ORISSA ECONOMIC JOURNAL

Vol. XXXXI No. 1 & 2

Jan.-June & July-Dec. 2009

ORISSA ECONOMICS ASSOCIATION
BHUBANESWAR

Orissa Economic Journal

Vol. XXXXI No. 1 & 2

Jan.-June & July-Dec. 2009

Editor :
Prof. Baidyanath Misra
17, Saheed Nagar
Bhubaneswar

ORISSA ECONOMICS ASSOCIATION
BHUBANESWAR

ORISSA ECONOMICS ASSOCIATION

EXECUTIVE BODY

2009-10

President :
Prof. Pulin B. Nayak

Vice-President :
Prof. Padmaja Mishra

Secretary :
Dr. Rabi N. Patra

Asst. Secretary :
Dr. Jagannath Lenka

Editor :
Orissa Economic Journal
Prof. Baidyanath Misra

Members :

Prof. R.K. Panda
Prof. Bhabani Prasad Dash
Prof. Adwait Mohanty
Prof. Kishor C. Samal
Dr. Sudhakar Patra
Dr. Uttam Charan Nayak
Dr. Raghabananda Mohapatra
Dr. Sanjukta Das
Dr. Rasananda Panda
Dr. Harapriya Patnaik
Dr. Purushottam Sahu
Dr. Narendra Kumar Behera
Dr. Babylata Shroff
Dr. Simanchal Mishra
Dr. Surendra Nath Behera
Dr. Dilip Ray
Smt. Susama Dash

CONTENTS

ECONOMIC AND SOCIAL PROBLEMS OF THE NON-FARM SECTORS OF ORISSA

❑❑❑

EDITORIAL

THE EFFECT OF ECONOMIC GROWTH ON INCLUSIVE DEVELOPMENT

PROF. BAIDYANATH MISRA

The economy has already moved decisively to a higher growth phase. We have almost reached a level of 8 per cent per year during the tenth five year plan. Further, according to the Planning Commission, the growth' objective is now more sustainable, and the economy can grow between 8 to 9% on a sustained basis provided there are no interruptions due to either external or internal hazards. All the same, the eleventh plan makes an attempt to restructure the policies to achieve a new vision of growth that will be much more broad based and inclusive, bringing about a faster reduction in poverty and helping bridge the divides that currently the focus of so much attention. All along the Planning Commission have emphasized rapid economic growth to raise the incomes of the mass of population sufficiently to bring about a general improvement in living condition. And we have also seen that because of sustained economic growth, the rate of growth of per capita income as measured by per capita GDP at market prices grew by an annual average rate of 3.1% during the 12 year period, 1980-81 to 1991-92. It accelerated marginally to 3.7% per annum during the next 11 years, 1992-93 to 2002-03. Since then there has been a sharp acceleration in the growth of per capita income, almost doubling to an average of 7.2 per cent per annum (2003-04 to 2007-08). In spite of all this, why has not the economic growth been broad based, why has not it benefited all parts of the country and essentially the rural areas?

This raises a number of questions regarding the impact of growth on (i) employment generation (ii) poverty reduction (iii) equity (iv) improvement in the economic and social well being of the people and (v) sustainability and/or ecological balance. We will try to answer some of these questions as briefly as possible. Let us first consider the question of employment, because without creation of productive employment opportunities, we can not reduce poverty. We start with the assumption that economic growth is not a zero-sum game. The demand keeps growing because that look like wants today are needs

tomorrow. If you believe human wants and needs are infinite, then there are infinite industries to be created, infinite businesses to be started and infinite jobs to be done, and the only limiting factor is human imagination. When Ricardo was writing, goods were tradable, but for the most part knowledge work and services were not. There is a difference between idea-based goods and physical goods. If you are a knowledge worker, making and selling some kind of idea-based product, the volume and type of transactions increase and employment opportunities gather momentum. Infosys, for example, received one million applications from young Indians for new knowledge based jobs in the year 2004-05.

In spite of all this, the knowledge based economy, which has been developed in India, employment has not increased in proportion to economic growth or in proportion to increased labour force. Another important factor which has affected employment is structural change in the economy. In the event of liberalization the importance of agriculture has come down. The latest growth position of different sectors shows that agriculture contributes about 18.5% of total GDP while the shares of industry and services respectively come to 26% and 55 per cent. The decline in over-all growth of employment during 1990-94 to 1999-00 was due to the lower absorption of labour in agriculture. The share of agriculture in total employment dropped from 61 per cent to 57 per cent. The trend continued and share of agriculture in total employment further dropped to 52 per cent in 2004-05. Even though the share of GDP increased in secondary sector and services, there was no substantial increase in the absorption of labour force in these sectors, the secondary sector absorbing about 18 to 19 per cent and services about 28 per cent. According to ILO, employment elasticity in India is only 0.3 per cent i.e., for every one per cent growth of GDP, employment elasticity is 0.3 per cent while in agriculture employment elasticity is 0.02 per cent.

It is also indicated in the Economic Survey that while employment growth during 1999-2000 to 2004-05 accelerated significantly as compared to the growth witnessed during 1993-94 to 1999-2000, from 24 million to 47 million work opportunities, i.e. employment growth accelerated from 1.25 per cent per annum to 2.82 per cent per annum, since the labour force grew at a faster rate of 2.84 per cent than the work force, unemployment rate also rose from 7.31 per cent in 1999-00

on CDS basis to 8.28 per cent in 2004-05. Again it is also noticed employment in the organized sector accounts only to 8% while 92 per cent is absorbed in the informal sector. According to ILO, the quality of employment in the informal sector is awfully bad, wages are low with insecurity of employment and absence of any social security. It is mentioned in one report that a beggar gets more than some of the labourers in the informal sector.

The most unfortunate part is that many of the industries are substituting technology in place of labour. Eduard Luce in Finance Times, London gives some examples to show how some of the industries in India are reducing labour force. The Jamshedpur Steel Plant employed 85,000 workers in 1991 to produce one tonne worth $ 0.8 m. In 2005, the production rose to 5 m tonnes worth about $ 5m while employment fell to 44,000, output increased by a factor of five, employment dropped by a factor of half implying an increase of labour productivity of 10. Similarly Tata-Motors in Pune reduced the number of workers from 35,000 to 21,000, but increased production of vehicles from 1,29,000 to 3,11,500 between 1999-2004, implying a labour productivity increase by a factor four. Stephen Stanley reports that Bajaj Motor Cycle factory in Pune, in mid 1990s, employed 24,000 workers to produce 1 m units of two wheelers. Aided by Japanese Robotics and Indian Information Technology in 2004 it produced 2.4 m units with 10,500 workers - more than double output with less than half of the labour force, an increase in labour productivity by a factor of nearly six. It is not only the private sector where there is substitution of technology in place of labour, many of the public sector units also retrenched labour due to continuous loss in these units.

In spite of unemployment in the economy the effect of growth shows that there has been over-all reduction in poverty as defined by the Planning Commission. The Planning Commission definition of poverty is in terms of consumption of calories, 2400 units per person per day in rural areas and 2100 calories in urban areas. The NSS recorded poverty rates as follows:

Year	Round	Poverty Rate %
1977-78	32	51.3
1983	38	45.65
1987-88	43	39.09

1993-94	50	37.27
1999-2000	55	26.09
2004-05	61	
On the basis of MRP(1999-2000)		22.15
On the basis of URP (1993-94)		27.5

Though it is true that the impact of growth on poverty depends on the quality of growth, it is also true that growth by itself tends to reduce poverty. Poverty reduction has been substantial in East Asian Countries which have experienced very high rates of growth. There was very little poverty reduction in India in the 1950s, 1960s and 1970s when the growth of income was meager. The much higher growth rate in the 1980s, 1990s and early part of the 10th plan resulted in a significant reduction in the extent of poverty. Further more, poverty reduction has been the greatest in states that have, grown faster. There is much less poverty in Punjab (8.4% in 2004-05) and Haryana (14.0% in 2004-05). Poverty is concentrated in the Eastern States of India that have experienced little growth. Also poverty is concentrated among the tribal areas as these have been left out of the economic mainstream.

But the definition of poverty has been questioned by many social scientists. In 1981 Streeten and Hicks considered poverty on the concept of basic needs. Since basic needs were loosely defined, the calory concept of the Planning Commission continues to determine the poverty level in India. As per NSSO, 61 round, about 260 million people (27.5 per cent) remained below the poverty line whose income was less than Rs.356.30 a month in the villages and Rs.538.60 a month in the cities. But in the mean time, the World Bank has revised the concept of extreme poverty, in place of $1 per person a day to $ 1.25 per person per day. On the basis of this concept the estimated number of poor in India during 2004-05 was 456 million or 41.6% of the total population. The World Bank has again estimated that extreme poverty in India calculated at $1.25 a day would be about 25% of India's population in 2015 and the number would be 313 million. India would be above only sub-Sahara Africa where the corresponding would be 37.1 per cent, while in China it would be 6.1 per cent. This shows that our inclusive growth reflects poor achievement despite attaining a growth momentum of as high as 8-9 per cent by the country over the last few years.

Though there are evidences to show that economic growth lowers poverty in many countries, what about income distribution? Does economic growth improve income distribution? After Simon Kuznets' hypothesis that growth initially worsens income distribution and later improves it, a lot of research has been undertaken in different parts of the world to study the interrelationship between growth and income distribution. Some of the research studies show that the impact of growth on income distribution depends on the factor endowments available in the economy and the growth strategy adopted to increase the rate of growth (Manmohan Agrawal and Amit Shovon Ray). For instance, when Korea initially adopted an export oriented development strategy, the increased exports came from labour intensive industries such as textiles and apparel. Workers in these industries were either earlier unemployed or came from agriculture where their productivity was low. During this phase of development, not only was there income growth, but also favourable income distribution. This falsifies the hypothesis of Simon Kuznets. But later on, when Korean economy shifted from the export of unskilled labour intensive goods to that of skilled labour intensive goods, the situation was changed. Wages of skilled labour were considerably higher and, therefore, even though poverty levels continued to decrease, the income distribution actualiy worsened.

In case of India, there is colossal difference in income distribution between the rich and poor. Human Development Report 2004 shows that the poorest 20 per cent receive 9 per cent of total income while the richest 20 per cent enjoy 42 per cent of total national income. The same report also indicates that there is considerable amount of income inequality in China, Vietnam and Brazil, where along with income growth poverty has been reduced substantially. This shows that poverty reduction is not synonymous with income distribution. The results of a survey by Merill Lynch and Capgenrini (which is reported in the media) shows that one lakh persons each with a personal net worth of more than 4 crores of rupees which makes for a share of 10 per cent of national GDP. Thus 0.001 per cent of more than a billion in India owns 10 per cent of the national GDP.

Sengupta Committee of the Planning Commission points out that over 22 per cent people who live below the poverty line were not even getting Rs.9 per day. The Report also indicates that income of 36 big industrial houses amounting to an estimated Rs.8,66,000 crore compared

to total central budget of Rs.4,33,000 crore. The Forbes enlisted numerous billionaires of India. The four richest Indians are collectively worth $ 180 billion - greater than the GDP of a majority of member states of the UN. These four are worth more than 40 richest Chinese combined. We have more billionaires than any country in Asia (even Japan has less) along with 260 million people living below the poverty line. Amit Bhaduri in his 'Development with Dignity' gives a contrast. According to him, more than one in three Indians live in abject poverty, spending less than 1 U.S. dollar a day in terms of purchasing parity. All this shows that though economic growth may reduce poverty but may not improve economic well being unless there is proper resource planning for a beneficial growth strategy.

Amartya Sen in 1982 argued that development economics has been discredited because of its very narrow focus on growth and its relative neglect of development which is not synonymous with growth. He stressed that the purpose of development was not merely to generate a higher income : higher income is not an end but an instrument for achieving a better quality of life. He developed the concept of entitlement and capability and increasingly defined development in terms of capability. Entitlement is the link between production and what a person actually consumes. A person's entitlement may be more or less than what he produces. This explains why the relation between per capita income and development in terms of health, education and poverty may be very weak. In fact, even though per capita income in India has increased substantially due to higher level of economic growth, there is great short fall in social development. India is seen as a wounded civilization — a place of pestilence, malnutrition, illiteracy, poverty and hunger. Capability is the ability of a person to function autonomously. While this may be partly a function of his consumption - what commodities do to the individual or what Sen calls functioning, is also a function of a society's institutional arrangements.

Poverty, ill health and illiteracy are major constraints to a person's level of functioning and capabilities. Enhancing capability means tackling these debilitating factors. Since we have not so far been able to improve the social sector of the country, India ranks 17th in economic wellness among 23 when economies are compared based on a measure of people's economic well being (ADB).

We may also indicate here another danger which rings alarm bells for humanity. Scientists studying climate change have set out a stark

vision of how the world will change if humanity fails to tackle surging green house gas emissions. Their research studies show how a warming world would threaten billions of people with thirst and malnutrition, endanger more than half of wild life species with extinction and initiate a melting of the Greenland ice cap that could raise global sea levels by more than 22 ft. Such warnings have been heard before but never with so much scientific certainty. For a long time the developing countries including India were thinking that they would not be a victim to such danger since their per capita emissions are much less. For example, India's per capita emissions are 25 times less than the US and 13 times less than EU. But this does not mean that India would escape from the danger. We are now facing the rigour of climate change. Even though per capita emissions are less in India, yet in individual terms relatively inefficient Indian power companies fare badly in comparison to rich country power generators and emit more carbon dioxide due inefficient use and rising fossil fuel. We have therefore, to make a move to a low carbon growth strategy. Climate change is an international problem and no country, whether developed or developing can escape the danger. As Dr. Rajendra Pachauri has said, climate challenge threatens the environment and unless each and every country makes effort to reduce carbon emissions, there cannot be any sustainable economic or social development. What we are consuming is more than what earth can sustain. Consumption levels are first depleting the world's resources outpacing regeneration.

In conclusion, we may point out that in order to maintain sustainable economic development, reduce poverty, improve equity, entitlement and capability, we have to change the pattern of development and involve the people directly in the process of development. The people should not be passive agents in the process of change. The proponents of development need to urgently produce the micro basis for Human Development. The development debate is mostly concerned with issues of stabilization, fiscal balance and GDP growth. But these really do not help in attaining human development. The approach of neo-classical economics may ensure micro approach and involve people in the process of change.

Another area which needs greater emphasis is how to utilize the rural unemployed for capital formation. If these people can be utilized in some productive enterprises, not only will there be increase in income

of the rural unemployed but the pressure of people on agriculture will also be reduced. As long as we do not reduce the pressure on agriculture, agricultural operations will not be a viable proposition. As propounded by economists like Rosenstein Rodan 1943, Nurkse 1953 and Lewis 1954, the policy formulation should be to divert unemployed to higher productive regime which facilitates agricultural growth and provides additional income to the rural poor. The primary focus of development policy formulation is to accelerate the rate of investment, mobilize the underemployed labour force, promote rapid industrialization and determine resource allocation through planning and controls. In this context, we have to point out that many subsidies are given today in India for water or power or fertilizers which are not only regressive as well as ecologically damaging even though they may be politically popular (Meghnad Desai). Such redistribution is always bigger in ambition than in actual transfers and is often appropriated by the not-so-poor who control the transmission channels of aid. We should therefore, make direct investment in both physical infrastructure like roads, electricity, irrigation etc. which will facilitate capital formation and social infrastructure like education, health, sanitation, drinking water etc. to improve the capability of the people who are engaged in different types of economic and social activities.

In the-sphere of industrialization, we have to give greater stress to manufacturing. The share of manufacturing in GDP has stagnated in India. Only 12 per cent of workers is absorbed in manufacturing. The country had the world's seventh largest manufacturing sector at the time of independence in 1947. The rate of growth of value added in manufacturing was 8.5 per cent between 1860 and 1900. Such a sustained rate of growth in the manufacturing sector has not been achieved since independence. Poverty will not be reduced by .the growth of .services. Even investment in agriculture will not improve economic well being unless surplus labour force is diverted to other productive enterprises like manufacturing. This would require a growth rate of manufacturing at 12 to 15 per cent with an aim of doubling the manufacturing from the present 40 million to 80 million over twenty years (Desai). China achieved such a rate between 1980 and 2000. There is no reason why India cannot do the same.

❑❑❑

SECRETARY'S REPORT

41st Annual Conference - 2009
Orissa Economics Association

Mr. President Professor Panda, Esteemed Chief Guest and Vice Chancellor of Utkal University Professor Rath, Guest of Honour and our most Respected Teacher Professor D.C. Misra, Guest of Honour Professor Baidyanath Misra, Local Organizing Secretary Professor Padmaja Mishra, Revered Former Presidents of the Association, Members of the Organising Committee, Distinguished Invitees, Members of the Media, Fellow Delegates, Ladies and Gentlemen.

I deem it a proud privilege to welcome you all to the 41st Annual Conference of the Orissa Economics Association. We are all fortunate to have in our midst Professor Binayak Rath, Vice-Chancellor of Utkal University, to inaugurate this Conference. We are uniquely privileged to have with us our most beloved teacher Professor Devendra Chandra Misra and the seat anchor of the Association Professor Baidyanath Misra as the Guests of Honour for this Conference. We are really grateful to you Sirs, for your kind gesture.

There is always a past in our present which we must be aware of, lest we become strangers. In this context, kindly let me present a brief profile of our Association. The Orissa Economics Association was founded on January 26, 1968 with the main objectives of promoting the study and improving the methods of teaching in Economics and stimulating research on economic issues of contemporary interest. It was accorded the status of a learned registered society by the Government of Orissa with Registration No. 5358/32 of 1968-69. It enjoys the unique distinction of being one of the oldest registered regional academic associations in the country with 3 Institutional Life Members, 358 Individual Life Members and 26 Annual Members as on 31 December, 2008. They include a galaxy of outstanding economists, professionals, executives, administrators and statesmen, besides teachers and researchers in the discipline of Economics.

The Association endeavors to achieve its objectives by organizing Annual Conferences, Symopsia and Workshops. It has the distinct honour of organizing a two-day Annual Conference regularly since its inception. The Association maintains the healthy convention of discussing two topics of contemporary interest in the Conference every year of which one concerns with the Indian Economy and the other with reference to the State of Orissa. The two topics chosen for discussion in this year's Conference are:

1. Climate Change in India : Challenges and Coping Strategy
2. Economic and Social problems of the Non-Farm Sectors of Orissa

The association has been publishing regularly its mouthpiece, the "Orissa Economic Journal" since 1968. The Presidential Address, Special Lecture(s) and the papers presented in the Annual Conference are published in the journal. Edited by Prof. Baidyanath Misra, the journal has earned appreciation and applause from the teachers and researchers and finds a place in reputed libraries in the country.

Friends, you will be pleased to know that we have received an endowment to the tune of One Lakh of Rupees from Dr. Basant Kumar Misra, an outstanding neurosurgeon, at present working in Hinduja Hospital, Mumbai. This amount has been donated by him to institute an endowment lecture every year on the occasion of the Annual Conference of the Association in honour of Professor Baidyanath Misra, a respected teacher of teachers in economics, former Vice Chancellor of Orissa University of Agriculture and Technology, former Deputy Chairman of Orissa State Planning Board, founding Director of Nabakrushna Choudhury Centre for Development Studies, Bhubaneswar, and a noted economist and social thinker. Incidentally the donor happens to be the son of Professor Misra. We take this opportunity to thank him for his generosity. Dr. Pulin B. Nayak, Professor of Economics at the prestigious Delhi School of Economics has given his kind consent to deliver the First Baidyanath Misra Endowment Lecture on Gandhian Economics. I express my deep sense of gratitude to Professor Nayak for having agreed to deliver the talk. You will be glad to know that Professor Bhabani Prasad Dash has kindly agreed to chair the endowment lecture session. I express my reverence to Professor Dash for accepting our request to chair the session.

I take this opportunity to express our deep sense of gratitude to Professor Rath for having accepted our invitation and inaugurating the Conference. We are thankful to Professor D C Misra for having agreed to our request at short notice to grace the occasion as the Guest of Honour. We are equally grateful to our Guest of Honour Professor Baidyanath Misra, the guiding angel of the Association, for his kind presence in the Conference and for undertaking the arduous task of editing the Orissa Economic Journal. We are greatly indebted to the Members of the Staff and Employees of the PG Department of Analytical and Applied Economics and more particularly to the members of the Local Organising Committee for the pains they have taken for hosting the Conference.

We are extremely thankful to the members of the present executive body of the Association, especially to our President Professor Raj Kishore Panda, for their kind cooperation. Our special thanks are due to Prof. Bhabani Prasad Dash for his precious guidance and supervision in the functioning of the Association. I really owe a great deal to the Dignitaries, Academicians, Invitees, Guests, Delegates and paper writers for their help in making this Conference a grand success and to you ladies and gentlemen and members of the press and media for having given me a patient hearing.

With warm regards, Jai Hind.

Dr. Rabi N. Patra
Secretary
Orissa Economics Association

□□□

PRESIDENTIAL ADDRESS

INCLUSIVE GROWTH IN INDIA-RECENT DEVELOPMENTS & CHALLENGES

Dr. R.K. Panda,

1. BACKGROUND

The Eleventh Plan defines inclusive growth as 'the growth process which yields broad based benefits and ensures equality of opportunity for all'. It says the Plan provides an opportunity to restructure policies to achieve a new vision based on faster, more broad-based and inclusive growth. It is designed to reduce poverty and focus on bridging the various divides that continue to fragment our society'. However, the concept of inclusive growth is not a novel one. Over the Five Year Plans, since independence, there has been emphasis on both growth and equity as the twin objectives of our planning strategy. Yet the terminology used in the 11th Plan is of significance in view of the changes in the approach to growth among economists and social scientists and recent developments taking place in the Indian economy. The old strategies of supplementing rapid growth with social spending and safety nets have been proved inadequate. The UNDP Report, 2000 indicates that, most of the poverty programmes are too narrow and confined to a set of targeted interventions. It suggests for a more pro-poor macro policy. Thus, many of the recent approaches to growth view growth and equity as complementary rather than trade-offs. In the context of the Indian economy we find a disquieting scenario in recent years. With GDP growth rate rising at about 8 per cent, inequality in income distribution has been increasing in the country. The Co-efficient of Variation worked out on per capita NSDP of 17 major states for the period from 1990-91 to 2004-05 has shown an increasing value from 29.37 per cent to 35.64 percent. The general perception that liberalization and globalization policies giving more weightage to market have excluded many sections of the population is getting formally acknowledged and troubling the minds of the policy makers for sustaining the growth.

* Professor, P.G. Department of Analytical & Applied Economics, Utkal University, Bhubaneswar

2. THE ISSUES

It is not inevitable that growth in GDP should lead to increase in inequality in income. Much depends on the development strategies adopted, prevailing social structure and spatial distribution of physical and social infrastructure. So the rise in inequality in the post- reform period can not be attributed to economic reforms. The growth strategy followed in the beginning of the post-independence period has been often debated among the economists. It is pointed out that the Indian development strategies have all along emphasized on poverty reduction through growth and very little attention has been paid to inequality. The social structure in the country continues to be hierarchical in terms of land holding and other forms of wealth and assets resulting in the socially better-offs cornering larger share of benefits of growth. Wide regional disparity in physical and social infrastructure across states and between rural - urban areas happens to be a major factor responsible for unequal sharing of the benefits of economic growth. Under these above circumstances we shall look at the recent developments taken place in the Indian economy and underline the challenges that need to be tackled under the reform package towards achieving a more broad-based and equitable growth in the country.

