AN ECONOMETRIC ASSESSMENT OF T.R. MALTHUSIAN THEORY OF POPULATION: EMPIRICAL EVIDENCE IN INDIA

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ABSTRACT

T. R. Malthus propounded a theory of the relationship between population growth and economic development. He wrote an essay in 1798 on “The Principles of Population”. He said that population increases in geometric ratio (i.e., 10, 20, 40, 80...) whereas, the food supply increases only in arithmetic ratio (i.e., 10, 20, 30, 40...). He stated that ‘nature will restore the equilibrium, if man fails to check his own growth’.

KEYWORDS: *Geometric Ratio, Arithmetic Ratio, Positive Checks & Preventive Checks*

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1. INTRODUCTION

In ancient times, several statesmen and thinkers applied their minds to the questions of the desirable size of population and the need for either encouraging or discouraging population growth. In recent years, economists, non-economists and demographers have begun to focus increasingly on the relationship between economic development and population growth. World population growth accelerated drastically between the Second World war and 1950 to one per cent a year, and following that to an unprecedented two per cent. The effect was to nearly double World population between 1950 and today.

2. MALTHUSIAN THEORY AND ITS RELEVANCE IN INDIA

Almost 220 years ago, the reverend Thomas R Malthus postulated his theory on the relationship between population growth and economic development. In his Essay on the Principle of Population, (1798), Malthus noted a universal tendency for the population of a country, unless checked by dwindling food supplies, to grow at a geometric ratio doubling every 25 years. At the same time, food supplies could only expand roughly at an arithmetic ratio, because of diminishing returns to the fixed factor-land. As each member of the population would have less land with which to work, his marginal contribution to food production would decline. Because, the growth in food supplies could not keep pace with the rapid growth of population, per capita food production would have a tendency to fall, leaving a stable population existing barely at or slightly above the subsistence level. Malthus contended that the only way to avoid this condition of a chronic low standard of living, or “Absolute Poverty” was for people to engage in ‘moral restraint’ and limit the members of their progeny. In the absence of such preventive checks, “Positive” checks (starvation, disease, wars etc.) on population growth would inevitably provide the restraining force. Thus, poor nations would never be able to rise much above their subsistence level of per capita income unless they initiated Neo-Malthusian “Preventive Checks” i.e., birth control on their population growth. From this viewpoint, although Malthus was against birth control for religious reasons, one may regard him as the father of the modern birth control

movement. As discussed, most of Malthus's predictions were proved incorrect in developed nations, as population growth rates slowed and rates of food grain production were very high due to improved farm technology. However, in most of the developing nations his predictions have been found correct. These countries are characterized by high growth rate of population, relatively low rates of food grains production and progressive impoverishment of a sizable section of the people. According to some economists, India is also no exception. This view is supported by the fact that the land supply is virtually fixed and already a high population land ratio exists. At the other extreme, it is argued that there is still great potential for increasing food grain production through increasing irrigation facilities and applying modern technology. Moreover, present per acre yield is very low, conditions are favourable, soil is very fertile and sufficient volumes of water, including sub-soil water is available. Hence these writers claim Malthus's predictions do not hold good even for the developing nations.

The “Qualified” Malthusian Doctrine

There were three important qualifications finally, which distinguish the Malthusian doctrine from a strict historical prophecy or forecast.

Rate of Growth of Population

According to Malthus, the population increases in geometrical progression i.e., in the ratio 1, 2, 4, 8, 16, 32, 64, 128, 256 etc.

The Rate of Growth Means of Subsistence

According to Malthus, the means of subsistence increase only in arithmetical progression, i.e., in the ratio of 1, 2, 3, 4, 5, 6, 7, 8, 9 and so on.

Every term corresponds to a period of twenty-five years, and a glance at the figures will show us that population supposed to double every twenty-five years, while the means of substance merely increases by an equal amount during each of these periods. Thus the divergence between the two series grows with astonishing rapidity.

The Checks to Population

The increase in geometrical ratio of population and arithmetical ratio of the means of subsistence tends to disturb the balance between the population and the food supply. Malthus exhorts mankind to practice preventive checks in order to escape the wrath of nature. The Malthusian theory of population can be explained by means of simple chart thus.

Figure 1

3. RESEARCH OBJECTIVES

The study has been guided by the following objectives

- To analyse the trends in the growth of population and food supply in India.
- The applicability of Thomas Robert Malthus view in the Indian Scenario with regard to population growth and food supply.

