00
38	1.00	1.83	1.83	2.74	3.75	1.98	1.00	1.00
39	1.00	1.98	2.98	1.99	2.96	1.00	1.98	1.00
40	1.00	2.71	1.00	1.87	1.87	1.00	1.69	1.63
41	1.00	1.90	2.00	2.96	2.96	2.97	1.00	1.93
42	2.57	1.60	1.95	1.96	1.00	0.75	1.00	1.99
43	1.00	1.00	1.00	1.00	1.00	1.99	1.99	2.80
44	3.75	1.98	2.98	1.00	1.00	1.00	1.00	1.96
45	1.00	1.00	1.80	1.81	2.70	2.00	1.98	1.00

HH Nos.	Jhalda-1	Joypur	Baghmundi	Balarampur	Barabazar	Arsha	Kashipur	Raghunathpur
46	1.99	2.88	1.85	2.80	2.88	2.99	2.82	2.68
47	1.00	3.79	2.00	1.87	2.00	1.79	1.00	3.87
48	1.00	1.82	2.00	1.88	2.83	1.95	1.00	1.00
49	1.80	1.94	2.00	2.92	1.98	2.92	1.00	1.00
50	1.80	1.99	1.98	1.82	2.92	1.73	1.99	1.00
51	2.73	1.98	1.00	1.00	1.00	1.00	1.00	1.00
52	1.00	1.00	1.00	1.84	1.71	1.00	1.00	1.00
53	1.00	1.00	1.98	2.86	1.00	1.00	1.00	2.67
54	1.99	1.74	1.94	1.00	2.00	2.00	1.00	1.00
55	1.00	1.99	1.97	1.86	2.92	1.00	1.00	1.00
56	1.99	1.42	2.80	2.85	2.34	1.80	1.98	1.00
57	1.83	1.62	1.93	1.96	2.00	1.82	2.00	1.99
58	2.88	1.92	1.00	1.00	1.99	1.00	1.00	1.83
59	1.00	1.00	1.99	2.83	2.93	2.88	1.99	1.80
60	1.75	1.87	1.00	1.98	2.69	1.73	1.00	1.00
61	1.48	1.00	1.00	1.00	1.00	1.00	1.79	1.00
62	1.00	1.00	1.32	1.00	1.00	1.00	1.00	1.92
63	1.99	1.98	1.99	1.00	1.00	1.72	2.00	1.00
64	1.47	1.88	2.78	1.85	1.00	2.00	1.00	2.00
65	1.60	1.95	1.00	1.00	1.90	1.87	1.00	1.00
66	1.00	1.92	1.38	1.92	1.82	1.86	1.00	2.96
67	1.00	2.88	1.96	1.96	1.00	2.78	2.00	2.57
68	2.94	2.92	3.92	2.00	1.95	1.99	2.85	1.69
69	2.00	1.88	2.94	2.00	1.00	1.79	1.00	1.00

HH Nos.	Jhalda-1	Joypur	Baghmundi	Balarampur	Barabazar	Arsha	Kashipur	Raghunathpur
70	2.00	1.00	1.98	1.69	1.00	1.00	1.91	1.00
71	1.60	1.00	1.99	1.00	1.88	2.96	1.00	1.00
72	1.00	1.00	2.79	4.30	1.00	2.00	1.95	1.00
73	2.66	1.00	2.91	1.00	1.00	1.00	1.00	1.88
74	1.67	1.82	2.96	1.99	1.99	2.65	1.99	2.93
75	2.59	1.97	2.59	1.97	1.89	1.99	2.73	1.00
76	2.52	3.82	1.00	2.67	1.00	1.75	1.97	1.97
77	1.69	1.00	2.99	1.99	1.97	1.99	1.00	1.00
78	1.72	2.54	1.72	1.00	1.97	1.91	1.00	1.00
79	1.00	1.99	1.00	1.00	2.84	2.69	1.00	2.86
80	1.25	2.90	1.00	1.88	3.95	1.70	1.00	2.88
81	1.69	1.96	2.92	1.00	1.00	2.90	1.88	1.00
82	1.62	1.00	2.69	1.00	1.99	1.00	1.88	1.00
83	3.64	1.88	1.00	1.00	1.00	1.00	2.92	2.93
84	1.00	1.00	1.00	1.00	1.00	1.90	3.81	2.66
85	1.00	1.89	1.00	1.00	1.00	1.00	1.00	1.00
86	1.00	1.88	2.78	1.97	1.88	1.92	1.99	1.86
87	1.99	1.00	2.70	1.00	1.88	2.00	1.80	2.94
88	1.97	2.98	1.00	1.00	1.00	1.00	1.00	1.00
89	1.86	1.00	2.00	1.97	1.97	1.99	1.00	1.00
90	1.92	2.90	1.00	1.87	1.00	1.58	1.99	1.96
S.D.	0.685	0.679	0.712	0.667	0.735	0.677	0.732	0.707

Source: Authors calculation from Primary Survey

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Department of Economics

The Department of Economics at Rabindra Bharati University was established in November 1972 and the Silver Jubilee and the Golden Jubilee of its activities were celebrated during 1997-98 and 2022-23 through a series of Foundation Lectures. Special lectures, Seminars and Re-union of past and present students and teachers.