3. RECENT DEVELOPMENTS IN THE ECONOMY

3.1 Pace and Pattern of GDP Growth

In recent years some remarkable developments have been noticed in the economic growth performance of the Indian economy for which there is now a strong belief in the academic circle that the country can have a sustained growth on a long term basis. The country's GDP growth which was 5.5 per cent on an average during 9th plan has come to around 8 per cent at the end of 10th plan. Taking into account this remarkable success the target for GDP growth rate has been fixed at 9 per cent for the 11th plan. Compositionally the GDP growth has also shown some significant changes. Along with the services sector which has been contributing overwhelmingly a high percentage to GDP growth since 1980s, during recent years there has been sharp acceleration in the growth of manufacturing from 3.3 per cent during 9th Plan to 8.6 per cent during the 10th Plan. The contribution of manufacturing to overall growth has increased from about 9.6 per cent in the 9th Plan to 17.7 per cent in the 10th Plan. The agriculture sector has also recently shown an upturn. The agriculture GDP growth rate which was dipped to a mere 2 per cent during 9th and 10th Plan period has shown an improvement to

nearly 3 per cent, on an average, over the last two years. The growth in per capita income has also been quite steady since 1980s. All these steady improvement in the economic growth profile of the Indian economy has brought the country increasing recognition as one among the few fastest growing economies of the world and this has influenced increasing flow of foreign investment into the country.

3.2 Policy Intervention in the Process of Growth

Higher growth in agriculture is an important element of inclusive growth as majority of country's population depend on this sector for livelihood. So in order to bring about an upturn in the growth performance in agriculture the Government of India has initiated a number of policy interventions in recent years. Investment in rural infrastructure being important for agricultural growth and rural development, Bharat Nirman Yojana has been launched in 2005 emphasizing on six critical areas of public expenditure such as accelerating irrigation, developing rural roads, rural electrification, rural water supply, rural housing and rural communication network. The public investment in agriculture has been geared up and it has been targeted to go up to 4 per cent of GDP by the end of 11th Plan. Institutional credit to agriculture which happens to play a major role in boosting agricultural investment has been targeted to be doubled within 3 years. What is seen institutional credit to agriculture has been more than doubled during the last three years and public investment in agriculture which was dipped to 2 per cent in 2002-03 has been now stepped up to nearly 3 per cent. To provide employment and income to the rural poor, the Rural Employment Guarantee Scheme has now been extended to the all the districts of the country and most of the evaluation studies conducted on REGS have revealed that the implementation of the scheme has been more effective than earlier anti-poverty programmes. National Food Security Mission and Rashtriya Krishi Vikas Yojana have been launched to raise food production through productivity growth. Major initiatives have been taken up in the social sectors like education and health through Sarva Siksha Abhiyan and National Rural Health Mission. Outlays on education and health have been stepped up in the 11th Five Year Plan. Aam Admi Bima Yojana and Rastriya Swasthya Bima Yojana have been launched to provide social security coverage to the rural poor. The share of central government on social services including rural development has increased from 10.97 per cent in 2001-02 to 16.42 per cent in 2007-08. More recently, on the recommendation of the National Commission for Enterprises in the Unorganized Sector (NCEUS, 2006), a bill has been passed in the parliament for providing social security to the workers in the unorganized sector.

4. CHALLENGES AHEAD

4.1 Weaknesses in Agriculture:

Agriculture sector continues to be under stress in terms of low yield, inter-region disparity and increasing instability. Recent data reveal that for the years from 2001 -2 to 2005-06 yield level of food-grains has almost remained stagnant at 0.5 per cent growth rate. The yield growth rate two major crops such as rice and wheat have shown some peculiar trend. Between 2001-02 to 2005-06, while rice yield growth has shown fluctuation, wheat has recorded a negative growth. Inter-regional disparity (across 17 major states) in agricultural GDP growth calculated in terms of co-efficient of variation has increased from 59 percent in the pre-reform period (1983-84-1993-94) to 103 per cent in the post-reform period (1993-94 to 2003-04). Gap between growth in GDP and agricultural GDP (AGDP) has increased during the 9th and 10th plan periods. The public investment in agriculture continues to be at a very low level and the private investment in agriculture has also not found to have increased adequately to meet the deficiencies of public investment. The share of agriculture and allied sector in the total GCF (at 1999-200 prices) comes to hardly 7.7 per cent at the end of 2005-06. The structure of our agriculture sector has changed considerably and we find that while there has been steady decline in large holdings both in number and operational area, concentration at the bottom has increased. The small and marginal farms taken together constitute about 82 per cent of holdings and account for more than 39 per cent of operational area (Agricultural Census, 2000-01). Here the question is whether we shall protect the small holders or eliminate rural poverty ? Besides technology use in agriculture has remained very much limited to a few regions and size-classes. We have Green Revolution but not Agricultural Revolution. More so the green revolution in recent years has shown signs of fatigue. Technology use in dry lands has not made much headway in the country. In recent years in the agriculture sector we find the reverse movement of land from the tillers due to industrialization, urbanization, housing etc. In this context the marginal and small farmers face greater difficulty in keeping up their livelihood.

4.2 Infrastructural Constraints

The development of adequate infrastructure is a critical prerequisite for sustaining the growth momentum and to ensure inclusiveness of the growth process. The Commission on Growth and Development recently constituted by the World Bank has come out with the opinion that

infrastructure spending is very much neglected in fast growing Asian countries and public investment in infrastructure in these countries works out to 5-7 per cent of GDP (The World Bank, 2008). A composite index of infrastructural development among 17 major states worked out for the year 2004-05 reveals wide disparity- Kerala securing top rank (0.6322) and Assam remaining at the bottom (0.1353) (Kapil & Raikhy 2008). The performance of certain other infrastructure industries has been far from satisfactory. Particularly, power sector reforms have more or less failed in most of the states resulting in mounting loss over the years.

4.3 Social Security to Under-privileged

It is commonly known that under-privileged in a developing country consists of a heterogeneous group of low-earning workers working as labourers in agricultural fields, micro-enterprises, and as self-employed. As per the calculation of the National Commission for Enterprises in the Un-organized Sector (NCUES), 2006 the total workers in the un-organized sector come to 340 .32 million. Besides, there are 107 million agricultural labourers in the country (Census, 2001). These households are subject to frequent risks arising out of natural as well as market-driven factors and need both growth-promoting and support-led social security. Over the last few decades a number of social safety net programmes have been implemented to protect the poor and vulnerable sections against risks. The experience in this context however give us mixed results. While some anti-poverty programmes in rural areas are found successful, quite a large majority of such programmes suffer from too much corruption and leakages and thus fail to make a significant dent on poverty and vulnerability of such households. In case of unorganized sector, we find three agencies such as the central government, the state government and the NGOs are found providing social security benefits. But what is seen that the social security provisions provided by these agencies are limited in their coverage and benefits. Recently the National Commission appointed under the chairmanship of Arjun Sengupta has given its recommendation on the minimum social security to be provided to all the workers in the unorganized sector and on the basis the recommendation a bill has been passed in the parliament giving statutory footing to social security scheme for the unorganized workers. The legislative sanction to such a scheme is no doubt an welcome step yet certain provisions contained in the recommendation need further examination before becoming operative.

4.4 Institutional Bottlenecks

Financial inclusion by the way of providing improved financial product and services helps to achieve inclusive growth. While liberalization has reduced the government control and provided more autonomy and freedom to the banks and financial institutions in managing their portfolios, the experience reveals that there has been retrogression on several indices of financial inclusion reflecting a severe set back to the objectives with which the commercial banks were nationalized during the late 1960s. The Committee on Financial Inclusion under the chairmanship of C. Rangarajan (2007) and the Committee on Financial Sector Reforms under chairmanship of Raghuram G. Rajan (2008) have given their observation for achieving better financial inclusion. No doubt, recently the commercial banks have extended the scope of banking to the weaker sections through introducing no-frill accounts. Yet the financial inclusion seems meaningless without financial transaction. The above committees have observed that the financial transactions effected through the newly created no-frill accounts remain quite dismal. As regards the coverage of farm households by the sources of loan the NSSO Survey, 2003 reveal that of the total indebted farmer households 56 per cent obtained loan from formal sources and 44 per cent from informal sources. Further it is noticed that the share of direct accounts with a credit limit of less than Rs.25000/- in total direct accounts has seen declining from 97 per cent in 1990 to 67 per cent in 2005 and their share in outstanding direct credit has declined from 0.66 per cent to 0.23 per cent during this period (Planning Commission, 2007). More over in recent years there has been a steady rise in the liquidation of rural branches of commercial banks from 35389 in 1993 to 32108 in 2005 (RBI, 2004-05).

4.5 Inclusive Governance

Inclusive growth necessitates inclusive governance. Experience shows that most of our development programmes at the grass root level suffer from poor delivery due to lack of people's participation. For achieving inclusive growth there is need for the inclusion of different social groups in the formulation and implementation of the development schemes. The 73rd and 74th Amendments of the Constitution empowering the Panchayats with some functions and finances are steps in that direction. But, what is noticed that there has not been serious efforts to transfer resources and responsibilities to Panchayats so far. Faster we move towards decentralizing the economic growth process, the possibility of realizing inclusive growth in the country will be nearer.

References:

Ahluwalia Isher J. & I.M.D.Little (2008) India's Economic Reforms and Development - Essays for Manmohan Singh (eds.), Oxford University Press, New Delhi

Visaria Pravin et.al (1996) Dilemmas of Growth- The Indian Experience, M.L.Dantwala (eds.) Sage Publications, New Delhi.

Dev Mahendra S. (2008) Inclusive Growth in India-Agriculture, Poverty and Human Development, Oxford University Press, New Delhi.

Rao, C.H.H (2005) Agriculture, Food Security, Poverty and Environment- Essays on post-reform India, Oxford University Press, New Delhi.

Misra Baidyanath (1993) The Political Economy of Development, Ajanta Prakashan, Delhi.

Reserve bank of India (2005), Handbook on Statistics on the-Indian Economy, (2004-05), Mumbai.

Government of India, Economic Survey (2007-08).

Bhalla, G.S (2006a) Agricultural Growth and Regional Variations, in R. Radhakrishna et.al (eds.) India in a Globalising World : Some Aspects of Macro Economy, Agriculture, Poverty, Essays in honour of Prof. C.H.Hanumantha Rao, Academic Foundation, New Delhi.

World Bank (2008), Report of the Commission on Growth and Development, Washington, cited by C.H.Hanumantha Rao in 'Achieving Inclusive Growth : Recent Experience and Challenges', First Sri Chandra Sekhar (Former Prime Minister) Memorial Lecture delivered at the Institute for Studies in Industrial Development , New Delhi on December 5,2008.

Kapil Anu and P.S.Raikhy (2008) Role of Infrastructure in Economic Development in India: An Inter-state Analysis, The Indian Economic Association 91st Conference Volume, Vol. I.

Planning Commission, Government India (2008), Eleventh Five Year Plan (2007-2012).

❑❑❑

Climate Change in India : Challanges and Coping Strategy

Climate Change in India :
Challanges and Coping Strategy

CLIMATE CHANGE: CHALLENGES AND COPING STRATEGIES

Aurobindo Behera

Weather is the day-to-day state of the atmosphere, and is a chaotic nonlinear dynamic system that manifests itself (generally) in the lower atmosphere as wind, rain and the variations in temperature as well as the influence of solar radiation. Climate is a cybernetic system that is the long-term result of the average of all weather conditions over a given period of time. As such, climate change is any long-term significant change in the expected patterns of average weather of a specific region over an appropriately significant period of time. Climate change reflects abnormal variations to the expected climate within the Earth's atmosphere and subsequent effects on other parts of the Earth, such as the ice caps over durations ranging from decades to millions of years.

The primary concern of the current generation is the unwanted and rapid changes that are occurring in the global climate and the environment. Changes are of course inevitable. What is alarming about the changes which are being experienced for some time past is the pace and their anticipated consequences. The climatic situation was quite different millions of years ago. Changes in geological time scale brought about many changes in the earth's geography. The natural processes of evolution created the hospitable atmosphere that we live in today. Similarly if, over a long period of time, nature changes for the worse, we may not be able to do anything about it. Natural climate changes are beyond the control of human beings.

Again, what is at issue is not the sudden or very slow changes that occur in our climate system because of natural disasters and other geological processes, but the changes occurring in the earth - atmosphere - ocean system due to anthropogenic interferences which are inimical to the health of the system that we live in. The changes in the climate in the recent decades has been a matter of concern world-wide. Even a few years ago there was no total unanimity as to whether climate change was a real issue. However, of late, due to the study of

scientists and experts, there is less and less debate regarding the seriousness of the issue. Much credit should go to the Inter Government panel for Climate Change (IPCC) and people like Al Gore for putting the climate change concerns at the centre stage. Recently the Secretary General of the United Nations during his visit to New Delhi referred to climate change as the most important existential challenge before mankind.

The issue of climate change due to human activities can be looked at from two broad angles: emissions of Green House Gases (GHGs) and damage to the environment. Global warming occurs due to excessive release of GHGs into the atmosphere. The main cause is Carbon Dioxide (CO_2), which is released in excess due to increasing use of fossil fuels which remain the primary source of energy for the global economic machine. Once GHGs enter the atmosphere, they do not follow any geographical boundaries and impact the entire globe. Reducing the emission of GHGs is an economic issue and hence a matter of global politics. Climate also changes due to over- exploitation of nature. Pressure on the climate system occurs due to deforestation, destruction of ecosystems and environmental pollution. This category of adverse impact on the climate system could be' more dangerous, because the recovery may take a much longer time.

The quantity of rainfall and its spread is becoming more uncertain across the globe due to climate change. The frequency of extreme climate events like floods, wind storms and droughts has been on the increase during the last few decades. The global mean annual temperatures at the end of the 20th Century are almost 0.7°C above those recorded at the end of the 19th Century. The 1990s were, on an average, the warmest decade of the earth since instrumental measurement of temperature started. The seven warmest year globally have occurred in the 1990s. It has also been seen that the number and frequency of natural catastrophes has been increasing from decade to decade. In the 1950s twenty great catastrophes had occurred in the world where as in the decade between 1990 to 1999 there were 82 events. The economic losses also increased exponentially. In the decade from 1950 to 1959, the economic losses were to the tune of 38.5 billion US dollars (1998 values). Economic losses due to these great natural catastrophes was of the order of 535.8 billion US dollars (1998 values).

According to the projection of the IPCC, the trend of global warming will continue and even worsen and the average temperature of earth's atmosphere would rise by 1.4 - 5.8°C over the next 100 years (IPCC,2001). The magnitude of projected changes in temperature, rainfall and carbon dioxide in future for different parts of the world, including India, as simulated by various general circulation models has been compiled by the IPCC. (Watson et.al.,1998). According to this, by 2010 the CO_2 level will increase to' 397-416 ppm from the current (2000) level of approximately 368 ppm. This is expected to further increase to 605-755 ppm by 2070.

CLIMATE CHANGE AND INDIA :

With alpine conditions, arid deserts and tropical regions, India's climate is as varied as its landscape. The summer monsoon marks the most important event in the economic calendar of rural India. Over 70% of the annual precipitation falls between the months of June and September, 50% of the precipitation falling in the 15 days. While a good monsoon brings in a bountiful harvest and financial security, excessive or failed monsoon cause suffering and economic loss on a wide scale. In other words, climate variability has been the source of both misery and prosperity for much of rural India. The risk of deeper impacts looms large if climate change projection are indicative of what may actually happen. The global predictions indicate that the impact of climate change will be the maximum on the poor countries and vulnerable populations living there. As such some of the most vulnerable areas of the world are also most densely populated. Projections show that climate variations in India will be varied and heterogeneous, with some regions experiencing most intense precipitation and increased flood risks, while others encounter decreased rainfall and prolonged droughts. The impacts are predicted to vary across sectors, locations and populations. Since the country is so diverse, there cannot be a standard and uniform approach to developing a climate risk management strategy. Rather approaches will need to be tailored to fit local conditions and vulnerabilities.

Despite scientific advances projecting future climate is a complex and uncertain exercise. The global models that generate projections have technical limitations, such as the level of resolution and data inputs. The inherently uncertain nature of socio-economic scenarios and

responses adds to be challenges of projecting future Green House Gas emissions and the associated climate impacts. Nevertheless it is necessary to attempt projections to assess possible future hazards, risks and opportunities, without which it would be difficult to develop a coherent climate risk management programme. The most widely quoted projections for climate change in India are those derived from the Hadley Centre regional climate model (HadRM2), which provides simulated outcomes for different scenarios. The following projections are available for the period 2041-2060.

- An increase in average surface temperature across all seasons, with art increase of 2° C to 4° C south of latitude 25°, and in excess of 4°C in the northern region;
- More variable precipitation during monsoon season, with a possible decrease towards the west and an increase over the Indian Ocean and the Western Ghats;
- An overall increase in rainfall intensity by 1-4 millimeters per day, accompanied by an increase in the highest one- day rainfall. Some parts of North-West India could witness a decrease in extreme rainfall;
- Glacial retreat caused by warming, though the extent remains uncertain;
- Rise in sea level which would threaten costal habitations and coast -dwelling populations..

Let us now look at the vulnerability of the State of Orissa to climate change scenarios. The coast line of Orissa extends over 480 kilometers. The State is highly vulnerable to natural calamities and extreme weather events such as cyclones, droughts, floods, and storm surges. Between 1965 and 2006, the State experienced 17 droughts, over 20 floods, 8 cyclones and a devastating super cyclone in 1999. There are years in which the State faces droughts and floods almost simultaneously. The State's population mainly resides in rural areas. The average size of land holdings is less than one acre which means a large part of the population consists of marginal farmers. The main crop is rice. Large tracts of cultivated land in the state have no access to irrigation and more than 60% of the cultivated area is rainfall dependant. Of the state's territory almost 21% is considered flood-prone.

IMPACT OF CLIMATE CHANGE

It is anticipated that climate change will have serious implications for water resources, agriculture, health and spread of diseases, population migration due to submergence of low lying areas, alteration of occupational practices, and increase in the occurrence of cyclone and droughts. These implications will be at the global and regional levels. The gross per capita water availability in India was 1820 m^3 in 2001. It is likely to decline to 1140 m^3/year in 2050. In Orissa the per capita water availability was 3359 m^3/year. It is likely to decline to 2218 m^3/ year in 2050. Though the situation in Orissa appears to be somewhat better, there should not be any room for complacency. What is sometimes forgotten is that most of the water in Orissa is available during the few monsoon months. With the melting of Himalayan glaciers there could be serious water shortages in the Indo-Gangetic basin threatening the lives and livelihoods of millions of people. In fact, in 2005 the World Wide Fund for Nature (WWF) listed the Ganges among the world's most endangered rivers. The Himalayan regions, called the water tower of Asia", has glacier coverage of 33000 sqkms. It provides around 8.6 million cubic meters of water annually. The shrinking glaciers bode ill for Asia's fresh water supply. The Ganges alone provides water for drinking and farming for more than 500 million people. Experts predict that the Ganges will become a seasonal river, largely dependent on monsoon rains. Like the Ganges other great Asian rivers also face a similar threat.

In order to insulate the population from the fluctuating climate pattern, water storage will assume greater significance. Water is normally stored underground and in reservoirs. The per capita water storage capacity in India is much less compared to the developed countries like USA, Australia etc. The per capita water storage in USA and Australia is 5000 cubic meters. The same in countries like China, Mexico and South Africa is 1000 cubic meters. In India it is only 200 cubic meters. In Orissa the average is even less. While creating large storage reservoirs is fraught with problems, different regions of the country will have to explore different alternatives with a greater sense of urgency. It is also important that recharging of ground water aquifers receives urgent attention. A lot more emphasis is required to be put on comprehensive water shed treatment. Wide spread awareness will have to be created regarding the importance of conservation of water.

India has been identified as one among 27 countries which are most vulnerable to the impacts of global warming and related sea level rise. The recent data suggest a rising trend of 2.5 mm per year in sea level rise along the Indian coast line. It has been estimated that at total area of 5763 sqkm in the coastal states of India could be inundated and almost 7.1 million of population could be directly affected (TERI,1996). There is high probability of population influx from Bangladesh to India owing to the possibility of submergence of the Brahmaputra- Padma Delta Region.

The coastal ecology of India will require urgent protection and regeneration. This would be possible only with a strong politico-administrative will and co-operation of the local people. The livelihood of a vast population in India depends on agriculture, forestry, aquaculture. The land use pattern is strongly influenced by water based eco-systems that depend on monsoon rains. Lower returns from the above mentioned occupations will cause shifts to other occupations.

Climate change is likely to affect agriculture through direct and indirect effects on crops, soils, livestock and pests. Increase in atmospheric temperature can reduce crop duration, increase crop respiration rates, affect the distribution of pest population and decrease fertilizer use efficiencies etc. All these can have significant impact on agricultural production and hence food security. Both Kharif and Rabi agriculture may be adversely affected due to climate change unless considerable adaptation takes place. There are indications that the nutritional quality of cereals and pulses may be moderately affected, particularly in areas where availability of nitrogenous fertilizers is already low. Future food security will mainly depend on the interrelationship between political and socio-economic stability, technological progress, agricultural policies and prices etc. Since, climate change is likely to affect the low income groups more severely, special strategies will be required to be put in place to mitigate their problems.

It is worth noting here that agriculture is itself responsible for about a third of green house gas emissions. However, the emissions can be reduced and steps can be taken to lessen their effect on production and on the livelihood of farmers. Farmers can adopt coping mechanisms that withstand climate variability through activities such as the use of drought- resistant or salt- resistant crop varieties, more efficient use of

water resources and improved pest management. Changes in cultivation patterns can include reduction of fertilizer use, improvement of live stock diets and better management of their manure. In addition, Governments have an important role to play in enforcing land use policies which discourage slash and burn expansion and extensive live stock rearing, as well as raising opportunities for rural employment.

Carbon sequestration can also be a means through which agriculture can make a positive contribution towards mitigation, and will be of growing economic and environmental importance in the context of the Kyoto Protocol. It is estimated that for the next 20 to 30 years, cropland contribution to carbon sequestration lies within the range of 450-610 million tonnes of carbon per year. By applying improved land management practices (better soil fertility and water management, erosion control, reversion of cropland in industrial countries to permanent managed forests, pastures or ecosystems, biomass cropping, conservation tillage, etc.), the role of agriculture as a major carbon sink and as a compensating mechanism for agriculture's contribution to GHG can be greatly enhanced.