Hypothesis

H1: An increase in population growth will decrease agricultural production.

4. REVIEW OF RELEVANT LITERATURE

In the words of Das M.M and Datta L (2006), it is a dismal fact that all the seven States of North East India has been suffering all along from food deficiency, as the food grains production has not been adequate because of the practice of traditional methods of cultivation, in spite of the fact that there has been enough potential of abundant food grains production. On the other hand, there has been tremendous growth of population, which has increased the demand of food to an unmanageable proportion. As a result, these States have to rely on imported food, which has found to be not sufficient and reliable making thereby the poor people vulnerable to food insecurity, not to speak of getting nutrition. As they do not have purchasing power, they cannot depend on food commodities available in the free markets. They have, therefore, to depend on the food supplied through the Public Distribution System (PDS) at subsidized price. But the Government's recent policy to reduce the subsidy to the food supplied through the PDS and to limit the number of beneficiaries only to those who fall below the poverty line, a large section of the people belonging to the small and marginal farmers in the States of the North East India, become the victims of food insecurity, malnutrition and under

nutrition. Therefore, the only alternative is to increase the production and productivity of food grains within the region itself through modern sustainable methods in order to make the people self-sufficient in food production, in which, there is enough potential in some areas of the region not yet realized to an optimum level. The empirical study reveals that there is still a big gap between the potential and the actual production of food grains at least in the biggest State of Assam with plenty of fertile alluvial plains. If the potential of Assam alone could be fully utilized by providing irrigation only, it could feed the entire North East India besides fulfilling its own needs. Emphasis should, therefore, be given on development of agriculture in the region for satisfying the need of the ever increasing population. As the explosive growth of population is not the result of natural birth rate alone, but of large-scale immigration from the neighbouring foreign countries and other States of India, strict measures should be taken to control immigration. Otherwise scarcity in the region will be a never ending phenomenon.

5. RESEARCH METHODOLOGY AND DATABASE

Materials and methods in this study covers study period, sources of data, tools used and analysis methodology.

Reference Period

The study covers a period of fifty seven (57) years. Decade-wise analysis has been followed in the study from 1960-1961 to 1969-1970, 1970-1971 to 1979-1980, 1980-1981 to 1989-1990, 1990-91 to 1999-2000, 2000-2001 to 2009-2010 and 2010-2011 to 2017-2018.

Sources of Data

The study is based on secondary data, since it requires aggregate time series data over a period of time. The secondary data have been obtained from various published and unpublished sources.

National Sources

The information required for the study have been collected from Reserve Bank of India Handbook of Statistics on Indian Economy, Economic Survey, Statistical Office records, Annual reports available in Government and Non-Government websites, various Indian Economy and Econometrics books, articles published in journals like Economic and Political Weekly, Indian Streams Research Journal, Southern Economist, Indian Economic Journal, Third Concept.

International Sources

The information required for the study have also been collected from various articles published in the International Journal of Economics and Management Sciences, International Review of Applied Economic Research, The Journal of World Economic Review and Asian African Journal of Economics and Econometrics.

Data Analysis and Tools used

The collected data have been processed both manually and with the help of computer software systems, Microsoft Excel and Statistical Package for Social Sciences (SPSS). The following appropriate statistical tools have been used in this study.

Trend Analysis

The objective of the present study is to analyse the growth of population and food supply in India. For this purpose, two popular forms of trend analysis, namely the linear trend model and the semi-log model have been used.

To fit the straight line, a model of the following type has been used

$$T = a + b_t + U_t$$

T = Population in crore and food supply in million ton.

“a” is the constant to be estimated, “ b_t ” is annual absolute growth in the variables.

“t” denote the time in years. “t” has taken values for 1,2,3, ... “ U_t ” is the disturbance term “b” is the regression co-efficient showing the annual growth or decline in the population and food supply in India. The compound growth rates have also been worked out for population and food supply growth for the six sub-decades and as also for the whole period.

To get the constant annual compound growth rate, another semi-log model of the following type has been used in this study.