Economics courses both at the Postgraduate and Honours levels have a well-planned and balanced approach to the teaching of this dynamic social science discipline. In the Post Graduate level semester system has been introduced in 2010. Semester syllabus for M.A. in Economics has been framed in 2010 and further revised in 2013. Courses in each subject area are detailed in separate Modules with references to specific reading materials. Specialization at the postgraduate level includes (1) Econometrics and Statistics (2) Rural Economics and (3) Economics of Money and Finance and (4) International Trade. Each of the area of Specialization contain Project Work emphasizing on theoretical as well as empirical analysis. Field Survey, Building up of theoretical model, Statistical analysis of result obtained by running computerized statistical software in respective area of research and finally preparation of the project in the Post Graduate Level encourage the research aptitude of the students. From April 2007, the department has already started M.Phil course. From 2010 the semester system has been introduced and curriculum have been revised and updated in the light of present need of the day. As per the new regulation of UGC a six month Ph.D. Course work has also been initiated from 2010 in this department successful completion of which give the opportunity to the students to be registered in the Ph.D. programme under this university.

Class-room teaching is regularly supplemented by Extension Lectures and Special Lectures by noted teachers and scholars from others Universities/Institutes, occasional seminars on contemporary issues in the subject area.

The Department has published quite a few books and monographs over the years. The NAAC Peer Team in its report made special mention of the research activities in this Department.

The Department takes pride in the fact that increasingly large number of its students have been qualifying in the NET/SLET examinations each year.

The Department has organized its 1st Refesher Course (UGC) in Economics on "Development Economics and India since 1991" during February, 2004.

In April, 2006, the department organized a national seminar on ‘‘IPR Awareness’’ sponsored by the Ministry of Human Resource Department, Govt. of India.

In March, 2009, the department organized a seminar on "Globalization: Conceptual and Empirical Issues."

In March, 2010, the department organized a seminar on "Empirical Issues on Indian Economy".

In March, 2011 and 2012, the department organized annual seminar on "Contemporary Issues in Development Economics."

In March, 2013, the department organized Seminar on "Development Paradiagm of the East and North-East States in India during the post-reform period: problems and prospects."

In February, 2014, the department organized a workshop on "Contemporary issues on Macroeconomics."

In February 2015, the department organized a workshop on "Advanced Issues on Microeconomics."

In March, 2015, the department organized a seminar on "Contemporary Issues in Development Economics"

In March, 2016, the department organized a seminar on "Contemporary Issues in Development Economics"

In February, 2016, the department organized three-day workshop in "Frontiers in Applied Econometrics".

In March 2017, the department organized a "Research Scholars" workshop.

In January, 2018, the department organized International workshop on 'Behavioural Economics.'

In March, 2018, the department organized a seminar on “Contempory Issues in Development Economics.

In February, 2019, the department organized a workshop on “Application of Techniques in the Area of Social Sector”.

In November, 2022, the department organized International Seminar on “Fifty Years of the Indian Economics since 1972”.

Publication of the Department of Economics

Rabindra Bharati University Journal Economics: Vol. I (2007), II (2008), III (2009), IV (2010), V (2011), VI (2012), VII (2013), VIII (2014), IX (2015), X (2016), XI (2017), XII (2018), XII-XIV (2019-20), XV (2021)

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Monographs:

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ii) (1998) Status of Women in India in the Fiftieth Year of Independence-Bela Dutta Gupta
iii) (2000) Marx after 150 Years of the Manifesto
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v) (2000) একুশ শতকে রবীন্দ্রনাথের অর্থনৈতিক চিন্তা
vi) (2001) Globalisation: On Failure of the Process of Planning and Rise of Human Distress Gurudas Dasgupta
vii) (2001) Corruption and Development
viii) (2001) Some Selected Sources of Official Socio-Economic Data on West Bengal
ix) (2004) Uncertain Growth and Growing Uncertainties: Some Thoughts on Globalisation-Anup Sinha
x) (2005) জানার বিষয় একটা যাত্রা পথের বিবরণ— ড. শুভেন্দু দাশগুপ্ত (স্মারক বক্তৃতা)
xi) (2006) Problem of Transition from Planned Economy to Market Economy in India-Deb Kumar Bose
xii) Newsletter of the Department: Inside
xiii) (2011) Liberalisation, Economic Development and some related issues-Prof. Hiron Kumar Banerjee.
xiv) (2011) সমাজবিকাশের প্রেক্ষিতে নারী' — অধ্যাপিকা অপরাজিতা মুখার্জী (স্মারক বক্তৃতা)
xv) (2014) Contemporary issues on Macroeconomics
xvi) (2023) 'Viewing Nature through an Economic Lens : Some Conceptual Issues' (Endowment Lecture) – Priya Sangameswaran
xvii) (2023) 'India's Path of Regaining Growth Momentum - The Search for the Best' (Endowment Lecture) – Ajitava Raychaudhuri

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1. (1990) The Changing Pattern of Consumption Expenditure in India: Raj Kumar Sen
2. (1991) Consumer Cooperatives in India: Durgadas Roy
3. (1999) অমর্ত্য ভাবনা, ১, ২ (রবীন্দ্রভারতী গ্রন্থমালা, ২,৩)
4. (2000) Amartya Sen's Economics I.II. 9 Rabindra Bharati Books 2,3): (ed) Raj Kumar Sen
5. (2000) The Indian Economic Issues: Essays in honour of Professor Santikumar Ghosh (ed) Raj Kumar Sen
6. (2002) Indian Labour in the post-Liberalization period: (ed). Raj Kumar Sen (K.P. Bagchi & Co.)
7. (2008) Emerging Issues in Indian Economic Development and Reforms, (ed). Raj Kumar Sen (Deep & Deep Publications Pvt. Ltd.)
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