Agriculture can also play a role in reducing the burning of fossil fuels. Up to 20 percent of fossil fuel consumption could be replaced in the short term by using biomass fuel. In Brazil 6 million cars are running partly on alcohol derived from sugar cane. China already has 10 million dung digesters which provide a clean cooking fuel and an organic fertilizer. Fast-growing grasses, oilseeds and agricultural residues offer great potential as energy alternatives. It is important to note that these bioenergy initiatives also have a positive impact on rural socio-economic development.

Policy response can not only enhance agriculture's mitigating role, but at the same time it can reduce the vulnerability of poor people to food insecurity. New rural employment opportunities can be generated in efforts to replace fossil fuels with bioenergy. In addition, carbon sequestration programmes can help boost agricultural production as well as improve its overall sustainability. Regardless of the approach, technological and institutional changes must take place now before the impact of climate change becomes irreversible. But most importantly poverty must be addressed and alleviated if the effects of climate change by the end of the next century are truly to be contained.

IMPLICATIONS FOR HEALTH

Higher incidence of diseases with increasing rates of morbidity and mortality in the wake of global warming can neutralize a substantial part of development gains in the less developed countries. Weather conditions determine malaria transmission to a considerable extent. Surat in Gujrat can be taken as an example where an epidemic of pneumonic plague was followed by a malaria epidemic in the year 1994. During that year, the summer temperature touched 50°C which was followed by unprecedented rains. Other contagious diseases like Dengue and Cholera may become more frequent and more intense in tropical countries like India. Special measures would be required to contain the adverse effect of the climate change on the health and well-being of people.

The economic, health- related and environmental effects of climate change will have to be taken more seriously by the policy makers and people of India. Action at three levels is urgently required. At the local level, steps will have to be taken to minimize the impact of global warming on communities wherever necessary and possible. The community-based disaster risk reduction initiatives are a case in point. At the national level scientists, economists and legal experts should be more actively involved in understanding the threats from global warming and climate change. Research and studies on the impacts of climate change, will be required to be adequately funded. Finally at the global level there has to be a much greater willingness to own the responsibility for global warming and a clear strategy agreed upon in the run up to the ensuing Copenhagen conference. India should insist in unequivocal terms that any global agreement on climate change has to be based on the principles of equal rights of all human beings to the atmosphere.

CONCLUSION

Although to a certain extent the climate change debate has been dominated by science and politics, economics is becoming and increasingly important discipline to understand and cope with climate change. Historically, economic growth has been the driving force behind the increased release of GHG. The industrial revolution and its reliance on fossil fuel-based energy as the main driver of production is mostly to blame for the build up of GHG in the atmosphere. However, for the

present and future, economics should contribute towards possible solutions to many aspects of the climate change problem. In the days to come economics should provide many of the practical solutions to the problems that will be encountered at high policy levels.

Costs and benefits of certain aspects of climate change will have to be worked out to facilitate the implementation of realistic policy options. Economics can make comparison of costs and benefits possible. Ultimately the challenge is to represent climate change as an economic problem where the production and consumption of goods and services today must be optimized in order to minimize the future impacts of climate change. It is in a sense the classic economic problem of allocating scarce resources over time given knowledge of preventable economic damage in the future. In this case the time frame is inter-generational, the scale is global and the future impacts still uncertain. The Orissa Economic Association in their wisdom have selected this very important topic for discussion and I hope that the issues that have been discussed would challenge the minds of some of the brightest teachers, researchers and students of economics present here today.

References:

1. Thirsty firms, Flooded Fields:
   Adaptation Strategies and Options to Address Climate Variability and Change in Rural India. A World Bank document.
2. Committee on World Food Security ; FAO - 29th Session 2003
3. Impact of Climate Change Scenarios on Indian Agriculture by Agarwal, Nagarjan et al. Central Research Institute for Dryland Agriculture, Hyderabad.
4. Climate Change and Economic Development: Jamie Sanderson and M.N.Islam. (2007)
5. Climate Change, an Indian perspective ; Sushil Kumar Dash (2007)

□□□

Assessment of Vulnerability to Climate Induced Natural Disasters and Coping Strategy in Orissa- A Study from Natural Resource Management Perspective

Prabhakar Nanda[1] **Benudhar Bhuyan**[2]

Ravendeer Singh[3] **Ashwani Kumar**[4]

INTRODUCTION

Climate is the prime decider of economic condition of any country or state. The history of Orissa economic condition is replete with climate induced upswings or down swings depending upon the nature of events. Climate induced natural disasters (CIND) like droughts, floods, and cyclones have been determining the shape of the agro economic condition of the state. Orissa economy is shaped by monsoonal variability and the aberrations are quite often in the periodicity and intensity of the precipitation that often results in severe flood, drought or cyclone. Orissa is prone to both natural and man made disasters. Since 1965, the state has experienced floods for 17 years, droughts for IS) years and cycle for 7 years (Table. 1). The agriculture has become real gamble in the monsoon. It has been observed that there has been either a flood or a drought or a cycle in every alternate year during last 130 years of observations. The impact of the climate induced natural disasters has been severe on the agro economic and socio economic conditions of the people. Already poverty riddled population has become more vulnerable to these climate induced natural disasters especially those living in high risk coastal areas. The farmers and fishermen who are the traditional food producers living in such fragile environment are ecologically, geographically and economically marginalized due to recurrent climate induced natural disasters. However, people living under such fragile risky environment, where natural disasters become a part

[1] Principal Scientist. Water technology Centre for Eastern Region (corresponding author) 2. Ex Dean OUAT, 3 and 4 Principal Scientist and Director respectively, Water Technology Centre for Eastern Region,

of life have developed certain coping mechanisms and adaptive strategies over time to reduce drought, flood and cyclone vulnerability. The management, of natural resources for developing coping mechanism has been prime adaptive mechanism in climate induced natural disasters in Orissa. The study undertaken under a collaborative project of UNEP-NCAP-WTCER reveal interesting patterns of management of natural resources and livelihood options to cope with the CN1D.

METHODOLOGY OF THE STUDY

Study area description

The study was carried out in two districts of Coastal Orissa for assessing the natural resource management strategy by the people of the CIND areas for coping with the severity of CNIDs. The basic information on how households and rural communities respond to CINDs, how do they manage the available natural resources to cope, escape or mitigate the impact has been collected through open ended questionnaire and FGD (focus group discussion). The coping strategies, rural households use in countering various CIND events were assessed through household survey in Kendrapara (affected) and Khurda (Control) districts of Orissa. Kendrapara district, forming a part of coastal Orissa, is characterized by fragile environment prone to flood and cyclone, highly variable rainfall, high water deficiency during Rabi, frequent rainfall failure, and of late also emerging as a drought prone district (Info Change, 2002; Down to Earth, 2001). The area is intersected by a network of rivers and creeks with Bay of Bengal on the eastern side making it flood prone. This is also one of the worst cyclone affected districts in Orissa. With 1.3 million populations, the district is home to more than 1.5 lakh rural families living below the poverty line. The following tables describe the basis agro economic parameters of the districts under study.

Sampling design and analytical tool

Six sample villages (Naladia, Jambu and Mangalpur from Mahakalpara block and Belapala , Gupti and Sanwara from Rajnagar block) were selected randomly. The two blocks Mahakalpara and Rajnagar were purposively chosen because of their proximity to sea and high degree of vulnerability to CINDs. These two blocks practically lie on the delta and floodplain of the four major rivers Brahmani,

Baitarani, Gobari and Paika and hence are influenced by sea level rise. Both the blocks are vulnerable to a number of natural hazards, but most particularly flooding both from the rivers and storm surges (cyclone). Focus Group Discussion, open ended questionnaire and rapid assessment tools have been used to assess the coping strategy to CINDs.

Description of FGD results from study area

Natural resources are prime mover for a society for sustainable growth and development. The coastal economy is more prone to its control due to enormous contribution it makes to livelihoods of the people. The village Naladiapalda under Mahakalpara block of Kendrapara district and Belpala of Rajnagar block in Orissa, the perpetual victims to the climatic turbulences testifies this. The tables (2-7) depict different agro economic and socio economic features about study blocks. The study team carried, out focused group discussion with the people of different age groups to ascertain the symbiotic relationship of natural resources within the coastal ecosystem and the livelihoods of the people.

Table 1. Increasing incidence of natural calamities in Orissa in recent past

Drought		Flood		Cyclone	Hailstorm, Whirlwind Tornado	Whirlwind, Tornado
1965	1984	1967	**1980**	*1967*	1978	1981
1966	**1987**	1968	1981	*1968*		
1972	1992	1969	**1982**	*1971*		
1974	1996	1970	1985	1982		
1976	1998	*1971*	1990	***1999***		
1979	**2000**	1972	1992			
1980	**2002**	1973	1994			
1981		*1974*	1995			
1982		**1975**	**2001**			
		1977				

Note: Bold letter represents severe incidence of drought/flood cyclone during that year: Italic letter represents the occurrence of more than one natural calamity during that year. Underlined letter represents deviations in rainfall of 20% or more than the normal (Source: Selvarajan et al, 2002).

Table. 2. Land Utilisation pattern 1994-95 to 2000-01 (Area in ha)

District	Block	Geographical area in Ha	Forest area	Miscellaneous tree crops & goves not included in net area	permanent pasture & other grazing land	Culturable waste	Land put to non-agricultural uses	Barren & unculti vable land	Current fallow	Other fallows	Net area sown
	2		3	4	5	6	7	8	9	10	11
1994-95											
Khurda	Khurda	30223	2,112	7,540	805	3,421	2.020	174165		1,523	12,650
Kendra para	Rajna gar	34429	1537	52	757	324	5901	754	1398	439	24311
	Mahak alapara	46964	1546	1436	2721	621	8150	—	1180	1034	31668
2000-01											
Khurda	Khurda	30223	2,173	4,999	1,299	2,782	2,107	362	1,300	1,855	13,507
Kendra para	Rajna gar	35359	931	54	1213	458		5783	705	2605	968 22642
	Mahak alapara	48400	3110	124	2154	230	13826	447661	1712	26137	

Table 3: Irrigation Potential (Ha) in Study Blocks of Kendrapara and Khurda

	Blocks					
	Rajnagar		Mahakalapara		Khurda	
Irrigation Sources	Area (Ha)		Area (Ha)		Area (Ha)	
	Kharif 2002	Rabi 2002-03	Kharif 2002	Rabi 2002-03	Kharif 2002	Rabi 2001-02
Canal	--	--	3007	2350	1336	72
GLIP	--	--	--	--	480	198
PLIP	300	--	75	--	8	8

STW	--	1 60	--	60	--	--
Dug wells	--	--	--	--	425	76
Other sources	1 500	800	1200	500	1087	728
Total	**1925**	**960**	**4282**	**2865**	**3336**	**1082**

Table 4: Selected sample villages and households

Categories	Kendrapara district				Khurda dist.
	Rajnagar block		Mahakalapara block		Khurda block
	Nuagaon	Gobardhan pur	Naldia palda	Raghunath pur	Somanath pur
Landless	1	0	2	1	0
Marginal	2	3	2	3	2
Small	5	8	8	9	4
Medium	3	2	1	3	2
Large	1	2	0	0	1
Total	**12**	**15**	**13**	**16**	**9**

Table 5: Demographic feature of sample farmers

(Households in percentages of total)

Villages	Social Group			Head of Family		Age of Family Members					
	SC	ST	Gen/Others	Man	Woman	Below 12 yrs.		12-60 yrs.		Above 60 yrs.	
						M	F	M	F	M	F
Nuagaon	11.43	51.51	37.06	93.85	6.16	7.69	8.72	36.95	29.66	9.17	7.8
Gobardhanpur	5.67	46.91	47.42	98.97	1.03	13.89	12.11	38.2	31.61	2.23	1.96
Naldiapalda	16.6	0	83.4	97.2	2.8	11.2	10.6	37.4	35.2	2.5	3.1
Raghunathpur	16.68	57.65	25.67	89.58	10.41	14.17	9.09	48.51	25.15	1.68	1.4
Somanathpur	11.02	46.61	42.37	95.76	4.24	7.84	9.49	36.31	32.87	7.98	5.5

Villages	Agriculture		Wage		Salary		Self Employed		Contractor ship etc.	
	Main	Sub	Main	Sub	Main	Sub	Main	Sub	Main	Sub
Nuagaon	76.29	25.77	3.89	16.63	0.78	0.05	1.76	1.23	1.13	0.48
Gobardhanpur	73.4		7.91	34.82	1.02	0.26	0.38	1.79	0.13	2.93
Naldiapalda	54.76	39.3	36.9	11.1	4.37	5.56	1.98	3.17	3.18	0.4
Raghunathpur	78.19		11.39		2.87		7.79		0.74	
Somanathpur	66.80	16.50	10.93	16.50	2.19	0.99	2.58	1.99	1.99	1.99

Table 6: Crop rotation followed by the farmers

Issues	Villages from Kendrapara				Village from Khurda
1 crop rotation	Naldia palda	Raghu nathpur	Gobar dhanpur	Nuagaon	Somanath pur
Paddy-vegetable fallow	10.5%	21.2%	15.9%	12%	10.8%
Paddy-fallow -fallow	72%	71.1%	89%	85%	84%
Paddy-paddy -fallow	17.5%	7.7%	12.6%	10.8%	11.5%

Note: Figures indicates the percentage of farmers adopting the crop rotation.

Table 7: Risk Management in the event of disasters

Yield Risk Managemen	Villages from Kendrapara				From Khurda
How to minimize risk in the event of yield risk	Naldia palda	Raghu nathpur	Gobar dhanpur	Nuagaon	Soma nathpur
1.Choice of variety	33%	23%	35.5%	43.6%	25.8%
2. Shifting of sowing time	13.4%	15.2%	12.2%	27.3%	17.8%
3. Control ot insects and pests by resistance variety and biological control	47.5%	51.3%	41.6%	47.6%	44.6%
4. Use of improved implements	41%	43.5%	42.5%	28.5%	16.9%
5. Fertilizer use	55.9%	58.7%	72.8%	85.9%	69.8%
In the event of drought					
1. Dug well excavation	12.8%	3.8%	3.82%	1.5%	3.5%

2. Raising the bund height	1.4%	2.1%	1.6%	3.5%	0%
3. Summer ploughing	74.5%	82.3%	73.6%	74.1%	82.5%

The initial discussion with the villagers revealed that the soil and vegetation of yester years are no more reassuring to make up whatever loss is caused to the people due to floods and droughts in the village. The elderly people recalled their memory that with little or no application of fertilizer, the paddy and groundnut yields were bumper in kharif and post kharif respectively. There were floods, but the duration of floods was less due to large spread area of the Paika river which has been narrowed down on either side with construction of embankments. The river was also flowing almost round the year and severity of salinity was not there till mid April or month of May. The people were mostly using " Janta" for water lifting from the river and the traditional " Chua" or water hole in the riverbeds was a permanent source of fresh water. However, the control of Mahanadi water at different places like Hirakud, Naraj barrage at Munduli and Jobra barrage in Cuttack intensified the woes of villagers due to reduced lean flow of the river and resulting salinity intrusion in as early as month of March. The dug wells use to supply water round the year. The villages had a good part of area under forest, which used to supply fuel woods and minor forest produce for daily livelihoods of the people. The land, water resources and vegetation endowment in the village took care of immediate needs of livelihoods that have dwindled with the progress of time.

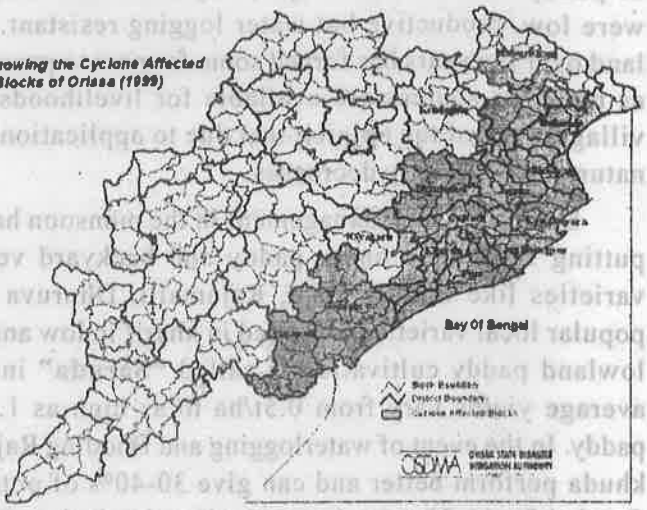
Table 7: Peoples' perception about recent trends in CINDs

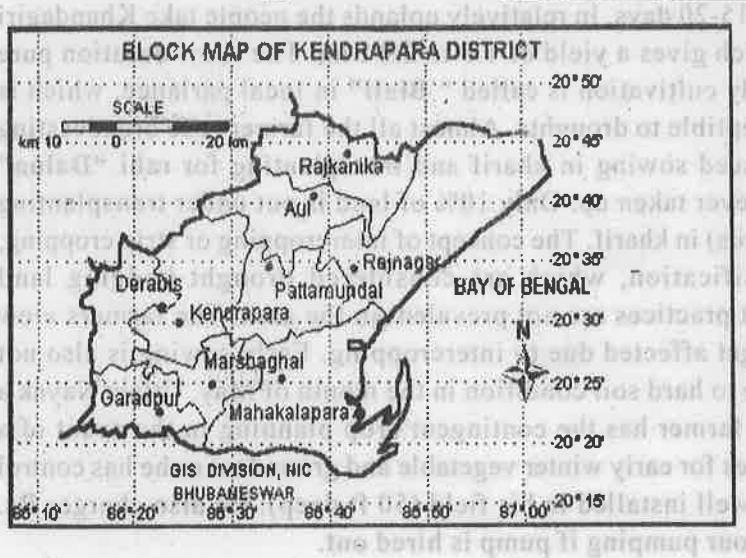
(% of respondents)

Frequency/Events		Increased	No Change	Decrease
Drought	Frequency	92	6	2
	Intensity	90	7	3
Flood	Frequency	57	23	20
	Intensity	17	48	35
Cyclone	Frequency	26	56	18
	Intensity	54	39	7

Dynamics of land resource management

Reacting to our query on quality of land resources, the villagers reacted that the land in the village has become less fertile over the years. Earlier they used to get 30 to 40 quintals of paddy per hectare of land put under kharif, which declined with the passage of time, and presently they used to get hardly 12 to 15 quintals of paddy. Even the productivity of HYV paddy is also declining. The villagers opined that the land resources under private and common property management are low productive due to top soil washout in floods or drought, which are common in the village. The soils have low water holding capacity. The private holdings are fragmented and distributed in 4 to 5 parshals in some cases. The general perception of the villagers towards management of natural resources especially land was that there was little scope for any contingent measures to prevent flood and drought as the problem is so severe that, human endeavor is not strong enough to prevent it. As per the villagers perception, around 70% of land was under low land category in the Tikhiri Gram Panchayat.





However the villagers opined that: upland counts for more than 40% in Naladiapalda village alone. Rest of the land resources come under medium and low land category. The uplands suffer maximum in the event of a drought. The low lands do not get ready for a second crop due to unfavorable edaphic condition. When the fields are ready, irrigation facilities are not available for the crop. Around 10% of land is perpetually in saturated condition in the village, indicating problem of waterlogging. The villagers used to grow local waterlogging varieties

of paddy like "Baunsa Gaja", Rajamalli and Dhuruva Khuda, which were low, productive but water logging resistant. The degradation of land over the years has forced some farmers to penury and out migration as no other sources are available for livelihoods in the village. The villagers are of the opinion that due to application of fertilizer the soil natural productivity decreases.

Scientific land management in the monsoon has little scope except putting some land under paddy and backyard vegetables. The local varieties like Baunsa Gaja, Rajamalli, Dhuruva khuda, Pakhira are popular local varieties practiced in kharif in low and medium lands. The lowland paddy cultivation is called **"Sarada"** in the local area. The average yields vary from 0.5t/ha to as high as 1.5 tons for the local paddy. In the event of waterlogging and flooding Raja Malli and Dhuruba khuda perform better and can give 30-40% of potential yields even if flooded for 15-20 days. In relatively uplands the people take Khandagiri (HYV), which gives a yield of 1.5 to 2.0 t/ha. The short duration pure upland paddy cultivation is called " **Biali"** in local parlance, which is highly susceptible to droughts. Almost all the farmers use broadcasting method of seed sowing in kharif and transplanting for rabi **"Dalua"** crop where ever taken up. Only 10% of land is put under transplanting (medium lands) in kharif. The concept of intercropping or strip cropping, crop diversification, which are considered drought hedging land management practices are not prevalent in the area. The farmers view that yields get affected due to intercropping. Early sowing is also not possible due to hard soil condition in the month of May. Uttam Nayak a progressive farmer has the contingent crop planning in the event of a flood. He goes for early winter vegetable and groundnut as he has control over a tube well installed in his field (50 ft deep). He also charges Rs. 50 for one hour pumping if pump is hired out.

Decrease in wetland area

The villagers reported that the wetlands that were around 20-25% of total geographical area decreased over the years due to encroachment for agriculture and habitation. The wetlands used to modulate heat waves in the extreme summer and lot of birds and reptiles were seen that was conducive for maintenance of ecosystem. However the wetlands have reduced to less than 10% presently.

Impact of climatic hazards on land resources

Uttam Nayak reported a grim picture of natural hazard that has forced him almost to penury. Consecutively he faced crop loss for 3 years out of last 5 years either due to flood or drought. In 2001 there was severe flood. In 2002 there was drought and again in 2003 there was flood. River Paika proved to be sorrow of Naladiapalda village. The embankment has worsened their plight. The 26 households caught outside the flood embankment are worst sufferers. One Shri Surendra Nath Samantray lost 2.5 acres of land to sand casting in the super cyclone. In the 2003 floods, he lost 100 % of crop in 2.5 acres of land. The floods usually come in the months of July and August and most of the land is put under kharif paddy by then. The flood not only affects the crop but also washes away field bunds and sometimes the topsoil is also affected. However the huge silt load also helps in improving soil quality due to sediment deposit which some times prompt the farmers to apply less fertilizer. The duration of flood sometimes last for month that completely destroys any sort of land based enterprise. Black gram or groundnut is taken up after flood instead of paddy wherever irrigation is available other wise the field is left fallow. Black gram is considered as best as the post flood crop as it does not require irrigation and fertilizer application is almost nil due to improved soil condition because of siltation. In the event of flood coming in the maturity of the crops, farmers used to cut top portion of the paddy and leave the rest in water. In the event of drought, the common land management practice is to strengthen bunding to prevent runoff and close rat holes in the fields.

The quality of soil is generally good as perceived by the farmers due to repeated flooding and siltation. However some times due to washout of topsoil under high velocity flood current, the yields do not commensurate the potentials of the soil, which is compounded by low fertilizer use.

Land management has little relevance for land less categories of population except some economic activities like grazing in common lands (which is scanty) and digging for mud wall construction. However they are indirectly affected in terms of availability of wage employment that gets affected due to flood or drought. The leasing in system though prevails in the area, the land less people seldom go for it due to high rental fixed for produces. The land less people who constitute around 20% of population in the village migrate in the event of severe drought and flood.