This semi-log model is $\text{Log } y = a + b_t$

Compound growth rate = $[\text{antilog}(b-1)100]$

The above regression models are estimated using the principle of least square. The compound growth rates of the population and food supply are estimated for the six sub-decades 1960-61 to 1969-1970, 1970-71 to 1979-80, 1980-81 to 1989-90, 1990-91 to 1999-2000, 2000-01 to 2009-10, 2010-11 to 2017-18 and also for the entire period of 1960-1961 to 2017-18.

6. ANALYSIS AND DISCUSSIONS

Table 1 shows the growth of food grain production and growth of population during pre-reform period.

Table 1: Growth of Population and Food Grains during Pre-form Period

Year	Population (in Crore)	Total Food Grains (Million Ton)
1960-61	43.4	82.02
1961-62	44.4	82.71
1962-63	45.4	80.15
1963-64	46.4	80.64
1964-65	47.4	89.36
1965-66	48.5	72.35
1966-67	49.5	74.23
1967-68	50.6	95.05
1968-69	51.8	94.01
1969-70	52.9	99.50
1970-71	54.1	108.42
1971-72	55.4	105.42
1972-73	56.7	97.03
1973-74	58.0	104.67
1974-75	59.3	99.83
1975-76	60.7	121.03
1976-77	62.0	111.17
1977-78	63.4	126.41
1978-79	64.8	131.90
1979-80	66.4	109.70
1980-81	67.9	129.59
1981-82	69.2	133.30
1982-83	70.8	129.52
1983-84	72.3	152.37

1984-85	73.9	145.54
1985-86	75.5	150.44
1986-87	77.1	143.42
1987-88	78.8	140.35
1988-89	80.5	169.92
1989-90	82.2	171.04
1990-91	83.9	176.39
1991-92	85.6	168.38
1992-93	87.2	179.48
1993-94	89.2	184.26
1994-95	91.0	191.50
1995-96	92.8	180.42
1996-97	94.6	199.43
1997-98	96.4	193.12
1998-99	98.3	203.61
1999-2000	100.1	209.80
2000-01	101.9	196.81
2001-02	104.0	212.85
2002-03	105.6	174.78
2003-04	107.2	213.19
2004-05	108.9	198.36
2005-06	110.6	208.60
2006-07	112.2	217.28
2007-08	113.8	230.78
2008-09	115.4	234.47
2009-10	117.0	218.11
2010-11	118.6	244.49
2011-12	122.0	259.29
2012-13	123.5	257.13
2013-14	125.1	265.04
2014-15	126.7	252.02
2015-16	128.3	251.57
2016-17	129.9	275.11
2017-18	131.6	284.83

Source: RBI Handbook of Statistics on Indian Economy, Various Issues.

Table 1 shows the growth of population and the growth of food grain production in India, since 1960-1961. The table shows that food grains production has increased from 82.02 million ton in the year 1960-1961 to 284.83 million ton in the year 2017-2018. The corresponding population growth in this period are 43.4 and 131.6 crore respectively.

Table 2: Growth of Population and Food Supply 1960-61 to 1969-70

Period	Items	Model	a	b	Std-Error	T-Stab	Sig-t	R ²	CGR
1960-61 to 1969-70	Population	Linear	42.28 0556	1.04 1667	0.103 19	100.947	0.0000	0.99 931	-
		Log- Linear	3.749 163	0.219 51	8.7486	250.906	0.000	0.99989	2.219
	Food Supply	Linear	77.98 6944	1.080 833	1.0240 85	1.055	0.3263	0.13 728	-
		Log- Linear	4.361 068	0.011 683	0.0124 10	0.941	0.37 78	0.11 238	1.175

From Table 2, it is vivid clear that in the decade from 1960-61 to 1969-70, the population had grown at an absolute rate of 1.04 crore per annum, whereas the food supply had grown at an absolute rate of 1.08 million ton per year. The semi log model shows that the values of slope coefficient of population and food supply in the years 1960-61 to 1969-

70 are 0.219 and 0.011, which shows that the population and food supply had grown at the rate of 21.95 and 1.2 per cent. The regression estimates are statistically significant at 5 per cent and 1 per cent level. In the decade from 1960-61 to 1969-70, the population and food supply had increased at a compound growth rate of 2.219 and 1.175 per cent, respectively. Thus, in the decade from 1960-61 to 1969-70, the growth of food supply is just over the growth of population.

Table 3: Growth of Population and Food Supply in the Decade from 1970-71 to 1979-80

Period	Items	Model	a	b	Std-Error	T-Stab	Sig-t	R ²	CGR
1970-71 to 1979-80	Population	Linear	51.37 6364	1.34 1818	0.0122 87	109.209	0.0000	0.99 925	-
		Log- Linear	3.946 532	0.226 11	8.1972	275.841	0.0000	0.99988	2.287
	Food Supply	Linear	96.68 7455	2.29 5727	0.854 999	2.685	0.0250	0.44 477	-
		Log- Linear	4.578 125	0.020 310	0.007 513	2.704	0.0243	0.44816	2.052

Table 3, shows that in the decade from 1970-71 to 1979-80, the population had grown at an absolute rate of 1.34 crore per annum, whereas the food supply had grown at an absolute rate of 2.29 million ton per year. The semi log model shows that the values of slope of coefficient of population and food supply in the years 1970-71 to 1979-80 are 0.226 and 0.02 which shows that the population and food supply had grown at the rate of 22.61 and 2.03 per cent. The regression estimates are statistically significant at 5 per cent and 1 percent level. In the decade from 1970-71 to 1979-80, the population and food supply had increased at a compound growth rate of 2.287 and 2.052 per cent respectively. Thus, in the decade from 1970-71 to 1979-1980, the growth of food supply just over the growth of population.

Table 4: Growth of Population and Food Supply in the Decade from 1980-81 to 1989-90

Period	Items	Model	a	b	Std-Error	T-Stab	Sig-t	R ²	CGR
1980-81 to 1989-90	Population	Linear	66.02 6667	1.598 788	0.0163 24	97.939	0.0000	0.99 917	-
		Log- Linear	4.195 586	0.021 384	7.1628	298.546	0.0000	0.99991	2.161
	Food Supply	Linear	124.4 9600	4.009 636	1.008 326	3.977	0.0041	0.66 405	-
		Log- Linear	4.834 501	0.026 969	0.006 687	4.033	0.0038	0.67028	2.734

Source: Computer by the Researcher

The table 4 shows that in the decade from 1980-81 to 1981-90, the population had grown at an absolute rate of 1.58 crore per annum whereas, food supply had grown at an absolute rate of 4.00 million ton per year. The semi log model shows that the values of slope coefficient of population and food supply in the years 1980-81 to 1989-90 are 0.0213 and 0.0269 which shows that the population and food supply had grown at the rate of 2.14 and 2.7 per cent. The regression estimates are statistically at 5 per cent and 1 per cent level of significant. In the decade from 1980-81 to 1989-90 the population and food supply had increased at a compound growth rate of 2.16 and 2.734 per cent respectively. Thus, in the decade from 1980-81 to 1989-90, the growth rate of food supply is just more than the growth of population.

Table 5: Growth of Population and Food Supply in the Decade from 1990-91 to 1999-2000

Period	Items	Model	a	b	Std-Error	T-Stab	Sig-t	R ²	CGR
1990-91 to 1999-2000	Population	Linear	81.95 3333	1.810 303	0.009 554	189.484	0.0000	0.99 978	-
		Log-	4.410	0.019	0.0001	137.526	0.0000	0.99958	1.992

		Linear		725	43				
	Food Supply	Linear	166.9 74667	3.938 970	0.6368 50	6.185	0.0003	0.82705	-
		Log-Linear	5.123 165	0.020 818	0.0034 01	6.121	0.0003	0.82404	2.104

From the above table 5, it is vivid clear that in the decade from 1990-91 to 1999-2000, the population had grown at an absolute rate of 1.81 crore per annum where as food supply had grown at an absolute rate of 3.938 million ton per year. The semi log model shows that the values of slope coefficient of population and food supply in the decade from 1990-91 to 1999-2000 are 0.019 and 0.020, which shows that the population and food supply had grown as the rate of 1.97 and 2.08 per cent. The regression estimates are statistically significant at 5 per cent and 1 per cent level. In the decade from 1990-91 to 1999-2000 the population and food supply had increased at a compound growth rate of 1.992 and 2.104 per cent, respectively. In this period also, the growth of food supply has just surpassed the growth of population.