TRADITIONAL WATER RESOURCE MANAGEMENT

Some old villagers recall that river Paika had been meeting their water requirements almost in all season and the current salinity problem in the month of April to June was not there some fifty years back. The village has no community irrigation pond and the private ponds are scarcely used for irrigation purpose as the ponds are shallow and get dried by February leaving little scope for irrigating a second crop. In total 5 shallow tube wells owned by private individuals are in operation in the village that irrigate around 60 to 80 acres of land in kharif and 30 acres in rabi through diesel pumps. Around 40-50 people are water users from private tube wells. The common method of irrigation in ayacut under private tubewell is through field channels and mutually decided scheduling among the beneficiaries. Large distance conveyance channel is not economic due to unlevelled field conditions. As little common land is available in the villages, community pond system is conspicuous in its absence. As the river Paika is nearby, pond water gets emptied by January due to lower riverbed. The traditional water lifting devices in the area are "Janta" or "Seria" for small and marginal farmers for surface water use. **Bund raising** is practiced in the event of an imminent drought. The villagers know the utilization of dew for black-gram and green gram as they term it " Kakar pani" for crops. They traditionally know how to use *Insitu* water harvesting system through maintenance of bunds. Repair and maintenance of field bunds are costly and get little attention by the farmers. **Mulching,** as a method of soil and water conservation is known to the people and some times practiced for vegetable cultivation to reduce ET. The people opine that large investment in river lift system using Paika river could irrigate around 500 acres of land and people are ready to form **Pani Panchyat** for the same. However the river water gets saline by April and hence summer crop is also constrained in the absence of assured irrigation. The drinking water problem is severe due to drying up of existing sources and salinity ingress due to over drafting in tube wells. Most of the hand pumps are defunct or dried due to non-maintenance. The absence of a strong water market prevents private investment on water resources. The water market is at nascent stage.

Recycling of drainage water

The villagers used to recycle drainage water for life saving and supplemental irrigation when the crops are stressed especially in kharif.

The quality of recycled drainage water is not bad as perceived by the farmers due low fertilizer and pesticide use. In the rabi the fields nearby the surface drainage system used to have vegetables or summer paddy by utilizing drainage water. Some times the community uses it for sanitary purpose also.

Dwindling Vegetation

The village had around 10-15% of land under forest cover 50 years back in community as well as private lands. The fuel wood requirement was met from the forest. Though the forest was not dense, the people were meeting the requirement of traditional forest species for religious functions and the bamboo was major species that was contributing to the household requirements. The timber species were not available in the forest. Rampant cutting of bamboo and other trees denuded the forest cover and exposed them to repeated grazing by cattle. The shrubs also dwindled in the process. The flower species like "Champak" etc. are no more available in the area. The private forest plantations are also becoming rare. A species of wood apple that was plenty is hard to get now. The smell of "Kadamba" a traditional forest species are extinct now. Earlier people used to plant these in the common forest land and private lands. The most preferred species now is "Chakunda" in private lands due to speedy growth and log availability. The preference has also shifted to eucalyptus due to economic reasons. But plantation activities are not common in the area. Cashew nut plantation in private lands is seen in backyards of some farm family. Organised orchards are not available in the area.

Common Property Resource Management

Earlier the village used to have small area under village forest, which dwindled with the passage of time. The villagers used to gather minor forest produce and fuel woods from the forest. However the forestlands are no more in existence and encroachments have taken the toll of forestlands. The community pond system is also not prevalent in the village. The publicly provided drinking water tube wells are mostly defunct due to ill maintenance and drying up of source. The use of tube wells for drinking water some times has caste biasness where upper castes getting easy assess. Previously the forestland used to be a grazing land for the cattle. With forestland gone, the grazing is a big problem for the cattle. Community Pasture land is not available in the village

and the cattle are set free in rabi for open grazing in fallow private lands. The stalk feeding is practiced in kharif only. Around 120 cows and 70 number of bullock population face severe deficit in feed availability and are under nourished. Total goat population is around 300 but sold early due to absence of grazing facility.

Coping Mechanism

Relief anticipation is immediate behavioral pattern in the event of a flood or drought. (It is a bureaucratic joke that Orissa has three cropping seasons. These are kharif, rabi and relief) The common approach to any imminent flood is to provide higher basement for grain storage and leave the crops to destiny. Some farmers cut down in inputs from the beginning anticipating drought and/or flood. The seed rate is lower than recommended doses and fertilizer use is also minimal. If flood comes in the month of August or September the kharif paddy gets destroyed and people do not go for paddy again. Instead they sow black gram and groundnut after receding of the flood and the field is ready edaphically. However some farmers (10%) go for transplanted paddy by procuring sapling from Marshaghai or Kujanga (Nearest block head quarters) if flood recedes in last week of August. Land draining in the event of excess rainfall is commonly practiced by constructing **"adinallaha".** No other conservation method is practiced. Varietal choice is not much influenced by calamities. However the preference is always for HYV due to promise higher yields even though risky. The people are of the opinion that due to destruction of plantations and village forest the severity of floods are more. Preparing land for vegetable cultivation after flood or drought are common crop management practices.

CONCLUSION

The severity of CNIDs has broken the back bone of rural economy in study areas. Recurring drought, floods, and cyclones in the study area have made the rural population extremely vulnerable and have weakened the economic condition over the years. The people in the study area have developed some cooping mechanism over the years to minimize the impacts of CND mainly through management of natural resources which they have conventionally learned from their tore fathers. Though scientific management of natural resources is not widely practiced, the conventional methods have strengthened the coping

mechanism to some extent. To minimize the losses in such exigencies, it is necessary that a system is created for increasing preparedness at all levels i.e. government, civil society and community. The study also reveals that CIND vulnerability is a part and parcel of coastal Orissa and cannot be totally escaped. But household's vulnerability to various CIND events can be managed and its effects can be reduced to certain extent.

A checklist of NRM approach in Coping with natural disasters and Village preparedness for the same as responded by the livelihoods groups.

Planning: No planning strategy is adopted in the village and the response is spontaneous and fatalistic.

Capacity building: People have developed inherent strength to face the calamities and little training or awareness camp organized except common Govt. advertisement for use of hygienic methods for drinking water or sanitation.

Insurance and other adapting mechanism: Crop insurance available and subscribed by around 50% of farmers but no compensation due to complicated procedures.

Social Response and adaptability: Group response in terms of sharing of common space and building group pressure on public machineries for relief and rehabilitation

Mitigation: Activities to prevent or reduce impacts of a catastrophic event prior to its occurrence, such as land use planning; retrofitting, building codes and public education are not prevalent in the area.

Disaster risk mitigation Structural approaches are almost nil

Non-structural approaches employ land-use controls, information dissemination, and economic incentives to reduce or prevent disaster vulnerability. No such control is available in the villages

Risk spreading measures: Adopted sometimes through crop management strategies and keeping lands fallow.

Institutions: NGOs, community-based organisations and government agencies. The village committee in position and other agencies step in after event. No coordination among the agencies for common strategies.

Conservation and Adapting to Climate Change: Conservation methods though known not adopted.

Intercropping: Seldom practiced

Soil Management - This approach for increasing the stability and productivity of soil is a general term that involves a range of specific techniques such as fallow cycling, forest buffering, selective planting, managed grazing, etc. Soil management is not systematically carried out due to lack of scientific approach and severity of problem.

Water harvesting: No water harvesting method practiced

Crop management strategy: Some times followed

Multiple cropping in waterlogged area: Not carried out

Sequence Cropping: Practiced to some extent (10-15% area)

Drainage Management in Waterlogged area: Field drains provided in excess rainfall situation

Pasture management: Not practiced

Water management methodology: Some times practiced.

❑❑❑

CLIMATE CHANGE AND INDIA'S CHALLENGE

Jagannath Lenka[1] **Minati Mallick**[2]

I. INTRODUCTION

The supreme reality of the 21st century is the spectre of dangerous climate change. That spectre confronts us with the threat of a twin catastrophe. The first is an immediate threat to human development. Climate change affects all people in all countries. However, the world's poorest people are on the front line. They stand most directly on harm's way and they have the least resources to cope. This first catastrophe is not a distant future. It has been reflected in slowing progress towards the Millennium Development Goals (MDGs) and deepening inequalities within and across countries. Left unattended, it will lead to human development reversals throughout the 21st century.

The second catastrophe is located in the future. Climate change poses risks not just for the world's poor, but for the entire planet - and for future generations. Our current path offers a one-way route to ecological disaster that has created uncertainties relating to the speed of warming and to the exact timing and forms of the impacts. Climate change has the potential to set in train processes that could recast the human and physical geography of our planet.

Erratic variation in global and regional climate over time triggered by global warming has therefore become a major environmental challenge. This chaotic climatic behaviour during past decades reflected in rising average temperature of earth's atmosphere, frequency of heat waves, lowering of rainfall, melting of snow and ice, rising average sea level has its root in the large scale emission of anthropogenic Green House Gases (GHGs). The concentration of these gases mainly carbon dioxide in the atmosphere was more or less constant i.e. 280 ppm before industrial revolution and the climate change was due to natural causes.

1. Professor in Economics, North Orissa University, Baripada
2. Lecturer in Economics, North Orissa University, Baripada

It has sharply increased to become 380 ppm in the beginning of the millennium and become a matter of grave concern for countries world over as the seriousness of the threat it possesses for the life on earth is perceived by everybody although differently. Global warming, no doubt is affecting the physical and biological systems of every continent in the world.

With the progress of development, people became more conscious about environment and international efforts were made to address the problem of global warming. The formal beginning started with the adoption of the United Nations Framework Convention on Climate Change in 1992 followed by the constitution of Intergovernmental Panel on Climate Change (IPCC) with the responsibility to assess the levels of GHGs in world's atmosphere and pass this information through reports to the policy makers. According to IPCC, a 2007 Nobel peace prize winner, the global temperature will increase by 6° C by the end of the century. The age old phenomenon of climate change has thus become an environmental, political and economic issue during the last decade.

With this backdrop an attempt has been made in the present paper to study the impact of climate change on Indian economy. In Section-II, we have discussed the main causes of global warming and India's contribution towards it. The impact of climate change on Indian economy is presented in Section -III. Section -IV contains the steps taken by the government to mitigate the impact followed by the Concluding Section.

II. POSITION OF INDIA

The accumulation of GHGs like carbon dioxide, ozone, methane, nitrous oxide and water vapour has led to global warming. Out of these, carbon dioxide alone constitutes 65 per cent of the Green House Gases. The major source of carbon dioxide is the burning of fossil fuels like coal, oil, and gas. Coal produces 1.7 times as much carbon dioxide per unit of energy when flamed as does natural gas and 1.2 times as much as oil. The power plants that use coal to produce power emit large amount of carbon dioxide followed by burning of gasoline in motor vehicles and use of fuel in construction of residential and commercial buildings. Extensive deforestation adds to the problem.

Methane, the second major Green House Gas is more than 20 times as effectual as carbon dioxide in causing global warming. The important sources of methane are paddy fields, bovine flatulence, bacteria in bogs

and fossil fuel manufactures. Initially large emission of methane gas was attributed to developing countries but Indian researchers found it to be over estimated.

Another important Green House Gas is nitrous oxide whose major sources are cars with catalytic converters, nitric acid and nylon production, use of fertilizers in agriculture and burning of organic matter.

The unsustainable consumption pattern of the developed countries has mostly accounted for the problem of climate change. Only 25% Of the global population live in industrialized nations but they emit more than 70 per cent of the total global emission of carbon dioxide and consume 75 to 85 per cent of world resources. In per capita terms disparities are even larger. Table-1 presents the list of world's top ten carbon dioxide emitters along with China and India.

Table-1

WORLD'S TOP TEN EMITTERS OF CO_2

Country	Per Capita CO_2 Emissions (tons)
USA	20.6
Canada	20.0
Austrailia	16.2
Japan	9.9
Germany	9.8
Britain	9.8
Netherlands	8.7
Italy	7.8
Spain	7.6
France	6.0
China	3.8
India	1.2

Source: CDIAC, 2007

It shows the relative contribution of countries towards carbon concentration. A cursory glance at the table shows that the USA tops

the list and emits 20.6 tons of CO_2 per capita followed by Canada (20t) and Australia (16.2t) respectively though in aggregate USA is the largest emitter with a very high carbon foot print (6 billion tons) followed by China emitting 5.32 billion tons. The present GHG Emission of India as a whole in terms of carbon dioxide is little above 3 per cent of global GHG emissions. The per capita emission of CO_2 by India is only 1.2 tons which is much less than that by USA, Canada, Australia and Japan.

The CO_2 emission in terms of Kg per annum of household appliances used by different income groups in India is shown in the table-2.

Table-2

CO_2 Emissions of household appliances (kg/annum)

Income group	<Rs3000	3000-5000	5000-8000	8000-10,000	10,000-15,000	15,000-30,000	30,000 & above
Lighting	134	156	214	219	188	187	218
Fan	40	73	120	137	135	129	142
Electric Geyser	4	14	36	71	78	52	65
TV	16	28	45	49	42	39	44
Washing Machine	0	0	4	16	10	58	22
AC	0	0	0	0	10	52	65
Others	4	8	27	55	57	129	534
Total	**198**	**279**	**445**	**549**	**521**	**646**	**1091**

Source: The Hindu Magazine

As the table shows the middle and high income groups emit more carbon dioxide as compared to the low income groups as most of these appliances are used by them.

The per capita energy consumption by different income groups and respective carbon dioxide emission are presented in the table below

Table-3 : Per Capita Energy Use and Carbon Emission

Income Group	Coal (kg)	Oil (kg)	Electricity (Kw)	Carbon Emission(kg)
Rural				
Bottom (50%)	74	22.5	95	54
Middle (40%)	127	39.7	152	93
Top (10%)	262	89.8	284	204
Urban				
Bottom (50%)	130	45.6	164	101
Middle (40%)	302	118.6	366	246
Top (10%)	765	332.3	858	656
EDR	10.3	14.8	9.0	12.0

Source: IDR.2007

EDR: Extreme Disparity Ratio = Urban top/ Rural bottom

Table-3 shows the per capita energy consumption by different income groups in both rural and urban areas and their corresponding carbon emissions. The 50 per cent of rural people emit only 54 kg of carbon while the top 10 per cent of urban population emits 12 times i.e. 656 kg .Still it is less than the world average and much less than that emitted by developed countries.

It is thus clear that the poor contribute very little to global carbon emissions as they have a life below subsistence level and they essentially use bio-fuel for cooking. However, as India uses coal in its power plants, that becomes the most important source of carbon emission in our country.

III. IMPACT ON INDIAN ECONOMY

The disturbing fact about climate change in India is due to its potential adverse impact on the economy. The key vulnerable areas are water resources, forests, coastal areas, agriculture and health. A large section of the country's population depends on these climate sensitive sectors. The impact of temperature increase on water resources bears an important connection with sustainable development. As per the IPCC projection, the moist tropics and high latitudes will be having increasing water availability while it will be declining for mid-latitudes and semiarid low latitudes.

So far as India is concerned, the impact will be reflected in increased droughts in some part of the country while the rest will be experiencing high occurrence of flood. The western part of the country will have rivers with water shortages and face acute scarcity and the river basins of eastern part are predicted to have severe flood conditions. The retreat of Himalayan Glaciers attributable to global warming will have serious impact on the hydrology of Indian rivers causing high incidence of flood and landslides initially and reduction in river flows in the long run.

The impact of climate change on agriculture is a mix of positive and negative effects. Higher concentration of carbon dioxide in the atmosphere that improves water use efficiency of crops may mitigate the negative impact of drought to some extent. In the summary, for policy makers of the 4th assessment report, Working Group-II of the IPCC states that crop productivity is projected to increase slightly at mid to high latitudes for the local mean temperature increase up to 1-3° C depending on the crop and then decrease beyond that in some regions. At lower latitudes, especially seasonally dry and tropical regions, crop productivity is projected to decrease for even small local temperature increase of 1-2° C. This would increase the risk of hunger. Globally, the potential for food production is projected to increase with increase in local average temperature over a range of 1-3°C but above this it is projected to decrease. In a more detailed study of India, Kumar and Parikh (2001) examined the impact of climate change on agricultural yield, output income and prices. They estimated, without considering carbon fertilization effect that the yield of rice varies between 15 to 42 per cent and for wheat between 25 to 55 per cent for a temperature increase of 2.5°C to 4.9°C. GDP would drop by 1.8 to 3.4 per cent and agricultural prices relative to non agricultural prices would increase by 7 to 18 per cent. With carbon fertilization effect there will be losses but by a smaller amount. Even with adaptation of cropping patterns and inputs by the farmers the losses will remain significant. With a temperature increase of 2°C and an accompanying precipitation change of 7 per cent, farm level total revenue would fall by 9 per cent. For a developing agrarian country like India these are very large changes which can cause acute food shortage and human misery.

Rising temperature will cause melting of polar caps and snow glaciers causing a rising sea level and leading to submersion of coastal

areas. Intrusion of sea water in ground water reduces agricultural and fishing incomes. As a result, there will be a large scale out- migration from the coastal regions. It is anticipated that a one meter rise in the sea-level will inundate up to 30,000 sq. km in Bangladesh and 5000 sq. km in India displacing millions of coastal dwellers. Many of the displaced in Bangladesh may spill over to India raising the size of environmental refugees. Construction of a sea wall to prevent submergence is a costly affair and countries like India and Bangladesh cannot afford a very large share of their GDP for the purpose.

Increased occurrence of extreme events due to climate change affects the poor most. This is corroborated by the frequent occurrence of cyclone in Andhra Pradesh and super cyclone followed by devastating flood in recent times in Orissa that resulted in huge loss of life, livestock and crop. It is predicted that by 2100, the sea level will rise by 40 cm and 50 million people of coastal India will be displaced by flood. The coastal states will be having increased frequency of coastal storm, higher mean temperature, more frequent drought and sudden flood. This will adversely affect coastal agriculture, fresh water resources, human settlement and tourism.

Change in global environment due to climate change has profound impact on human health in India. Increasing concentration of GHGs in the atmosphere will affect air quality leading to respiratory illness. Lack of safe water shall trigger outbreaks of diarrhoea and other food and water borne diseases. Excessive monsoon rainfall and high humidity will enhance mosquito breeding spreading malaria, dengue and kala-azar. Natural disasters will also affect health adversely. Reduced food production will lead to hunger and malnutrition.

Because of erratic rain fall and change in precipitation level, India's forest is depleting and will deplete rapidly in near future. It possesses a major threat to the flora and fauna that may be extinct by 2030. Thus, climate change is posing a serious threat to the plant's biodiversity changing the type of vegetation in near about 80 per cent of country's existing forests. However, all these impacts are long term issues. What affects India immediately is the fast pace at which international negotiations are taking place. Traditionally, India's energy strategy is based on coal, its most abundant resource. Because of the threat of climate change India is called upon to reduce the use of coal and substitute it by other alternatives like oil, gas, renewable and nuclear

energy which are very expensive. So India has to go for a drastic change in its energy strategy along with its land use and agricultural strategy which is not an easy task.

IV. POLICIES

The IPCC and Stern review suggest that there are cost effective ways of mitigating the threat. The problem is global and therefore requires a cooperative effort by all governments. The principal global instrument for doing this is United Nations Framework Convention on Climate Change (UNFCCC) which was opened for signature at the 1992 Rio-Earth Summit and has now been in force for over a decade. It recognizes the historical responsibilities of developed countries for the accumulated stock of carbon in the atmosphere and the responsibilities to address the problem as common but differentiated. The Kyoto protocol to the UNFCCC was negotiated in the mid-nineties and includes an obligation on the industrial countries to contain their emissions of GHGs to certain limits. Europe, Canada, Japan, Russia have accepted some obligations while USA, the highest emitter has not. The convention at Bali in 2007 came out with resolution to have a "deep cut" in global emissions though no specific target figures have been spelt out. It has set 'quantified emission limitation and reduction objectives' for developed countries and the need to 'supported and enabled by technology, financing and capacity building' for developing countries.

India has pursued GHG-friendly policies for some time in her own interest because of its compulsion to reduce oil consumption and protect environment. These efforts have been made by both government and people. These include (a) emphasis on energy conservation, (b) promotion of renewable energy resources, (c) abetment of air pollution, (d) afforestation and waste land development, (e) economic reforms, subsidy removal and joint ventures in capital goods, (f) fuel substitution policies. Some of these efforts have been ongoing for several decades and have been institutionalized through polices, programmes and the creation of specific institutions. In addition to government efforts, a number of measures have also been taken by the people. The age old resource minimizing traditions as well as good practices that exist in India have helped on the one hand and the forced savings by poor due to deprivation on the other.

Energy conservation and increased energy efficiency is getting importance in the energy and industry sector plants. In India, power sector emits highest CO2 (42%) followed by iron steel and transport. Improving the efficiency of coal and electricity used significantly reduces emissions from these sectors.

Apart from this India has tried to find, develop and exploit non-conventional energy sources like wind farms, mini-micro hydel projects, biomass and cogeneration power plants, biomass based gasifies systems and solar photo voltaic systems. The activity has started since 1950's under the ministry of science and technology which grew into a separate department under the ministry of Energy and then became full fledged ministry of non-conventional energy sources. Expected energy generation and energy savings from these renewable energy systems come to about 26.3 million tons of wood equivalent which amounts to a significant 12 to 15% savings in total wood consumption. Use of CNG, increased energy efficiency through improvement of fuel quality prescribed mandatory pollution levels for vehicles have helped reduced air pollution and improve air quality especially in urban areas. It is hoped that more strict norms will be followed in near future.

Afforestation and waste land development have found support from both governmental as well as non-governmental organizations. The programmes undertaken not only aim to halt deforestation but also increase green cover. If all efforts at afforestation were to succeed, India's net emission of CO_2 would come down significantly. There is much scope for carbon sequestration through improving the quality of forests and also it is desirable to arrest soil degradation, to improve soil fertility, to provide renewable fuel timber and non-timber forest products as well as to provide livelihood to millions of poor people.

Power sector reforms and joint venture in capital goods have raised the energy efficiency in the country. There is fuel substitution from coal to oil and gas as the use of oil and gas is permitted more freely in a post liberalization period. The Prime Minister of India, Dr. Manmohan Singh made an important announcement at the Heiligendamm Summit of the G-8 in 2007 that India would ensure that its per capita emissions never exceed the average for the Industrial countries.

V. CONCLUSION

The risks of climate change virtually depend upon the stock of GHGs in the atmosphere rather than fresh emissions. In order to prevent the global temperature to rise by 2° c we have to keep the atmospheric concentration of GHGs at 450-500ppm as against current levels of 430 ppm. The developed countries have already used up much of ecological space. Then how to get a fair share of the space is an important issue. In the light of this following suggestions are made.

- The allocation should be on per capita basis. An equally important issue is sharing the inevitable costs of mitigation and of adaptation to the change. Of course, there are uncertainties about the nature, the extent and impact of climate change. However, that should not be a ground for inaction. A little delay in action may have serious impact on economic growth.
- Each country should be held accountable for its own emissions and the decisions during negotiations should be applicable retroactively so that unnecessary delay can be avoided. A vulnerable country like India should focus on the higher end of the warning range and urge actions now.
- The countries those who have already emitted more than their share in a cumulative manner must offset this by larger reductions. Compensation to the sufferer should be on the basis of the cumulative addition of CO_2 "Polluter pays" principles should be applied. This will help in reducing use of delaying tactic to free ride on others.
- The clean development mechanism could be risky for developing countries. So to share the gains from COM projects equitably, a global carbon price floor should be fixed.
- Apart from this, a major attraction of COM for the developing countries like India is technology transfer. It should be available at a cheap price and with ample freedom to choose from anywhere in the world.
- Even if the world becomes successful in restricting the temperature increase to 2° c, some impact on development is unavoidable. Hence, strategies should be framed to enhance the adaptability of agriculture, human settlements and health systems.

India with its vast diversities need be more careful about this. If the environmental, societal and ecological benefits of mitigation will be well recognized and valued properly, it will be much more than large mitigation costs. Postponement of action now would put a larger burden on the future generation.

References

1. Noor Mohmmed,A and Sreemathi, S.(2008), Climate Change: Needs International Effort". Southern Economist, January1 ,pp-5-7
2. Sengar.R.S. and Sengar, R. (2008), "Global Warming and Its Effects on Agriculture" Kurukshetra, July,pp-21 -27.
3. The Economic Times, Various Issues.
4. Human Development Report,2007/2008

□□□

CLEAN DEVELOPMENT MECHANISM- A COPING STRATEGY FOR CLIMATE CHANGE

Dr. Gitanjali Panda*

ABSTRACT

The Clean Development Mechanism (CDM) is one of three "flexibility mechanisms" identified in the Kyoto Protocol that participating countries can use to meet their GHG reduction targets. The CDM is the only mechanism under the Kyoto Protocol that involves developing countries or non-Annex I countries. Article 12 of the Kyoto Protocol allows developed countries and countries with economies in transition to meet their greenhouse gas reduction commitments by engaging in CDM projects that reduce GHG emissions. Developing, or non-Annex I, countries that have ratified the Kyoto Protocol can benefit from these CDM projects to promote sustainable development. Annex I countries, in return, receive certified emission reduction (CERs) credits for investing in CDM projects in non-Annex I countries, which can be used against their GHG reduction commitments under the Kyoto Protocol.

This paper explains one of the three flexibility mechanisms accepted under Kyoto Protocol called clean development mechanism (CDM) to reduce legally binding GHG emissions reduction to an average of approximately 5.2 percent below their 1990 levels as an average over the first commitment period in 2008-2012, for industrialised countries. The technicalities involved in calculating the size of the transaction unit i.e., CERs(Certified Emmission Reductions) and the concept of carbon trading through a sample calculation have been discussed in the article. The sectoral scopes for CDM, and the likely projects that would be eligible under the CDM modalities are stated in the article. The phases of a CDM project cycle starting from the phase of conceptualization till the actual payment for certified emission

* Department Of Social Science, F.M.University Vyasha Vihar, Balasore.

reductions (CERs) have been explained with box-digrams. It also makes an attempt to study the Green House Gases emission facts in India and contribution of different sectors to total emissions. Indian initiatives with regard to CDM project implementation have been discussed in the article. The potential of India in terms of registered project activities and expected annual CERs from registered projects by host party by 2006 in comparison to other countries are presented through pie-charts. Indian companies can earn carbon revenue by reducing GHGs emissions through energy-saving mechanisms and by replacing electricity and heat generation using fossil fuels with that of electricity and heat generation using natural gas and oil in future.

1. INTRODUCTION

Concerns about global warming and climate change led to a growing debate on the impact of development on the environment. Human activities are increasing the concentration of Green House Gases ('GHGs') in the atmosphere. This enhances the green house effect, commonly known as " climate change" which leads to rise in average global temperature(expected to go up 1-4 Celsius in next 100 years), changes in vegetation and sea level rise(parts of Maldives and Bangladesh might submerge in next 50 years). A series of international meetings were held during the 1990s, culminating in the Kyoto Protocol, initialled in December 1997 at the third Conference of Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Kyoto, Increasing industrial activity, burning of fossil fuels and deforestation have resulted in higher levels of Carbon dioxide (CO_2) and other Greenhouse Gases (GHG) being released into the atmosphere, leading to global warming. The Kyoto Protocol specifies the level of CO_2 emission reductions, the deadlines and methodologies that signatory countries (i.e., countries who have signed the Kyoto Protocol) are to achieve. The Kyoto Protocol set legally binding GHG emissions reduction to an average of approximately 5.2 percent below their 1990 levels as an average over the first commitment period in 2008-2012, for industrialised countries, or so-called Annex-I Parties. The Kyoto Mechanisms includes three flexibility mechanisms aimed at achieving cost-effective GHG emissions reduction- International Emissions Trading (IET), Joint Implementation (JI), and the Clean Development Mechanism (CDM) .

2. CLEAN DEVELOPMENT MECHANISM

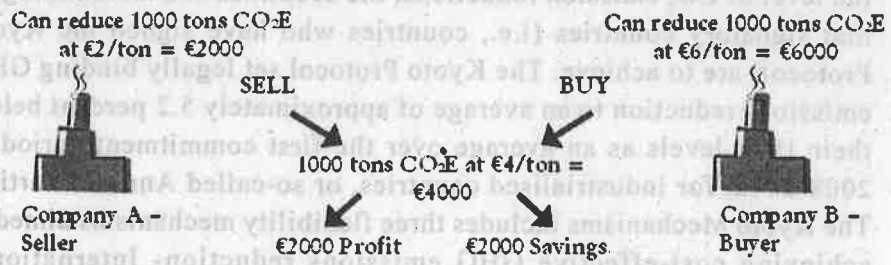
Clean Development Mechanism (CDM) enables developed countries and economies in transition (known as Annex I countries of the UNFCCC) meet their GHG reduction targets at lower cost through projects in developing countries. Under the Kyoto Protocol, projects that reduce six GHGs and gas classes may qualify for CDM projects;

- Carbon dioxide,
- Methane,
- Nitrous oxide,
- Hydrofluorocarbons (HFCs),
- Perfluorocarbons (PFCs) and
- Sulphur hexafluoride (SF_6).

The Kyoto Protocol allows governments or private entities in industrialized countries to implement emission reduction projects in developing countries and receive credit in the form of "certified emission reductions," or CERs (1 CER- one metric tonne of carbon dioxide equivalence), which they may count against their national reduction targets. The CDM strives to promote sustainable development in developing countries, while allowing developed countries to contribute to the goal of reducing atmospheric concentrations of greenhouse gases.

Emission Trading – A Comparative Advantage [Cost of abatement is less for Company A]

Emission Trading – A Comparative Advantage [Cost of abatement is less for Company A]



The above concept of emission trading, also known as carbon trading, is based on the theory of comparative advantage of international trade. Suppose company A in a developing country is capable of reducing CO_2 at a lesser cost compared to a company B in a developed country. So, if both the countries engage themselves in emission trading to achieve targeted emission reduction at a price which lies between the cost of reduction in developing country and the cost of reduction of CO_2 in B country , then both the companies gain from such trading as exemplified in the above picture.

2.1 CDM Sectoral Scopes

The industries and sectors where the scope for reducing emissions is possible are energy industries(Renewable/non-renewable sources), Energy Distribution, Manufacturing Industries, Chemical Industries, Transport, Mining/mineral production, Fugitive emission from fuels (Solid, oil and gas), Fugitive emissions from production and of halocarbons and sulphur hexafluoride, Waste handling and disposal, Afforestation and reforestation, and Agriculture.

2.2 Projects eligibility under CDM activity

The requirement that the CDM assist developing countries to achieve sustainable development has wide ranging implications. One, the project should be in line with the host developing countries development priorities. Two, the project while reducing GHG emissions should not result in increase of negative local environmental impacts.

CDM Projects are eligible for registration if they began after January 1, 2000.There must not be any regulatory compulsion on the proposed economic activity. The project should lead to real, measurable and long term GHG mitigation in terms of climate change mitigation. The additional GHG reductions are to be calculated with reference to a baseline. The reductions must be additional to any that would have occurred without the project. The activities under CDM project should lead to transfer of environmentally safe and sound technologies and know-how. Sustainable development - assuring Social, Environmental, Economic and Technological Well Being for the host country must be assisted by the Clean Development Mechanism project activity.

The likely projects that would be eligible under the CDM modalities are the projects that lead to energy use efficiency on both demand as

well as supply side, the projects that improve the production processes resulting in lower GHG emissions as well as local pollution, projects that substitute shift from fossil fuels to carbon free fuels or renewable energy projects, Projects that substitute high carbon fuels for low carbon fuels. Though, these projects are grey areas as some of these projects would have happened anyway due to economic reasons. Afforestation and reforestation projects are the only sink projects,i.e., that absorbs carbon dioxide are eligible under CDM activity.Annex-I Parties must refrain from using CERs generated through nuclear energy to meet their targets

2.3 Technicalities in calculating the Revenue potentiality in CDM projects

Transaction units (CERs – Certified Emission Reductions)

The measuring unit for the six GHG gas is CO_2 .Carbon emission reduction is measured as tCO2(tones of carbon oxide) and also measured as tCO2 e (tonnes of carbon dioxide equivalent) which is applicable to other five GHG like Methane, Nitrous oxide, Hydroflurocarbons, Perfluorocarbons and Sulphur hexafluoride.

Table:1 Scope for emission reduction in India per year

GHGs	tCO_2 equivalent	Approx. million tCO_2 emission reduction per year in India	Cost per tCO_2 in US $	Expected revenue in million US $
Carbon dioxide (Steel, power, sugar, paper, cement, glass & ceramics etc.)	1	416.6	15	6249
Methane (Livestock)	23	10.08		3478
Nitrous oxide (Fertilizers)	296	14		62160
Hydrofluorocarbons (HFC-23) (Chemical industry)	12000	10		1800000
Perfluorocarbons (Aluminium industry)	5700	10		855000
Sulphur hexafluorides	22200	10		3330000

Source :UN"s Inter-governmental Panel on Climate Change

The above table depicts the scope of reducing million tCO_2 in India per year and the expected revenue generation that Indian corporate and govt. sector can generate.

CO_2 energy equivalence – Sample calculations for power generation/utilisation

- CO_2 Emissions rate per kWh from Electricity and Heat Generation Using Coal (1 kWh = 1.21 Kg CO_2)
- CO_2Emissions rate per kWh from Electricity and Heat Generation Using Natural Gas (1 kWh = 0.49 Kg CO_2)
- CO_2 Emissions per kWh from Electricity and Heat Generation Using Oil (1 kWh = 0.72 Kg CO_2)

Ilustration for electricity and heat generation using coal, natural gas and oil – Sample calculation:

Table-2

Gram of CO_2 per kWh	1207	
Kg CO_2 per kWh	1.2068	
1 MW	1000	kw
Kg CO_2 per MW	1206.8	
tCO_2 per MW	1.21	
Running hours	24	
Operation days	365	
tCO_2 per year	10571.57	
Average plant load factor in India	0.80	
Net tCO_2 per year	8457.25	

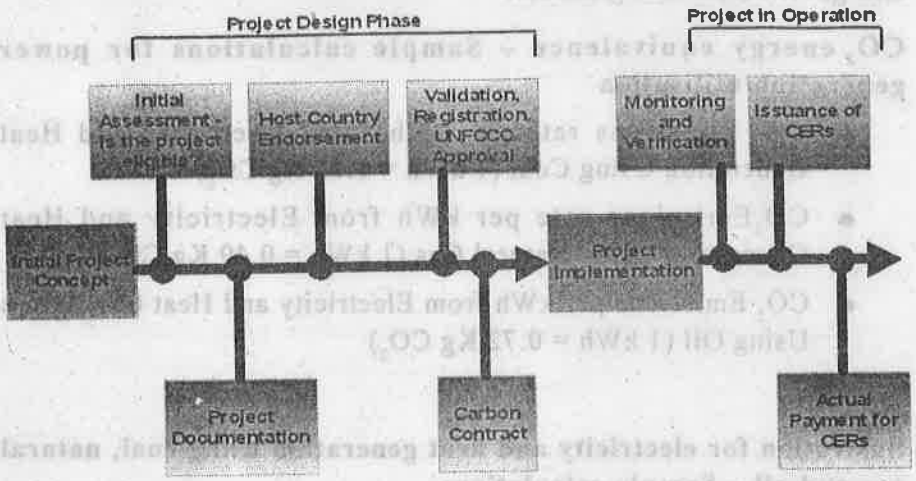
- Natural Gas : Net tCO_2 per year 3434 with 80% PLF
- Oil : Net tCO_2 per year 5018 with 80% PLF

84573 tCO2 per year for a 10 MW capacity

4,22,865 tCO_2 for 5 FY (2007-2012)

As per the above example the expected revenue from CERs over 8.46 million US $ in ten years at an average market price of 10 US $ per CER (= Rs. 3721.19 lakhs) for a 10 MW capacity cogeneration power plant in either cement, sugar, paper or other industries. The revenue expected from the CDM activities is Rs. 372 lakhs per year.

2.4 CDM Project cycle

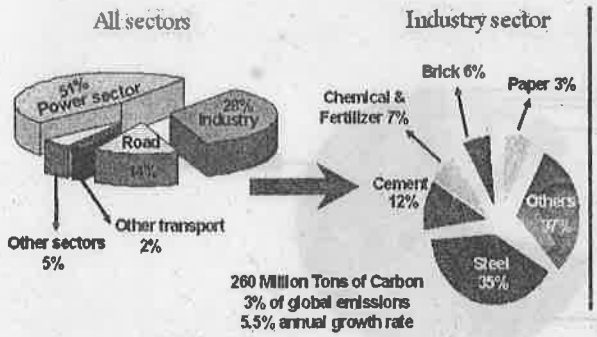


The above diagram explains the phases of a CDM project cycle starting from initial project concept till the actual payment for certified emission reductions through the phases of project designing , implementation and its operation.

3.1 Indian Initiative

India signed Kyoto Protocol in December, 1997 & ratified in August, 2002 and established Designated National CDM Authority for CDM (DNA-MoEF) in December, 2003.The proactive DNA is an effective institutional framework which issues Host Country Approval in 40 days of the project submission. Active participation is solicited from the private sector. India has consolidated its position among non Annex-I Countries in CDM implementation. Among non-Annex-I Countries, India is the first Nation to recommend highest number of CDM projects to CDM Executive Board of UNCCC. Indian Designated National CDM authority has offered a simple, first tracked Clearance system for the issuance of ' Host Country Endorsement'.

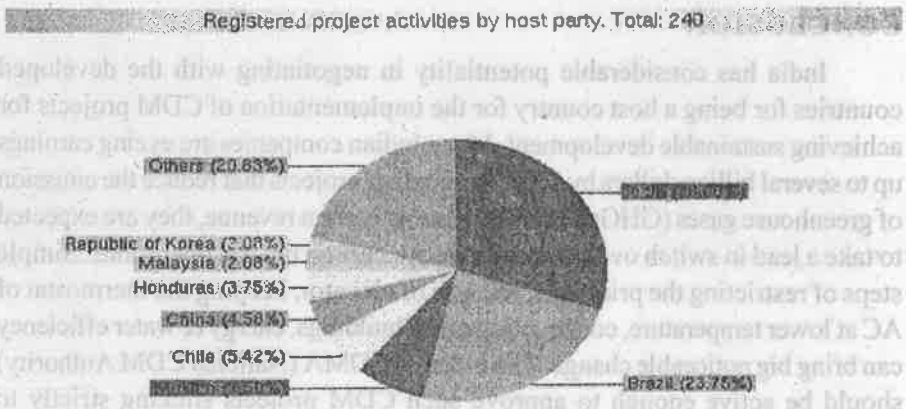
GHG emission facts in India

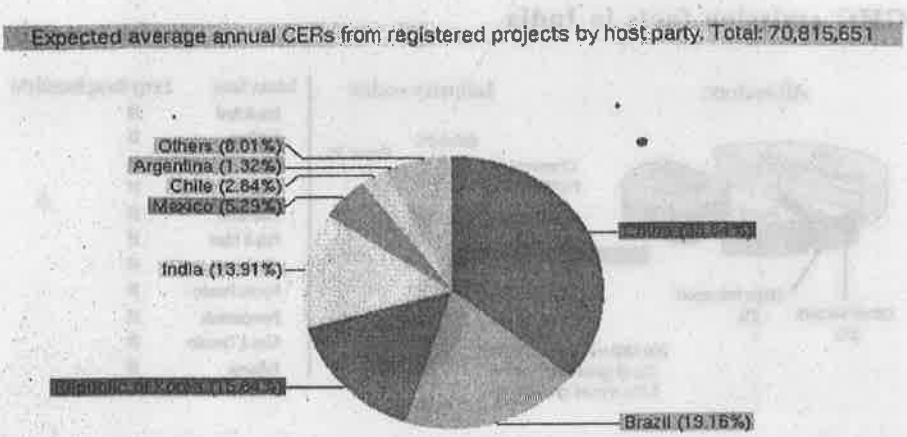


Industry Sector	Energy Saving Potential (%)
Iron & Steel	10
Fertilizers	15
Textiles	25
Cement	15
Chlor-alkali	15
Pulp & Paper	25
Aluminium	10
Ferrous Foundry	20
Petrochemicals	15
Glass & Ceramics	20
Refineries	10

It can be observed from the above pie-diagram and the table that the size of carbon emitted from different sectors is estimated at 260 million tons of carbon which is 3% of global emissions increasing at 5.5 percent annually in 2006. Power sector contributes maximum to GHG emission followed by Industry, road and other sectors respectively. The energy saving potentiality is highest in industries such as textiles, pulp and paper, ferrous foundry and glass and ceramic.

POTENTIAL IN INDIA





India accounts for the highest proportion of projects (30 per cent) of the global total (240) registered with the Clean Development Mechanism (CDM) Executive Board by 2006, far higher than Brazil's 23.75, Mexico's 7.50, and China's 4.58 per cent. (In annual CERs, however, India's share is 13.91 per cent, compared with China's 35.84 per cent). The single largest Indian deal, for Rs.1,000 crores, was bagged by Gujarat Fluorochemicals, which runs a refrigerant plant but is better known for its "Inox" multiplexes. No wonder much bigger companies like Reliance, Grasim Industries, Gujarat Ambuja and Tata Chemicals are considering investing in carbon trading.

CONCLUSION

India has considerable potentiality in negotiating with the developed countries for being a host country for the implementation of CDM projects for achieving sustainable development. Many Indian companies are eyeing earnings up to several billion dollars by 2012 by adopting projects that reduce the emission of greenhouse gases (GHGs). Besides gaining carbon revenue, they are expected to take a lead in switch over to carbon free or carbon neutral operations. Simple steps of restricting the print outs, less use of elevator, keeping the thermostat of AC at lower temperature, constructing green buildings, energy & water efficiency can bring big noticeable change. The Indian NCDMA (National CDM Authority) should be active enough to approve such CDM projects sticking strictly to sustainable development criteria of economic, social, environmental and technological wellbeing. The developed countries can achieve national GHGs emission reduction target through a combination of direct domestic action and by investing in developing countries that reduce these emission levels through CDM projects.

❑❑❑

CLIMATE CHANGE – A CONCERN FOR UNDER DEVELOPED COUNTRIES

P.K. Samal[1] **Dr. S. Behera**[2]

CLIMATE CHANGE - AN INTRODUCTION :

Climate change is a highly complex subject, involving as it does science, economics and politics in almost equal measure. It is emerging as a major economic and energy security consideration in India and also in the world. No country can address it adequately alone.

Definition: - Climate change describes the variability or average state of the atmosphere or average weather over time scales ranging from decades to million of years (at a global or regional level over time). These variations may come from process internal to earth; driven by external forces e.g. variations in sunlight intensity or most recently, caused by human activities.

Climate Change is an issue of intergenerational justice. If we know how our actions affect our planet, it would be criminal to keep acting like we are now, knowing that it jeopardizes future generations."

"...Climate change is going to devastate communities that are already the most marginalized in our society, domestically and on a global level, communities that are least responsible for the industrial and historical emissions that created the problem. This is why a quick solution for climatic threat like global warming & greenhouse effect is urgently needed."

CLIMATE CHANGE IS A "CRITICAL PILLAR OF THE DEVELOPMENT AGENDA"

According to Robert Zoellick, world group president at the United Nations Climate Change Conference in Bali, Indonesia, Dec. 2007- "Climate change is a development, economic and investment challenge .It offers an opportunity for economic and

---

1. Lect. in Economics, G.C.College, Ramachandrapur
2. Reader in Economics, Revenshaw University, Cuttack

social transformation that can lead to an inclusive and sustainable globalisation. That is why addressing climate is critical pillar of the development agenda.

In recent usage, especially in the context of environmental policy, the term "climate change" often refers to changes in modern climate, which according to the IPCC are 90-95% likely to have been in part caused by human action. Consequently the term anthropogenic climate change is frequently adopted; this phenomenon is also referred to in the mainstream media as global warming. In some cases, the term is also used with a presumption of human causation, as in the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC uses "climate variability" for non-human caused variations.

WHY IS THERE A CLIMATE CHANGE?

Climate change factors

1. Human Caused variations or anthropogenic Factors :

- Increase in CO_2 and other GHGs
- Emission from fossil fuel combustion
- Aerosol
- Broad scale deforestation
- Ozone depletion
- Live stocks

2. Non-Human caused variations or Climate Forcing :

- Variations within the earth's climate
- Variations in solar radiation / solar variations
- Variations in earth's orbit / orbital variations
- Natural variations

HOW CLIMATE CHANGE WILL AFFECT THE WORLD ?

- Global warming and Green house effects
- Impact on health, agriculture, forest, water resources, coastal areas, species and natural areas.
- Extreme weather like drought, flooding, severe storms & winter, Tropical cyclone and hurricane, wild fires, extreme heat waves and desertifications.

Global warming and Green House effects : The green house effect is at the centre of climate change debate. Therefore, it is important to understand how it affects our planet.

THE GREENHOUSE EFFECT

The term 'Greenhouse Effect' is commonly used to describe the increase in the Earth's average temperature that has been recorded over the past 100 years. However, without the 'natural greenhouse effect', life on Earth would be very different to that seen today.

The GHGs

Almost all of the Earth's atmosphere (99%) is made up of nitrogen (about 78%) and oxygen (about 2 1%). While both of these gases play important roles in the vast number of processes that support life on Earth, they play almost no direct role in regulating the climate. This is carried out by some of the trace gases in the remaining 1% of the atmosphere which occur in relatively small amounts:

- Carbon dioxide
- Methane
- Nitrous oxide Ozone
- Water vapour
- Halocarbons

Although the proportion of the trace gases in the atmosphere appears relatively small, they can still have a big impact on climate change - and they are mainly caused by human activities.

The 'enhanced greenhouse effect'

Although most of the greenhouse gases occur naturally in the atmosphere, some are man-made and the most well-known of these are the fluorocarbons. Since the industrial revolution, human activities have also resulted in an increase in natural greenhouse gases, especially C_2, CH_4, N_2O, Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF_6) etc. Out of these just three CO_2 (Carbon dioxide), CH_4 (methane) and N_2O (nitrous oxide) account for almost 99% of the total. An increase in these gases in the atmosphere enhances the atmosphere's ability to trap heat, which leads to an increase in the average surface temperature of the Earth.