Table 6: Growth of Population and Food Supply in the Decade from 1999-2000 to 2009-2010

Period	Items	Model	a	b	Std-Error	T-Stab	Sig-t	R ²	CGR
1999-2000 to 2009- 2010	Population	Linear	100.5 46667	1.65 6970	0.0153 86	107.693	0.0000	0.99 931	-
		Log-Linear	4.6131 76	0.015 139	0.000 233	65.012	0.0000	0.99811	1.525
	Food Supply	Linear	189.00 4667	3.912 424	1.4842 43	2.636	0.0299	0.46 482	-
		Log-Linear	5.243 100	0.018 782	0.007 401	2.538	0.0348	0.44597	1.896

It is evident from Table 6 in the decade from 2000-01 to 2009-2010, the population growth at an absolute rate of 1.65 crore per annum whereas the food supply had grown at an absolute rate of 3.91 million ton per year. The semi log model shows that the value of slope coefficient of population and food supply in the decade from 2000-01 to 2009-10 are 0.015 and 0.018, which shows that the population and food supply had grown at the rate of 1.5 and 1.9 per cent. The regression estimates are statistically significant at 5 per cent and 1 per cent level. In the decade from 2000-01 to 2009-10, the population and food supply had increased at a compound growth rate of 1.525 and 1.896 per cent, respectively.

Table 7: Growth of Population and Food Supply in the decade from 2010-11 to 2017-2018

Period	Items	Model	a	B	Std-Error	T-Stab	Sig-t	R ²	CGR
2010-11 to 2017- 2018	Population	Linear	117.8 4286	1.744 048	0.083 506	20.885	0.0000	0.98643	-
		Log-Linear	4.770 863	0.013 915	0.000 745	18.690	0.0000	0.98311	1.401
	Food Supply	Linear	243.4 11071	3.94 9762	1.527 303	2.586	0.0414	0.52711	-
		Log-Linear	5.497 189	0.014 871	0.005 797	2.565	0.0426	0.52309	1.498

Table 7 shows that in the decade from 2010-11 to 2017-2018, the population had grown at an absolute rate of 1.74 crore per annum, whereas, food supply had grown at an absolute rate of 3.94 million ton per year. The semi log model shows that the values of slope coefficient of population and food supply for the period from 2010-11 to 2017-18 are 0.013 and 0.014, which shows that the population and supply had grown at the rate of 1.4 and 1.5 per cent. The regression estimates are statistically at 5 per cent and 1 per cent level of significant. In the decade from 2010-11 to 2017-18, the

population and food supply had increased at a compound growth rate of 1.401 and 1.498 per cent respectively. Thus, in the decade from 2010-11 to 2017-18, the growth rate of food supply is just over the growth of population.

Table 8: Growth of Population and Food Supply in the Decade from 1960-61 to 2017-2018

Period	Items	Model	A	B	Std-Error	T-Stab	Sig-t	R2	CGR
1960-61 to 2017-2018	Population	Linear	36.51 6152	1.597 173	0.016 250	98.289	0.0000	0.99 424	-
		Log-Linear	3.784 620	0.019 920	0.000 192	103.819	0.0000	0.99483	2.012
	Food Supply	Linear	60.85 9056	3.496 414	0.087 307	40.047	0.0000	0.96626	-
		Log-Linear	4.360 510	0.022 646	0.000 614	36.878	0.0000	0.96045	2.290

Source: Computer by the Researcher

In the whole period from 1960-61 to 2017-18, the population had grown at an absolute rate of 1.59 crore per annum, whereas the food supply had grown at an absolute rate of 3.49 million ton per year. The semi log model shows that the values of slope coefficient of population and food supply in the whole period from 1960-61 to 2017-18 are 0.019 and 0.022, which shows that the population and food supply had grown at the rate of 1.99 and 2.26 per cent. The regression estimates are statistically significant at 5 per cent and 1 percent level. In the whole period from 1960-61 to 2017-18, the population and food supply had increased at a compound growth rate of 2.012 and 2.290 per cent, respectively. Thus, the study clearly shows that for the whole period the compound growth rate of food supply and population are almost equal.

7. CONCLUSIONS

In India, the changes in agricultural production due to Green Revolution, agribusiness, fertilizers, pesticides and now more recently agri tourism have really undercut the Malthus thesis, which was written well before any of the aforementioned technologies existed. Sustainable development is a concept which is an outcome of the deterministic approach, which Malthus uses in that time frame control on human greed by the ethical value is good indication of Malthusian theory, which is still valid in the context. In conclude, Malthus theory is not fully functioning in present context.

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