- Solar energy passes through the atmosphere, is absorbed by the earth's surface and warms it up.
- GHGs absorb some of the reflected heat energy, without them the Earth's average temperature would be around 18°C.
- Human actions gradually increase concentrations of GHGs in the atmosphere and lead to global warming.

Given below are some of activities:

1. **Agriculture:-** Agriculture is a huge source of Methane and nitrous oxide and responsible for 15%-18% of world's GHGs.
2. **Traffic :-** One quarter of all man-made CO2 emissions and CO also, is transportation related. 750 million cars worldwide emit a total of approximately 2.25 billion tones of CO2 each year.
3. **Industrialization** industrial production is responsible for more than half of all CO2 emissions.

   Largest quantities of CO emitted by energy producers and energy intensive industries.

   New filtration technology could reduce CO2 emissions by 30-40%.
4. **Deforestation** :-A quarter of CO2 emissions worldwide result from deforestation. Net forest lost since 2000:7.3 million hectares per year (roughly the size of Panama.) Improvement measures; afforestation, reforestation and avoid deforestation.

Following effects emerge :

The accelerated warming process has a number of dangerous **impacts.**

- **Melting Glaciers:** since the early 1960s, mountain glaciers around the world have experienced an estimated net loss of over 4000 cubic kms of water. This loss was more than twice as fast as during the 1990s as in the previous decades.
- **Projections** : 4°C rise in average global temperatures would cause nearly all of the world's glaciers to melt resulting in rising sea levels.
- **Increase of storms** : Globally the annual number of strong storms doubled from around 8 (early 1970s) to 18 (2000-2004).

Hurricane Katrina in 2005 was the sixth largest hurricane in record and caused over 60 billion US dollars in damage.

The magnitude and damages caused by the 27 tropical storms in the Atlantic during 2005 were the highest yet recorded.

- **Desertifications : 2** billion people of 110 countries are affected and threatened by accelerating desertification.

  The UN projects that 30% of the world's fertile land surface will turn into deserts in future.

  For example in Niger, 2,50,000 hectares an area about the size of Luxemburg, becomes desert every year.

POTENTIAL CLIMATE CHANGE IMPACTS IN INDIA:

Impact -Economic & social

The rapidly growing population and economic development are leading to the environmental degradation in India through the uncontrolled growth of urbanization and industrialization, expansion and massive intensification of agriculture, and the destruction of forests. India is having 18% of the world's population on 2.4% of world's total area has greatly increased the pressure on its natural resources.

Water shortages, soil exhaustion and erosion, deforestation, air and water pollution afflicts many areas. The uprising population and the environmental deterioration face the challenge of sustainable development. These include heavy pressure on land, land degradation, forests, habitat destruction and loss of biodiversity. Changing consumption pattern has led to rising demand for energy. The final outcomes of this are air pollution, global warming, climate change, water scarcity and water pollution.

- **Extreme heat waves:** In India, a heat wave during mid-May 2007 produced temperatures as high as 45-50°C (113-I22°F) resulting in at least 128 fatalities. Extremely hot weather and associated fatalities do occur in India during late spring preceding the climatological onset of the monsoon season in June.
- **Flooding** :Extreme flooding .the most widespread direct risk to human settlements is driven by extreme rainfall and sea level rise. In south Asia (India) extreme flooding by Sept. 2008 monsoons bursts dams and overflowed embankments killing 1500

people. In Orissa, tens of thousands were stranded on embankments and highways after a large areas were flooded when authorities opened sluice gates of a dam on the Mahanadi river after heavy rains .

- **Natural Resources Degradation** :India is heading towards a severe food crisis due to natural resources degradation.

Climate change Impact:

- **Health** :water related mortality, infectious diseases, Air-quality respiratory illness are on the rise.
- **Agriculture:** Crop yield is adversely affected.
- **Forest : Forest** composition, health & productivity are changed.
- **Water resources:** Water scarcity, water pollution and competition for water.
- **Coastal areas:**
  a) Erosion of beaches, inundation of coastal lands and additional costs to protect coastal communities.
  b) Increased damage from Hoods and storms.
  c) About 30% of global coastal wetlands lost
- **Species & natural areas: Loss** of habitat and species, cryosphere – diminishing glaciers.
- **Ecosystems:**
  a) Upto 30% of the species are at increasing risk of extinction and significant extinction around the globe already.
  b) Increased coral bleaching—widespread coral mortality.
  c) Terrestrial biosphere tends towards a net carbon source as 15% -40% of ecosystems affected.
  d) Increasing species range shifts and wildfire risks.
  e) Eco-system changes due to weakening of the meridian overturning circulation.

CLIMATE CHANGE PROBLEM AND THE CONTROVERSY:

The UN Conference on Environment and Development (UNCED) in 1992 at Rio de Janeiro led to FCCC (Framework Convention on Climate Change), which laid the framework for the eventual stabilization

of greenhouse gases in the atmosphere, recognizing the common but differentiated responsibilities and respective capabilities, and social and economic conditions. The Convention came into force in 1994. Subsequently, the 1997 Kyoto protocol, which came into force in 2005, reasserted the importance of stabilizing greenhouse gas concentrations in the atmosphere and adhering to sustainable development principles. As per the Protocol industrialized countries are required to reduce their greenhouse gas emissions by a weighted average of 5.2%, based on the 1990 greenhouse gas emissions. The reduction is to be achieved

by the end of the twelve-year period, 2008 to 2012 for a stabilization of climate change by 2100. The Kyoto Protocol does not require the developing countries to reduce their green house gases emission.

Contribution of industrialized and developing countries:

Historically, the industrialized countries have been the primary contributors to emissions of CO2 and are responsible for about 83% of the rise in cumulative fossil fuel related CO2 emissions since 1800. In the 1990s, they accounted or about 53% of the 6.3 GtC/year, which was released as CO_2 from fossil fuel combustion. According to another estimate, developing countries accounted for only 37% of cumulative CO_2 emissions from industrial sources and land-use change during the period 1900 to 1999 whereas industrialized countries accounted for 63%, but because of their higher population and economic growth rates, the fossil fuel CO2 emissions from developing countries are likely to soon match or exceed those from the industrialized countries. Large countries, such as China and India, could match the USA's year 2000 greenhouse gas emissions within two to three decades.

Mitigation issue: The controversy

Curbing CO2 emissions along the lines of the Kyoto accord becomes controversial on the following grounds.

1) *USA's refusal and objection:* In the first place, the United States, the largest source of carbon dioxide emissions, has refused to ratify the treaty and has made clear its intention of having no part in any future such agreements. The principal American objection is that the developing countries - including such major contributors to future carbon dioxide emissions as

China. India and Brazil are effectively outside the process and determined to remain so. Indeed, both China and India currently subsidize carbon-based energy.

2) *Developing countries' argument:* The developing countries' argument is a simple one. They contend that the industrialized countries of the western world achieved their prosperity on the basis of cheap carbon-based energy; and that it is now the turn of the poor developing countries to emulate them. And if there is a problem now of excessive carbon dioxide concentrations in the earth's atmosphere, it is the responsibility of those that caused it to remedy it. Nor are they unaware of the uncertainty of the science on the basis of which they are being asked to slow down their people's escape from grinding poverty.

The consequences of the exclusion of the major developing countries from the process are immense. China alone last year embarked on a programme of building 562 large coals fired Power stations by 2012 - that is, a new coal-fired power station every five days for seven years. Since coal-fired power stations emit roughly twice as much carbon dioxide per gigawatt of electricity as gas-fired ones, it is not surprising that it is generally accepted that within the next 20 years China will overtake the United States as the largest source of emissions. India, which like China has substantial indigenous coal reserves, is set to follow a similar path, as is Brazil. Then there is the cost of the Kyoto approach to consider.

Adaptation -the cost effective approach:

3 reasons why adaptation is far and away the cost effective approach.

a) *Firstly,* many of the feared harmful consequences of climate change such as coastal flooding in low-lying areas are not new problems, but simply the exacerbation of existing ones so that addressing these will benefit even if there is no further global warming at all.

b) *Second* is that, unlike curbing CO2 emissions this approach will bring benefits, whatever may be the cause of the warming, whether man-made or natural.

c) *Thirdly,* why adaptation, most of which incidentally will happen naturally (market-driven, without much need for govt.

intervention-is the most cost effective approach. Besides many studies show that there are benefits as well as costs from global warming. Adaptation enables us to pocket the benefits while diminishing the costs.

Clean Development Mechanism—the need of the time

The *Clean Development Mechanism* (CDM) is a market based trading mechanism Created by the Kyoto Protocol, functions by delivering a subsidy to the developing world in return for lower emissions of greenhouse gases. The subsidy offsets the cost of reducing GHG emissions, thereby encouraging less developed countries to emit less GHG than they otherwise would. As such, it represents the first attempt to address a global atmospheric commons problem using a global market. The CDM was designed around the insight that the marginal cost of emissions reductions in developing, and especially rapidly developing, countries would be less than for developed ones. The idea was that paying to build efficient, low GHG emitting industrial and energy facilities in the developing world. By means of the CDM, carbon dioxide (CO_2) emission reductions could occur in the developing world that would otherwise have occurred in the developed world at far higher cost.

CDM & India :India acceded to the Kyoto Protocol in August 2002 and one of the objectives of acceding was to fulfill prerequisites for implementation of Clean Development Mechanism projects, in accordance with national sustainable priorities, whereunder, a developed country would take up greenhouse gas reduction project activities in developing countries where the costs of greenhouse gas reduction project activities are usually much lower.

"We have to give climate change a human face - it is not all about 'Sinks,' 'emission trading schemes' and technology. Climate change is About people, children, families and of our relationship with the world Around us. To Inuit it is a question of our very survival as hunting people and a hunting culture. Our human rights - to live our traditional way - are being violated by human-induced climate change."

Sheila Watt-Cloutier, chair, Inuit Circumpolar Conference

❑❑❑

CLIMATE CHANGE: AN OVERVIEW

(WITH REFERENCE TO INDIA)

Shova Das*

Climate change is one of the most important global environmental challenges facing humanity with implications for food production, natural ecosystems, freshwater supply, health, etc. According to the *A* latest scientific assessment, the Earth's climate system has demonstrably changed on both global and regional scales since the pre-industrial era, Further evidence shows that most of the warming (of 0.1°C per decade) observed over the last 50 years, is attributable to human activities. The climate change issue is part of the larger challenge of sustainable development. The impact of climate variability and change, climate policy responses, and associated socio-economic development will affect the ability of countries to achieve sustainable development goals. The pursuit of these goals will in turn affect the opportunities for, and success of, climate policies. In particular, the socio-economic and technological characteristics of different development paths will strongly affect emissions, the rate and magnitude of climate change, climate change impacts, the capability to adapt, and the capacity to mitigate.

The threat of climate change that led to the Framework Convention on Climate Change (FCCC) at Rio is perceived differently by different countries. The UN Conference on Environment and Development (UNCED) in 1992 at Rio de Janeiro led to FCCC, which laid the framework for the eventual stabilization of greenhouse gases in the atmosphere, recognizing the common but differentiated responsibilities and respective capabilities, and social and economic conditions. The Convention came into force in 1994. Subsequently, the 1997 Kyoto Protocol, which came into force in 2005, reasserted the importance of stabilizing greenhouse gas concentrations in the atmosphere and adhering to sustainable development principles. The Protocol laid out guidelines and rules regarding the extent to which a participating industrialized country should reduce its emissions of six greenhouse gases - carbon

* Lecturer in Economics, Plot No.-71, Krishnayana, Satyanagar, Bhubaneswar

dioxide, methane, nitrous oxide, chlorofluorocarbon, hydrofluorocarbons and perfluorocarbons. It requires industrialized countries (listed as Annex B countries in the Protocol) to reduce their greenhouse gas emissions by a weighted average of 5.2%, based on the 1990 greenhouse gas emissions. The reduction is to be achieved by the end of the five-year period, 2008 to 2012. The Kyoto Protocol does not require the developing countries to reduce their greenhouse gas emissions. Thus, understanding of perceptions and positions of different countries makes it easier to explore possibilities of effective action. The Kyoto reduction, by itself, is inadequate to achieve a stabilization of climate by 2100. A continual and larger reduction, similar to that stipulated in the Kyoto Protocol for the 2008-2012 period, will be needed in the future in order to begin to stabilize long-term greenhouse gas emissions. Even if stabilization of greenhouse gases is achieved, global warming will still continue for several decades and sea levels will continue to rise for several centuries. IPCC studies make it abundantly clear, however, that industrialized countries alone cannot achieve this reduction. The participation of all countries, including the developing countries such as India, is essential for a successful worldwide effort to arrest the growth of greenhouse gas emissions. In the global climate change debate, the issue of largest importance to developing countries is reducing the vulnerability of their natural and socio-economic systems to projected climate change. Their concerns include increasing food security, reducing freshwater scarcity, protecting the livelihoods of forest dwellers, dry land farmers and coastal settlements and reducing health risks.

IMPACT OF CLIMATE CHANGE: INDIA'S CONCERNS

The impact of climate change is projected to have different effects within and between countries. Developing countries have to carefully evaluate the need for, and the roles of global and national institutions in promoting both mitigation and adaptation programmes. Mitigation and adaptation actions can, if appropriately designed, advance sustainable development and equity both within and across countries and between generations.

Indians should be concerned about climate change since this phenomenon might have substantial adverse impacts on them. Not all possible consequences of climate change are yet fully understood, but

the three main 'categories' of impacts are those on agriculture, sea level rise leading to submergence of coastal areas, as well as increased frequency of extreme events. Each of these pose serious threats to India. With the threat of climate change, India is called upon to change its energy strategy based on coal, its most abundant resource, and to use other energy sources (e.g. oil, gas, renewable and nuclear energy) instead, which may turn out to be expensive. Thus, an immediate issue is to come up with a better negotiation strategy such that we have more freedom to decide which type of energy we use, how we generate power, how to reduce methane emissions by agricultural practices or forestry and so on. Negotiations are important for us as a means to reduce or postpone future vulnerability by getting the developed countries to reduce their emissions. By examining the impact on agriculture of different climate change scenarios, one can get an idea of what is tolerable. Rosenzweig and Parry (1994) have estimated significant adverse impact on the agriculture of many developing countries. Using an alternative methodology Kumar and Parikh (2001a) showed that even with farm-level adaptations, the impacts of climate change on Indian agriculture would remain significant. For a developing country, these are very large changes which can cause much human misery. From India's point of view, a 2°C increase would be clearly intolerable. Other developing countries may be even more vulnerable (possibly Bangladesh or Small Island States). Increased occurrence of extreme events due to climate change will also affect the poor most. In the cyclone in Andhra Pradesh in India in 1996, more than 1,000 people died and there was huge property loss. Cyclones of similar intensity in advanced countries like the U.S. may not lead to any deaths and much hardship, due to stable and durable housing and other infrastructure and extended safety net available to the people in distress.

Therefore, developing countries are faced with immediate concerns that relate to forest and land degradation, freshwater shortage, food security and air and water pollution. Climate change will exacerbate the impacts of deforestation and other economic pressures, leading to further water shortages, land degradation and desertification. Increasing global temperatures will result in rising sea levels. Populations that inhabit small islands and/or low-lying coastal areas are at particular risk of severe social and economic disruptions from sea-level rise and storm surges that could destroy cities and disrupt large coastal livelihoods.

The widespread retreat of glaciers and icecaps in the 21st century will also lead to higher surface temperatures on land and increasing water stress. By 2025, as much as two-thirds of the world population, much of it in the developing world, may be subjected to moderate to high water stress. Estimates of the effects of climate change on crop yields are predominantly negative for the tropics, even when adaptation and direct effects of CO_2 on plant processes are taken into consideration. Ecological productivity and biodiversity will be altered by climate change and sea-level rise, with an increased risk of extinction of some vulnerable species.

Even though the ability to project regional differences in impact is still emerging, the consequences of climate change are projected to be more drastic in the tropical regions. This is true for all sectors that are likely to bear the brunt of climate change - sea level, water resources, ecosystems, crop production, fisheries, and human health. The populations of the developing world are more vulnerable as their infrastructure is not strong and extensive enough to withstand a deleterious impact.

In the global climate change debate, the issue of largest importance to developing countries is reducing the vulnerability of their natural and socio-economic systems to projected climate change. Adaptation can complement mitigation as a cost-effective strategy to reduce climate change risks. If adaptation of climate change could be carried out at negligible cost then it may be less expensive, at least in the short-term, than any alternate strategy. Further, there are significant co-benefits of many mitigation and adaptation measures, which need to be estimated. The co-benefits could play a critical role in making decisions regarding the adoption of any mitigation or adaptation strategy.

India is a large developing country with nearly 700 million rural population directly depending on climate-sensitive sectors (agriculture, forests and fisheries) and natural resources (such as water, biodiversity, mangroves, coastal zones, grasslands) for their subsistence and livelihoods. Climate change is likely to have impact on socio-economic systems. The latest high resolution climate change scenarios and projections for India, based on Regional Climate Modelling (RCM) system, known as PRECIS developed by Hadley Center and applied for India using IPCC scenarios A2 and B212 shows the following:

- An annual mean surface temperature rise by the end of century, ranging from 3 to 5°C under A2 scenario and 2.5 to 4°C under B2 scenario, with warming more pronounced in the northern parts of India.
- A 20% rise in all India summer monsoon rainfall and further rise in rainfall is projected over all states except Punjab, Rajasthan and Tamil Nadu, which show a slight decrease.
- Extremes in maximum and minimum temperatures are also expected to increase and similarly extreme precipitation also shows substantial increases, particularly over the west coast of India and west central India.

India has potential to supply substantial mitigation at a relatively low price. Major opportunities exist both on the supply and demand side of energy, in case of carbon emissions. There are also low cost opportunities for mitigation of methane and nitrous oxide. Together with mitigation, UNFCCC also emphasizes adaptation; its Article 4(4) exhorting to assist particularly vulnerable developing country parties in meeting the costs of adaptation to the adverse effects of climate change. The 'Marrakech Accords' have established the Adaptation Fund as an instrument for implementing this requirement in the future. The 'Buenos Aires Programme of Work on Adaptation and Response Measures' adopted by COP10 in 2004, aims to step up the implementation and funding of targeted adaptation activities, as well as activities to address the impact of the implementation of response measures, in developing country parties. These measures notwithstanding, adaptation has received less attention than mitigation in the climate regime. Adaptation is a private or local public good, whereas mitigation is a global public good. The individuals or communities bear the risk wherever there is under supply of adaptation measures. Adaptation costs are the insurance payments and the costs of not addressing adaptation are the damages from unmitigated climate risks. Sustainable development has become part of all climate change policy discussions at the global level. Sustainable development does not preclude the use of exhaustible natural resources but requires that any use be appropriately offset. This concept is not acceptable to many developing countries since it seems to disregard their aspirations for growth and development. Further, sustainable development cannot be achieved without significant economic growth in the developing countries. Three critical components

in promoting sustainable development are economic growth, social equity and environmental sustainability. The question often asked is, should the current economic growth (GNP, employment, etc.) be sacrificed for long-term environmental conservation? Policy makers in developing countries often perceive a trade-off between economic growth and environmental sustainability. However, there is a growing evidence to show that environmental conservation for sustainability of natural resources is not a luxury but a necessity when considering long-term economic growth and development, particularly in the least developed countries. The decline and degradation of natural resources such as land, soil, forests, biodiversity and groundwater, resulting from current unsustainable use patterns are likely to be aggravated due to climate change in the next 25 to 50 years. Africa, South Asia and some regions of Latin America are already experiencing severe land degradation and freshwater scarcity problems21. There are many ways to pursue sustainable development strategies that contribute to mitigation of climate change. A few examples are presented below.

- Adoption of cost-effective energy-efficient technologies in electricity generation, transmission distribution, and end-use can reduce costs and local pollution in addition to reduction of greenhouse gas emissions.
- Shift to renewable, some of which are already cost-effective, can enhance sustainable energy supply, can reduce local pollution and greenhouse gas emissions.
- Adoption of forest conservation, reforestation, afforestation and sustainable forest management practices can contribute to conservation of biodiversity, watershed protection, rural employment generation, increased incomes to forest dwellers and carbon sink enhancement.
- Efficient, fast and reliable public transport systems such as metre-railways can reduce urban congestion, local pollution and greenhouse gas emissions.
- Adoption of participatory approach to forest management, rural energy, irrigation water management and rural development in general can promote sustained development activities and ensure long-term greenhouse gas emission reduction or carbon sink enhancement.

- Rational energy pricing based on long-run-marginal cost principle can level the playing field for renewable, increase the spread of energy-efficient and renewable energy technologies, and the economic viability of utility companies, ultimately leading to greenhouse gas emission reduction.

THE CLEAN DEVELOPMENT MECHANISM (CDM):

The clean development mechanism allows governments or private entities in rich countries to set up emission reduction projects in developing countries. They get credit for these reductions as 'certified emission reductions (CER's). This system is different from the Joint Implementation as it promotes sustainable development on developing countries.

The Clean Development Mechanism (CDM) proposed in the Kyoto Protocol offers developing countries finance and technology by allowing Annex -1 Countries to offset emissions through investing in emissions reduction in non-Annex-1 countries. Apart from the generally recognized problems of appropriate determination of base line, India's concerns relate to 'getting fair compensation for sink projects,ensuring real transfer of technology and an uneasiness about selling "low hanging fruits", i.e., the exploitation of cheap emissions reduction early on in the process by developed countries. India is a large developing country with nearly two-thirds of the population depending directly on the climatesensitive sectors such as agriculture, fisheries and forests. The projected climate change under various scenarios is likely to have implications on food production, water supply, biodiversity and livelihoods. Thus, India has a significant stake in scientific advancement as well as an international understanding to promote mitigation and adaptation. This requires improved scientific understanding, capacity builidng, networking and broad consultation process.

SUMMARY AND CONCLUSIONS :

- India and other developing countries feel strongly that they are not responsible for the threat of climate change that has been created. Unsustainable consumption patterns of the rich industrialized nations in the world are responsible for it.
- Yet, India and other developing country economies may be highly vulnerable to climate change. India's food production would be

adversely affected. Sea level rise would displace a large number of people. The developing countries are particularly vulnerable to the likely increase in the incidence of extreme events. The impacts of climate change could hinder development and delay progress in eradicating poverty, potentially aggravating social and environmental conditions in these countries.

- An analysis of India's emissions show that its per capita emission of carbon is one fourth of the global average. Even the top 10% of urban population emits well below the global average per capita emission.
- If countries like India recognize the environmental, societal and ecosystem benefits of mitigation and value them properly, it would justify incurring large mitigation costs. We need to increase awareness of citizens.
- A more interesting option over the longer term could be to go to a fully fledged emission trading system, which would increase the economic efficiency of long term mitigation and, if emission quotas are allocated in an equitable way, begin to compensate developing countries for any costs that significant mitigation might impose on their developing economies.
- The need for an approach to mitigating the threat of climate change that is equitable and one that can accommodate differing perspectives on risk need to be elaborated. To initiate action now even with differing perspectives of uncertainties and risks that different countries have, we suggest a scheme where a global trading system of carbon emissions with futures market is introduced. The allocations of quotas are made on an equitable basis. However, the total quota will depend upon each country's subjective trajectory that restricts global temperature change to a desired limit, say 2°C. Countries, however, are responsible for their cumulative emissions in carbon-ton-years that they have made and the range of permissible trajectories narrows as our knowledge and understanding improve.

N.B: Annex-1 Countries include the industrialized countries that were members of the OECD in 1992 plus countries with economies in transition. Non-Annex-1 countries are mostly developing countries.

Concluding Remarks:

In the context of the current debate about climate change, it is necessary to show that far from being inactive, the developing countries, especially India, are taking considerable actions in terms of policies, programmes and projects.

Technology transfer can speed up the modernisation process and additional funds can accelerate Government initiatives in energy conservation. However, policies for poverty alleviation must take priority.

REFERENCES

Climate Change 2001: Synthesis Report, Intergovernmental Panel on Climate Change, Geneva, Switzerland, 2001.

Global Environmental Outlook, United Nations Environment Program

Human Development Report: 2003, United Nations Development Programme (UNDP), Oxford University Press, New York. (UNEP), Oxford University Press, 1999.

Kumar, K.S.Kavi, Parikh, J., 2001a.

'Socio-economic Impacts of Climate Change on Indian Agriculture', *International Review for Environmental Strategies,* 2(2).

Mitra A.P. (Ed.), (1992)

Global Change: Greenhouse Gas Emissions in India -1991 Methane Campaign, Scientific Report No. 2, NPL, Publication and Information Directorate, CSIR, New Delhi, India, June 1992.

Parikh Jyoti, (1994)

"North-South Issues for Climate Change", Economic and Political Weekly,pp.2940-2943,November5-12

Rosenzweig, C. and M.L. Parry. 1994

"Potential impact of climate change on world food supply", *Nature,* 367(6450), pp.133-138.

Tenth Plan Document, Planning Commission, New Delhi, 2002.

World Bank, (1992)

World Development Report (1992), World Bank, Washington D.C.

❑❑❑

GHGs AND CLIMATE CHANGE:

A DEVELOPMENT GENERATED DESTRUCTION

Sri Prakash Chandra Panigrahy[1] **Dr. Krishna Chandra Pradhan[2]**

Sunlight which energizes the mother earth passes through atmosphere to reach the surface. In this course a considerable part of the solar radiation is reflected back to space. The rest is absorbed by the surface. Earth's surface in turn radiates heat through the atmosphere in the form of infrared radiation.

The green house effect is a natural atmospheric process caused by the presence of certain gases in the atmosphere that prevent the infrared radiation emitted from escaping from the earth's surface to space. As a result, the temperature of the atmosphere increases, until a new equilibrium between ingoing solar radiation and out going infrared radiation is reached. The process is analogous to the way in which a greenhouse increases the temperature inside. The gases that absorb outgoing infrared radiation are called greenhouse gases (GHGs).

Emissions of GHGs through human activities are sometimes called anthropogenic emissions. These emissions also include certain GHGs that do not exist in nature. The main anthropogenic emissions of concern are three natural GHGs (carbon dioxide, methane and nitrous oxide) and several "man-made" gases including chloroflurocarbons (CFCs), hydrofluorocarbons (HFCs),perfluorocarbons (PFCs) and sulphur hexafluoride (SF6).

Atmospheric concentrations of the natural GHGs can be determined for thousands of years in the past, from ice-core samples in Antarctica. The concentration of these gases in the atmosphere has been increasing because of a variety of reasons. Carbon dioxide in the atmosphere is increasing as a result of the burning of fossil fuels such as coal, oil and, to a lesser extent, natural gases. Certain industrial processes such as

1. Lecturer in Economics, Biju Pattnaik Women's College, Digapahandi , Odisha.-761012.

2. Sr. Lecturer in Economics, Khemundi College, Digapahandi,Odisha.-761012

cement manufacture also emit carbon dioxide. Another source of carbon dioxide is deforestation, e.g. from the conversion of forests to farmland, since trees absorb carbon dioxide through photosynthesis. Methane is emitted from solid waste, waste water, and from certain agricultural activities such as rice cultivation. Certain industrial processes as well as from agriculture and solid waste also emit nitrous oxide. The remaining principal GHGs are emitted by industrial processes and from products that contain these gases.

It is an observed fact that mother earth's temperature has changed considerably during the geological times. This rise of temperature is called Global Warming, which is commonly described as climate change, although global warming is only one of the changes that affect the global climate. his is known from the publications of the Intergovernmental Panel on Climate Change (IPCC).Climate is the average weather of an area. It is the general weather conditions, seasonal variations and extremes of weather in a region. Such conditions which average over a long period – at least 30 years is called climate.

FACTORS LEADING CLIMATE CHANGE

The reasons behind the climate change are natural and man made.

NATURAL FACTORS

a) Continental Drifts

Continents are drifting apart at the rate of 1 mm every year, which is ultimately causing the changes in the climatic system.

b) Volcanoes

Volcanic eruptions results in the release of a large amount of sulphur-dioxide, water vapors, dust and ash into the atmosphere. Gases and dust particles block the incoming rays of the sun, leading to the cooling effect. Sulphur-dioxide combines with the water and form the sulphuric acid. These particles stay in atmosphere for long time, and start behaving like reflectors of the sunlight.

c) Ocean Current

Oceans are the major components of the climate system. They cover around 71% of the Earth. Ocean currents help to move a vast amount of heat across the planet. Winds push horizontally against the

sea and drive ocean current pattern. The **El Nino** event in the Pacific Ocean is affecting the climatic conditions all over the world.

El Nino is a shift in ocean temperature s and atmospheric conditions in the tropical Pacific that disturbs the weather around the world.

El Nino means "**the boy**" in Spanish. It was named after the Christ child since its effects are first felt around Christmas. It leads to the terrible Extremes of weather. The warm phase of the **El Nino** lasts for 8-10 months.

The impacts of the El Nino are

- The famine in the Indoncsia.
- Bush fires in Australia during droughts
- Droughts in California
- Destruction of fishery off the coast of Peru
- Devastating floods in America
- Storm hits in China
- Drought in Australia
- Forest fires in South-East Asia and Brazil

La Nina is the reverse of the **El Nino** event it is the cold event, it is the cooling of water in the Pacific Ocean.

The impacts of the La Nina are:

- Abnormal change in the cooling and heating if the temperature
- Snow and rain in the west coast
- Cold weather in Alaska
- Great increase in the number of hurricanes in the Atlantic.

MAN MADE CAUSES

Rapid industrialization leads to the exploitation of the resources for the construction, industries, transport and consumption. These activities lead to the exploitation of the forest cover, fossil fuels etc. which ultimately lead to the rise on the level of green house gases ion the atmosphere.

a) Green House Gases

Carbon dioxide is the most important green house gas in the atmosphere. Changes in land use pattern, deforestation, land cleaning, agriculture and other activities have all led to arise in the emission of carbon dioxide. Methane is another important green house gas which comes from the animal dung, released from the rice or paddy fields if they are flooded during the mature periods, it is also emitted from the landfills and other waste dumps, incineration activities, oil drilling, coal mining etc. and Nitrous oxide from the fertilizers.

Ozone acts as the green house gas in the atmosphere, which safeguards the planet from the harmful radiation from the sun. Ozone is formed in the troposphere from the reaction of CO, and oxides of N and non-methane hydrocarbons and from chemical feed backs involving methane. Ozone has the dense cover over the equators and decreases over the poles.

Ozone depletion

It was first observed in 1974. The depletion of the ozone layer was clearly seen in the South Pole i.e. Antarctica, where there is a large hole. The depletion of ozone is due to the increasing presence of the CFC's (Chloro Floro Carbons).The process of depletion:

- When CFC's and other ODS;s (Ozone Depleting Substance) releases in the atmosphere
- Winds efficiently mix it with the troposphere and evenly distribute the gases, but ODS's do not dissolve into the atmosphere
- Strong UV radiation break apart the ODS molecules.
- These free atoms destroy the Ozone molecule. One of the chlorine can destroy over 100,000 ozone molecules
- This decrease in the level of the ozone concentration leads to the penetration of more UV radiations, which ultimately causes the ill effects to the human beings.

Depletion in ozone layer causes the fallowing health impacts:

- Skin cancers: non-melanoderma and melanoderma
- Effects on eyes: cataracts
- Photokeratitis (snow blindness)

- Effect on immune system
- Effect on respiratory system
- Effect on food production

There are few activities, of which are responsible for the change in climate:

- Over consumption of the fossil fuels for the electricity generation, extraction of coal and petrol, paper making etc.
- Plastic used in day-top-day life
- Over population

IMPACTS OF CLIMATE CHANGE

(i) Agriculture

- The change in climate will ultimately lead to the alteration in the temperature and rainfall, and indirectly through changes in the soil quality, pests, and disease.
- The rise in temperature is the favorable condition for the pests to complete their reproductive cycles that will
- Put negative effects over the agricultural activities.
- At higher altitudes the rise in temperature is favorable for the agriculture.
- Extreme weather condition such as high temperature, heavy rainfall, floods, droughts, etc. will also affect crop production.

(ii) Weather

- The change in the weather changes the rainfall and snowfall activities.
- Increase in the droughts and floods
- Melting of glaciers and polar ice sheets
- Results in the accelerated sea-rise level
- Increase in the level of evaporation of surface water, will increase the moisture holding capacity of the air.
- Increase in the cyclones and hurricanes

(iii) Sea Level Rise

The heating of the oceans and melting of the glaciers and polar ice sheets result due to the global warming which is increasing the level of sea.

Sea level rise leads to the:

- Loss of land due to inundation and erosion
- Increase in flooding
- Salt-water intrusion
- Adverse effects over the coastal agriculture, tourism, fresh water resources, fisheries and aquaculture, human settlements and health.
- There will be increase in the level the water due to the melting of the glaciers

(iv) Forest and Wild Life

- Ecosystems are the storehouse of the species and genetic diversity. Plants and animals are very sensitive to the changes in the climate.
- Climate change adversely affects the ecosystems at the high latitudes, the tundra forests, Polar Regions.
- Animals living in the Alpine region are very much susceptible to the change in climate.
- Migratory birds from the cold regions of the world are affected badly due to changes in the climate; these changes affect the flight pattern and feeding points during the flight.

(v) Marine Life

- Changes in the climate lead to the damage to the coral reefs in the ocean water, changes in the temperature causes the bleaching of the corals.
- Zooplanktons, fishes and sea birds are facing the reduction in number.

(vi) Impacts on Human Beings

- Extreme weather events cause the respiratory and cardiovascular disorders.

- Ecological imbalance,, changes in food production levels, increase in distribution level of malaria and other vector born diseases
- Changes in climate especially in temperature, humidity and precipitation influence the lives of living organisms and lead to spread of the infectious diseases
- Rise in water level results in floods which ultimately lead to the deaths
- Rise in level of photo chemical oxidants
- Decrease in level of Ozone layer results in the exposure of the UV radiations of sun which lead to the problem of the cancer

GLOBAL RESPONSE TO GLOBAL WARMING

Climate change first gained significant attention in 1988. Not long afterwards, the United Nations Framework Convention on Climate Change(UNFCCC) was adopted by various government representatives in May 1992, and came into force in 1994 (UNFCCC 1994). Today, the UNFCCC is one of the most widely supported international environmental agreements ratified by 188 states and the European Community.

The ultimate objective of the UNFCCC is to achieve stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. Countries that are parties to UNFCCC are classified into two categories, giving rise to a third category including those countries that do not belong to the first two categories. They have different commitments imposed on them.

INDIA'S STAND ON THIS ISSUE

Climate-related consequences of climate change have already been felt in India, and their impact, including future projections, has been documented in the national communication. Of course, even before climate change, these climate-related phenomena had an impact, and measures could be justified to reduce the impact of floods, droughts, etc.

Some of these measures are as old as India. Our sacred books prohibit the cutting of Shiva's hair for they are the forests of India. According to our myths, only Shiva's hair could withstand the force of the Ganges falling from the skies. When *Ganga Maa* falls to Earth from heavens above, Shiva's hair- India's forests –Gently stops the huge mass of water, which is then absorbed by the vegetation and soil little by little.

The fundamental cause of climate changes is the increased consecration of greenhouse gases in the atmosphere. As long as the concentration of GHGs keeps increasing, there will be the impact of climate change. Many studies have demonstrated increased damage from climate change, and project this trend would continue even if GHG concentrations can be stabilized. Many mitigation options provide other benefits, and often the action can be justified in terms of these co-benefits alone.

The following list is illustrative:

(i) ***Energy efficiency*** saves money, natural resources, and often benefits the local environment,

(ii) ***Many renewable energy options*** are suitable for rural areas and can be an instrument for promoting rural development. India already has been promoting rural development. India already has been promoting renewable energy for many years. It is probably the only country to have a ministry for non-conventional energy sources or to have a development bank to promote renewable energy investments : the Indian Renewable Energy Development Authority (IREDA)

(iii) ***Large-scale wind power*** can supply clean electricity to the grid. Through India is not gifted with excellent wind resources, the country has identified windy areas and already has one of the highest installed capacities in wind power,

(iv) ***Switching fuels*** can reduce GHGs while reducing local air Pollution. Again, India has taken major steps to convert urban vehicles to natural gas. While the main motivator was reducing local air pollution, natural gas combustion produces far less CO2 emissions than petrol or diesel. Integrated transport design can reduce energy use, local air pollution, congestion, and damager from traffic accidents and

(v) ***Improved agricultural practices*** can reduce methane emissions from cattle and rice cultivation, at least per unit of output.

(vi) Other steps like; ***planting more trees, reducing beef products, stabilizing population growth, removing atmospheric CO_2 by utilizing photosynthetic algae, increasing Nuclear Power Plants for electricity production*** etc.

CONCLUDING OBSERVATIONS

It is proposed that India should invest some percent of the annual damage from climate change each year in order to adapt to the consequences, and mitigate the causes, of climate change. Besides all the countries have to take preventive steps to stop the changes occurring in the climatic system. Bring down the activities of deforestation, fossil fuels, cut down the consumerism and use of the more environment-friendly agricultural methods. Cut down the use of the coal and sources of the clear energy. Biotechnology can be used to reduce the water requirement of the crops, increase crop yield, and reduce the use of chemical fertilizers and pesticides.

Selected References

Kaushik Anubhab & Kaushik C.P. (2005): *Perspectives in Environmental studies, New Age International Publications, New Delhi.*

Eco Club, Paper published by Indian Environmental Society, New Delhi.

Dutt Gautam & Gaioli Fabian (2007): *Co ping with Climate Change, EPW Vol. XLII No.42*

Pakala S & R Socolow (2004): *Stabilization Wedges Solving the Climate Problems for the Next fifty years with the Current Technology, Science, 305 (5686) August 13 pp 968-72.*

IIPC Reports on Climate Change

Pradhan K.C.& Panigrahy P.C (2008) *Forest and Mothers: Concerns with Hopes, Paper presented in the National Seminar at Savitri Women's college , Bhanjanagar Odisha.*

❑❑❑

CLIMATE CHANGE ISSUE: THE NEED FOR INDIA'S ROLE

— AT THE NATIONAL AND INTERNATIONAL LEVEL

Sanjukta Das*

INTRODUCTION

Climate disasters have been a recurrent theme in human history. They are increasing in frequency and touching the lives of more people. Some 262 million people were affected annually from 2000 to 2004, more than double the level in the first half of the 1980s. The heart of the climate change problem is that the Earth's capacity to absorb carbon dioxide (CO_2) and other greenhouse gases (GHGs) is limited. Humanity is living beyond its environmental means and running up ecological debts that future generations will be unable to repay. The window of opportunity for successful mitigation is closing. There is a growing concern over the issue of climate change. Concerns are relating to the strategies to be adopted for mitigation of climate change. However, there are differences among the developed and the developing countries relating to the actions to be taken by them in this regard.

India, being one of the important developing countries, with a population of more than one billion, has an important role to play in halting the process of climate change and in designing the coping strategies. In this paper an attempt is made to analyse the role India needs to play to take care of the interest of its own citizens as well as that of the poor of the world. At first it describes the emerging risks and vulnerabilities of climate change in general, the need for quick action, the mitigation strategies and coping mechanisms. Then it analyses the climate change risks and vulnerabilities to India. This is followed by a discussion of India's role at the international level to arrest the emission of GHGs and assistance to the developing countries for climate change.

* Reader in Economics, Sambalpur University

Finally it also discusses the strategies to be adopted within the country for reducing emission and lessening vulnerabilities.

CLIMATE RISK AND VULNERABILITY

There are large risks in but differential vulnerability to climate change. An inverse relationship is found between the emission of pollutants causing climate change and the vulnerability to its impacts. Rich countries, with 15 percent of world population, account for almost half of emissions of CO2-High growth in China and India is leading to a gradual convergence in 'aggregate' emissions. However, per capita carbon footprint convergence is limited. The carbon footprint of the United States is five times that of China and over 15 times that of India. But public debate in rich nations increasingly highlights the threat posed by rising greenhouse gas emissions from developing countries. They are concerned over the rise in CO2 emissions from India for climate security. But that perspective is very partial. The number of people in India living without access to modern electricity is around 500 million—more than the total population of the enlarged European Union. These are the people who rely on firewood or animal dung for cooking. While access to energy is increasing across the developing world, progress remains slow and uneven, holding back advances in poverty reduction. Rich countries even view that, large emissions of methane gas from the paddy fields of developing countries contribute to climate change. However, the empirical basis of these estimates was questioned; subsequently experimental measurements by Indian researchers showed that these doubts to be well-founded (Mitra, 1992, 1996).

It is a fact that, while the world's poor walk the Earth with a light carbon footprint they are bearing the brunt of unsustainable management of our ecological interdependence. Their high levels of economic dependence on agriculture, lower average incomes, already fragile ecological conditions, and location in tropical areas that face more extreme weather patterns — increase their vulnerability. Thus, living in vulnerable rural areas and urban slums, these poorest billion are highly exposed to climate change, the threats for which they carry negligible responsibility. In the Organisation for Economic Co-operation and Development (OECD) countries one in 1,500 people was affected by climate disaster. The comparable figure for developing countries is one in 19—a risk differential of 79.

In rich countries, coping with climate change to date has largely been a matter of adjusting thermostats, dealing with longer, hotter summers, and observing seasonal shifts.

But high levels of poverty and low levels of human development limit the capacity of poor households to manage climate risks. With limited access to formal insurance, low incomes and meager assets, poor households have to deal with climate-related shocks under highly constrained conditions. These risks force people into trade-offs that limit substantive freedom and erode choice. The forced trade-offs that follow climate shocks can rapidly erode human capabilities, setting in train cycles of deprivation. Producers in drought prone areas often forego production of crops that could raise income in order to minimize risk, preferring to produce crops with lower economic returns but resistant to drought. When climate disasters strike, the poor are often forced to sell productive assets, with attendant implications for recovery, in order to protect consumption. And when that is not enough households cope in other ways: for example, by cutting meals, reducing spending on health and taking children out of school. These measures can create lifelong cycles of disadvantage, locking vulnerable households into low human development traps. There are five key transmission mechanisms through which climate change can halt and then reverse human development:

- Loss in Agricultural production and rise in food insecurity;
- Water stress and water insecurity;
- Rising sea levels and exposure to climate disasters;
- Effects on Ecosystems and biodiversity loss;
- Rising health problem.

The case for action

Business-as-usual trajectories will take the world well beyond the threshold. If the world acts now it will be possible– just possible– to keep 21st Century global temperature increases within a 2°C threshold above pre-industrial levels. The starting point for avoiding dangerous climate change is the recognition of three distinctive features of the problem. The first feature is the irreversibility and cumulative outcomes of climate change. Once emitted, carbon dioxide (CO_2) and other greenhouse gases stay in the atmosphere for a long time. There are no

rapid rewind buttons for running down stocks. It has wide-ranging implications. Urgency is the second feature of the climate change challenge—and a corollary of inertia. Every year of delay in reaching an agreement to cut emissions adds to greenhouse gas stocks, locking the future into a higher temperature. The third challenge is its global scale. The Earth's atmosphere does not differentiate greenhouse gases by country of origin. No one country can win the battle against climate change acting alone. Collective action is not an option but an imperative. Political momentum is now gathering pace. And dialogue between developed and developing countries is strengthening. But practical outcomes are less impressive. With the expiry of the current commitment period of the Kyoto Protocol in 2012, the international community has to devise a framework for emission reduction and to follow it. Developed countries have to take the lead. They carry the burden of historic responsibility for the climate change problem. And they have the financial resources and technological capabilities to initiate deep and early cuts in emissions. The principle of "common but differentiated responsibility" does not mean that developing countries should do nothing. The credibility of any multilateral agreement will hinge on the participation of major emitters in the developing world like China and India. However, they are to make the transition to a low-carbon growth path at a rate consistent with their capabilities.

Strategies for mitigation

Climate change mitigation is about transforming the ways that we produce and use energy. And it is about living within the bounds of ecological sustainability. Setting credible targets linked to global mitigation goals is the starting point for the transition to a sustainable emissions pathway. Then translating targets into policies is politically more challenging. Most developed countries are falling short of the targets set under the Kyoto Protocol.

Enhanced energy efficiency has the potential to deliver a 'double dividend'. It can reduce CO_2 emissions and cut energy costs. If all electrical appliances operating in OECD countries in 2005 had met the best efficiency standards, it would have saved some 322 Mt CO_2 of emissions by 2010— equivalent to taking over 100 million cars off the road. Low levels of energy efficiency in developing countries are currently a threat to climate change mitigation efforts. Raising efficiency

levels through international cooperation could transform that threat into an opportunity, generating large- gains for human development in the process. A model is proposed in HDR-2007-08, UNDP under the auspices of the post-2012 Kyoto framework, of a Climate Change Mitigation Facility (CCMF) which would mobilize US$25-50 billion annually to finance low-carbon energy investments in developing countries.

The automobile sector accounts for about 30 percent of greenhouse gas emissions in developed countries—and the share is rising. Regulatory standards matter because they can influence fleet efficiency, or the average number of miles travelled per gallon (and hence CO_2 emissions). Personal transportation is another area where regulatory standards can unlock double- dividends.

Coal is the major source of power for electricity generation worldwide. Rising prices of oil and natural gas have increased the use of thermal energy in countries like China, India and the United States. Carbon Capture and Storage (CSS) is a key breakthrough technology and it holds out the promise of coal-fired power generation with near-zero emissions.

Deforestation is another key area for international cooperation. Currently, the world is losing the carbon assets contained in rain forests at a fraction of the market value they would have even at low carbon prices. In Indonesia, every US$1 generated through deforestation to grow palm oil would translate into a US$50- 100 loss if the reduced carbon capacity could be traded on the European Union's ETS. Beyond these market failures, the loss of rain forests represents the erosion of a resource that plays a vital role in the lives of the poor, in the provision of ecosystem services and in sustaining biodiversity. There is scope for exploring the potential of carbon markets in the creation of incentives to avoid deforestation. More broadly, carbon finance could be mobilized to support the restoration of degraded grasslands, generating benefits for climate change mitigation, adaptation and environmental sustainability.

Adapting to the climate shocks

For too long, climate change adaptation has been treated as a peripheral concern, rather than as a core part of the international poverty reduction agenda. For the first half of the 21st Century there is no alternative to adaptation to climate change. But there are inequalities

in capacity to adapt to climate change. Rich countries have already recognized the imperative to adapt and have acted accordingly. In the absence of Government action, poor people themselves are forced to bear those. Governments can play a critical role in creating mechanisms that build resilience, support pro-poor risk management and reduce vulnerability. Policies in these areas can create an enabling environment for human development. But Governments of developing countries face severe challenges. They lack the capacity and the resources to assess climate risks. Many of them lack the financial resources required for infrastructural adaptation. The foundations for successful adaptation planning can be summarized under four 'i's:

- ***Information*** for effective planning;
- ***Infrastructure*** for climate-proofing;
- ***Insurance*** for social risk management and poverty reduction;
- ***Institutions*** for disaster risk management.

Following the publication of the Stern's Review on *The Economics of Climate Change*, most governments also accept that the solutions to climate change are affordable—more affordable than the costs of inaction. Between now and 2030, the average annual cost would amount to 1.6 percent of world GDP. This is not an insignificant investment. But it represents less than two-thirds of global military spending. The costs of inaction could be much higher. According to the Stern Review, they could reach 5-20 percent of world GDP, depending upon how costs are measured (HDR UNDP-2007-08).

Climate Change Risk to India

. The Intergovernmental Panel on Climate Change (IPCC) in its 2001 Report predicts temperature rise by 2.7-4.3 degrees Celsius for India by the 2080s. The panel also predicted an increase in rainfall over the sub-continent by 6-8 per cent and that sea level would rise up to 88 centimeters by 2100. Local climate change will affect the region in various ways. Changing rainfall patterns are likely to affect food security. Extreme events, such as droughts, torrential rain, flash floods, cyclones and forest fires, could become more common. Rising sea levels could threaten coastal mangrove and wetland systems, and increase the flood risk faced by the quarter of India's population that lives on the coast. Climate change could also threaten human health by favouring water- and vector-borne diseases such as cholera, malaria and dengue.

Mitra estimates that by the 2080s, climate could support breeding mosquitoes ten per cent more in Indian states.

Simulations of the future scenarios indicate that there will be an overall decrease in the number of rainy days over a major part of the country. The decline will be greatest — more than 15 days — in the western and central parts of the nation. Such impacts will be most evident after 2040s, when maximum temperatures may increase by 2-4°C from the 1994 levels. Models, in fact, indicate that minimum temperatures may also rise by 4°C across the country. Such dramatic increases will result in more severe droughts and acute water scarcity. The forest ecosystem would be worst affected — by 2050, about 70 per cent of the vegetation is expected to be less than optimally adapted to its existing location, making it vulnerable to increased biotic stresses.

Some impacts of global warming have already become visible in India. The rising temperatures have already taken their toll on the country. With global average surface air temperature increasing by 0.4°C during the past 100 years, there has been a 10-12 per cent increase in monsoon rainfall along the west coast and northwest of India and in the north Andhra Pradesh. But a decline of six to eight per cent of the same has been observed over east Madhya Pradesh and adjoining areas and the northeast and parts of Gujarat and Kerala. Between 1998 and 2007, India has lost more people due to extreme weather events caused by climate change than any other country. A well-known German NGO has calculated that on an average 4,532 people were killed every year due to climate risk in India. This amounts to monetary losses of $12 billion a year on an average in terms of purchasing power parity, representing 0.62 percent of India's GDP.

Need for India's Action

India should be concerned about potential climate change for its own sake and should take steps for halting the process of global climate change. In this context it has the responsibility of cutting GHG emission domestically and put pressure on others for the same.

Although India has signed the UN Framework Convention on Climate Change (UNFCCC) in June 1992, it has no binding commitment to reduce greenhouse gas emissions because it is a developing country. On June 21, 2004, the Indian government released its first 'National Communications' report on climate change. It is the country's first

'official' document detailing the emission levels of greenhouse gases, and their present/future impacts. As per the report, in 1994 — the base year — 1,228,540 gigagrammes of greenhouse gases were emitted from India, resulting in a per capita emission of about 1.3 tonnes. The report concludes by stating that comprehensive planning is required to ensure that the least percentage of the population is affected. "At present, we practically have no policies related to adaptation and mitigation, despite millions of people at risk", says Subodh Sharma, national project director, National Communications Project, the Union ministry of environment and forests.

In India, due to the natural growth of population, rural urban migration and rise in per capita income, the demand for power and transport have increased many folds. The total number of different types of vehicles has increased over time in the country. The decadal growth rate of all vehicles is more than 200 percent from 1951 to 2001. However, it was highest during 1981 - 91, approximately 400 percent. In case of two wheelers the rates are higher than those of all vehicles, but in this case it was more than 650 percent increase during 1961 to 1971. In 1981 to 1991, it increased by around 550 percent. Though this vehicular growth is accompanied by the growth of gross domestic product, it is higher than the economic growth rate. Moreover, rising growth rate raises the use of personal vehicles rather than the common transports. Automobile sector in India is not environmentally conscious. Under the project rating scale, the best company of India gets less than 45 per cent marks and the sector as a whole gets even lesser, scoring 31.4 per cent. Economists and scientists are to develop ways to cut emissions incrementally over several years. The 'carbon-intensity' of world GDP has been falling over the past two-and-a-half decades, however, the decline in carbon intensity has stalled since 2000, creating further upward pressure on emissions.

The World Resources Institute, a US-based environmental think tank, estimates that by 2025, India will rank fourth in the world for total greenhouse gas emissions. But there are arguments that India cannot simply give up industrialisation. "Imposing restrictions on development will affect the GDP. A 30 per cent reduction in carbon dioxide emissions will raise the number of poor by 17.5 per cent," explains Manoj Panda, a professor at the Indira Gandhi Institute for Rural Development in Mumbai. About a third of India's population lives below the poverty

line, earning less than US$1 a day. India's development strategy focuses on strengthening the economy and alleviating poverty, aiming to increase Gross Domestic Product (GDP) and per capita income. But as India struggles to develop its economy, rising industrialisation and urbanisation will rapidly increase greenhouse gas emissions, which trap heat and contribute to global climate change. According to A. P. Mitra, emeritus scientist at Delhi's National Physical Laboratory and former director general of the Council of Scientific and Industrial Research, a four-fold increase in the country's GDP would require a 2.8-fold increase in carbon dioxide emissions, 1.3 times more methane and 2.6 times more nitrous oxide unless action is taken. However, "sustainable development must address issues of food, nutrition and energy deficits," says M. S. Swaminathan, Chairman of Chennai-based M. S. Swaminathan Research Foundation (MSSRF).

An added concern is the fast pace of international negotiations. India needs to come up with a better negotiating strategy on energy use and methane emissions and set suitable standards for acceptable risks. India needs to tell the industrialized world how it wants the entire world to deal with this global catastrophe, already beginning to hurt it. When attacked and pressured in different meetings by the developed countries it should remind the developed countries their past and present emissions, their inaction and low actions to cut GHGs. It should also ask their planning of emission reduction to meet the Montreal Protocol requirements. It should organize the developing countries on this issue to have more pressure on the developed countries. It should also tell that it is serious about climate change; is aware of cutting emissions and already doing a lot, at her own considerable cost and pain. For instance, it is targeting the coal, transport, petroleum, steel, cement and agricultural sectors by promoting energy conservation, alternative fuels, renewable energy technologies and afforestation. In 2001, Delhi was the first capital city to introduce a public transport system based on an alternative fuel (compressed natural gas) to reduce polluting gases. India is planning to fund public transport buses, not private cars, as part of its financial stimulus plan, a move that will transform mobility patterns and reduce emissions in the years to come. The Union ministry of urban development, managing this programme, has already announced that purchase of buses would require cities to undertake internal reform, including compulsory waiver of taxes on public transport and increased

taxes on private cars. This car-restraint strategy even the richest have not attempted. We are also learning the great leapfrog - jumping the fossil fuel trajectory by cutting before we add to the emissions pool. For instance, large numbers of Indians, particularly poor and energy - insecure, have already jumped to using compact fluorescent lamps (CFLs), side-stepping the inefficient bulb. Many states are undertaking this programme - to push for efficiency - at their own cost; these appliances are more expensive than what we currently use. In other words, we are not waiting to first get rich and then move towards a low - carbon trajectory, as the western world has done. This is not to say we are doing enough or cannot do more. Resource constraint remains a hindrance in this context. We need funds to be able to move faster, to make investments today, not tomorrow. We can, and would like to, build solar powered facilities that would substitute the coal - powered stations of the future. But this energy source is expensive. Developed countries should bear the moral responsibility provide financial help for that. The Indian government should make this clear: we are not the climate renegades. We can change. We are ready to believe.

Adapting to the inevitable

India should also take some steps to reduce the impact of climate change on the poor. Creation of public infrastructure like multi-purpose shelter houses in flood prone areas, creation of grain banks in climate risk areas, setting up of infrastructure for prior information of climate related occurrences and provision of social insurance for the poor — are some of such requirements which Government should provide. National programmes to improve watershed and ground water management may qualify as adaptation strategies. Swaminathan suggests the setting up local gene and seed banks, monsoon management systems, and even crop-weather watch groups to help local farmers and fishermen prepare for droughts and floods.

Small efforts are underway. Some non-governmental organisations have already begun assessing the risks of climate change to local communities. The Energy Resources Institute (TERI) in Delhi has studied climate-sensitive regions of India to assess the dual impacts of climate change and globalisation. But these are small steps forward. The road ahead is long for India.

Bibliography

Bose, R K1998, 'Automotive Energy Use and Emission Control: A Simulation Model to Analyze Transport Strategies for Indian Metropolises'. *Energy Policy, vol 26, no 13.*

Government of India, 2003, *'INDIA-2003: A Reference Manual 'of Ministry of Information and Broadcasting.*

Planning Commission, Govt. of India, 1994, *Perspective planning for Transport Development, Report of Steering Committee, Energy Policy Division.*

Ray, Amit. 2001, Control of Vehicular Pollution through Regulation and Technology, in *Indian Journal of Transport.*

UNDP, 2007, *Human Development Report 2007/2008Fighting Climate Change: Human Solidarity in a Divided World*

❑❑❑

CLIMATE CHANGE – A CALL FOR AN ALTERNATIVE DEVELOPMENT PARADIGM

Dr. Dilip Kumar Panda[1] **Sri Narendra Kumar Behera[2]**

While brooding over the crisis of World's environment which is being faced for the last one century in particular it is apt to remind the statement of Mahatma Gandhi that "The Earth provides enough to satisfy everyman's needs, but not for anybody's greed'. Perhaps the development paradigm adopted globally has failed to recognize it properly.

The environment has become affected due to human activities, thousands of year ago, by burning and felling trees and performing agricultural activities on the soil. But probably until the last century man had little effect on climate, although it has begun with the industrial revolution. The effects of human activities on the planet have accelerated the pace of climate change during the last one century in a more aggressive and disproportionate manner. The rich countries and the rich people of the poor nations are largely responsible for the climate change in numerous ways but the brunt of climate change is likely to be largely borne by the less developed countries and the poor people of the underdeveloped countries. In India the richest class produces 4.5 times more Co_2 than the poorest class and almost three times more than the all India average. This is true for both in case of developed as well as developing nations. The problem of environment/ecology needs a broader perspective of the globe rather than from the point of view of any particular nation or individual sector. The natural bodies like air, water, soil, forest are adversely affected by the anthropogenic actions

1. Reader in Economics, P.G. Department of Economics, G.M. College, (Autonomous), Sambalpur

2. Lecturer in Economics, Department of Economics, Larambha College, Braja Vihar, Larambha, Bargarh-768102

to conquer the world to scale higher and higher ladder of economic development. The aggressive economic activities of the west followed by the developing countries like India, China and many more have contributed largely to the problem of environmental degradation and global warming. The industrial emission, chemical waste, vehicular emission , agricultural activities, all have led to compound degradation of air, water & soil. The developed countries are the prime actors towards the cause of global warming, followed by unchecked population growth in the developing countries which has negatively affected the nature's balance.

CAUSE OF CLIMATE CHANGE:-

Issues involved in climate change are multidimensional in nature such as depletion of ozone layer, GHG effect, acid rain, deforestation, biodiversity, and many other related factors which are directly or indirectly helping in bringing climate change in the globe. The increase in carbon dioxide @ of about 0.4% per annum is alone responsible for about half of the GHG effect. Nitrous oxide which forms largely due to use of nitrogenous fertilizers fossil fuel combustion, biomass burning is also responsible for about 6% GHG effect. The CFC represents about 15% of GHG effect.

Industries in general consume nearly 40 percent of the world's energy and cause 50% of the total emission of world's $Co_{2,90}$ percent of world's So_2 and almost all toxic chemicals discharged to water bodies, soil, and air. The demand pattern in the developing countries like India, Pakistan particularly the growth of automobile sector in the last five years has alone contributed to 4% of industrial pollution of large-scale industries. Although industrial pollution may come out from localized sources but its impact may spill beyond the geographic and administrative jurisdictions. The growth of industries and factories along with the growth of output are a great consolation, but increases in the anxiety of the earth in the form of pollution and warming many a time are matters of great worries. It is estimated that about 85 million barrels of oil are used everyday in the world. As a result the oil price is surging and emission is increasing everyday.

The Environmental Kuznet Curve(EKC) which tells that environment get worse treatment at the initial stage of economic development but once the economy reaches a peak level of development

, treatment to envi onment reverse and the quality improves. Thus it claims that let us get rich first and clean up the environment later . But empirical evidence perhaps fails to support the EKC. This claim of high per capita income and clean environment is not substantiated by the economic growth of the West. Thus this model can not help in reducing the problem of climate change.

EXPRESSING CONCERN FOR GHG:-

The emission of GHG into the atmosphere has become a world wide concern at least for scientists, environmentalist, social workers, researchers and the people at large who are working for a clean environment. The GHG effects environment slowly but surely in the long run i. e. a secular dimension of time horizon do necessarily mean the policy action right from the present day development paradigm. The long run effects of pollutants like GHG, methane carbon dioxide etc. are dangerous, chronic and cumulative as well. The insidious effect should be tackled before it becomes uncontrollable. In London burning of coal was considered as a major cause for air pollution as early as fourteenth century. But the nineteenth century saw great expansion of chemical industries which led to the setting up of the Alkali Inspectorate in Britain in 1863 and the first comprehensive legislation to control the emissions from factories. Control of domestic fires did not come until much later. It required the 'smog' of 1952 which led to 4000 deaths in London to bring this source of air pollution under effective control with Clean Air Act of 1956. Water Pollution Control commenced somewhat earlier. As the great towns of England grew in the early years of the nineteenth century, the death rates from water–transmitted fevers rose dramatically. The great sanitary reforms initiated by Edwin Chadwick in 1842-43 led to the Public Health Act of 1848, a land mark in the provision of safe water in cities. (Munn, 1979, p6)

So also in 1912, American President Roosevelt embarked on a series of proclamation for the preservation of natural ecosystem. The post World War II saw a series of rapid expansion of industrial and commercial activities in developed and developing countries of Europe and Asia without expressing much concern to environment. Although number of countries have legislation to preserve and protect natural ecosystem but failed to implement adequately in the face of strong profit oriented private sector. And in the age of LPG the urge for profit has

further intensified. The US enacted the comprehensive legislation of National Environmental Policy Act 1970 on January 1, 1970.

India following the proclamation adopted by the United Nation Conference on Human Environment, held in Stockholm in June 1972 has come up with a number of legislations to take of the environment.

Numerous global summit and national meet have been organized from time to time to deal with the issue in a more effective manner. But no conclusive actions have so far been taken due the conflicting interest of the developed and developing countries. It is a naked fact that climate change has a global impact not withstanding with its sources of emission of GHG or depletion of ozen layer or the acid rain. Hence it is not possible to control with the individual country's effort but requires the concerted whole hearted action by all the global players engaged directly or indirectly in the generation of GHG. To work out over this global problem the several conventions have been held and yet the emission of Co_2 in the world are going up by 3 percent. The newly industrial countries like India and China don't want to discuss much of climate change because these countries also want to enjoy the natural resources as the West did. So also the oil exporting countries want to become richer by exporting more and more of oil bothering least to the cause of GHG. The only escape from the emission due to fossil fuel is to curb demand, which is a very hard task.

The 190-nation talks on global warming have faced deadlock over the issue of emission goals with the developed countries particularly the US, Japan and Canada who opposed to any reference to a set of numerical goals for emission. The Bali's Talk (Dec.3-14, 2007) shows a divide over the issue of reducing emission level by 2020 by the US and European Union. These industrial countries oppose to the cut of emission, mainly from burning fossil fuels of 25 to 40 percent below 1990 level by2020.In the very recent past (13th Dec.2008) to tackle the global recession the European Union has sealed the agreement on climate change and global warming so as to carry out industrial output with out bothering about its impact on climate. This shows that the economic growth precedes climate change. Climate change must concede every individual for a minimum quantity of emission for growing food, to prepare food or to purify water access to electricity and technological benefits.

To sum up over the issue of climate change, the prevailing levels of economic development and pattern of pollution patterns constitute the basis for regulation with global warming law which will be of little real effects due to hectic political and economic consideration. An equitable and effective global warming regime should be based on an all together separate paradigm that takes into consideration of a large number of variables. The initial point of global warming should base on human benefit that ensures a healthy global environment for all living beings on the earth. The implementation of laws against polluters is an imperfect one and allows leakages knowingly or unknowingly.

❑❑❑

GLOBAL WARMING & RESULTS OF CLIMATE CHANGE IN ORISSA

Manoj Kumar Hui*

INTRODUCTION:

Climate change is a global phenomenon which invites the attention of the climatologists & economists at the present time. Life on the earth exists because certain gases like Carbon Di-Oxide, Methane & Nitrous Oxide play a key role in maintaining heat balance in atmosphere. These green house gases (GHGs) act like a blanket. They prevent much of the absorbed solar heat from escaping into the atmosphere. This natural phenomenon keeps the Earth warm enough to sustain life. Problem arises when the concentration of GHGs starts increasing due to human activities. Burning fossil fuels like coal 85 oil to derive energy & deforestation are the examples of such activities. As the world became heavily dependent on Carbon-based fossil fuels, the Earth's temperature has increased consistently leading to Global Warming 85 Climate Change. Unsustainable consumption patterns of the rich industrialized nations are largely responsible for the threat to our climate. Only 25% of the global population lives in these countries, but they emit more than 70% of the total global carbon di-oxide (CO_2) emissions. In per capita terms, the disparities are also large. An Indian citizen emits less than 0.25 tonnes of carbon per year whereas a citizen of the U.S.A. emits more than 5.5 tonnes. Growth in India is expected to cause energy consumption to quadruple from 2005 levels by the year 2030. If current trends continue, most of this energy will be produced from coal-fired power plants, making India one of the top three green house-gas-emitting countries by 2025. But, with per capita emissions only 6% that of the average U.S. American, India argues that Industrialized nations are solely responsible. Large emissions of 'Methane' from our paddy fields may be a threat to our climate but

* Lecturer in Economics, D.L. Degree College, Bahalda, Mayurbhanj

Agarwal 85 Narain (1991) argue that emissions by poor who live on the margin of subsistence should be considered a basic human right. The power sector is responsible for the highest direct CO_2 emissions in India (42%), followed by iron 8& steel, road, railways, air transport 8& coal. (Parikh 1993).

RESULTS OF CLIMATE CHANGE IN ORISSA :

For the first time in 1999, Indian Meteorological Department officials acknowledged that there was something wrong with the climate of Orissa. They noticed that the state's ecology & weather conditions have undergone a dramatic change due to population explosion, rapid industrial growth & massive build up of economic & social infrastructure. Orissa's seasons have all but vanished, its trees have altered their flowering time, its birds have changed their mating habits, and people are resorting to strange measures to cope with the changes. The global focus on climate change has awakened the feeling that people of Orissa could be paying the price for it. The state's fluctuating weather conditions suggest, it is reeling under climatic chaos. For more than a decade now, it has experienced contrasting extreme weather conditions : from heat waves to cyclones, from droughts to floods.

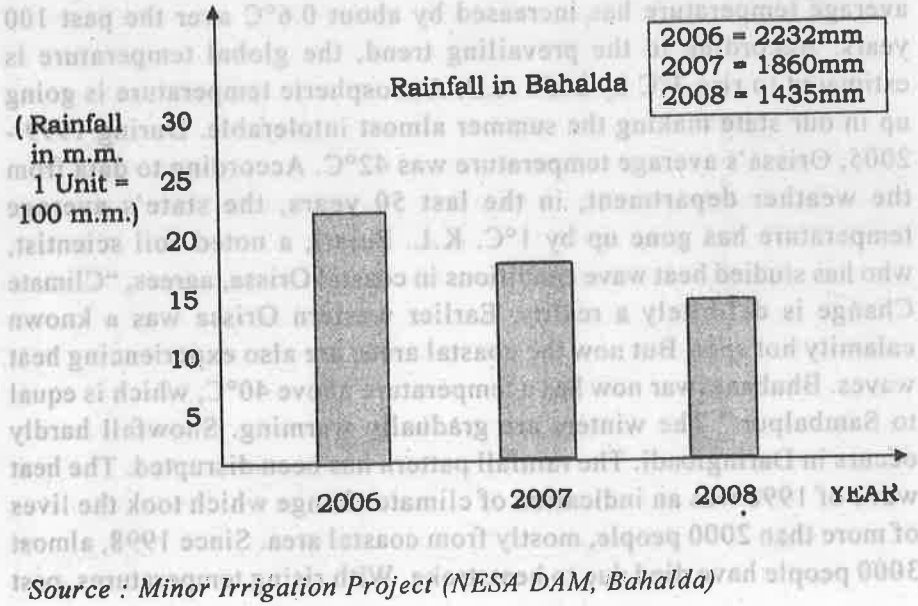
TEMPERATURE RISE IN ORISSA :

Temperature is one of the key parameters of climate. Global average temperature has increased by about 0.6°C aver the past 100 years. According to the prevailing trend, the global temperature is estimated to rise 3°C by 2050 A.D. Atmospheric temperature is going up in our state making the summer almost intolerable. During 1999 - 2005, Orissa's average temperature was 42°C. According to data from the weather department, in the last 50 years, the state's average temperature has gone up by 1°C. K.L. Pujari, a noted soil scientist, who has studied heat wave conditions in coastal Orissa, agrees, "Climate Change is definitely a reality. Earlier western Orissa was a known calamity hot spot. But now the coastal areas are also experiencing heat waves. Bhubaneswar now has a temperature above 40°C, which is equal to Sambalpur." The winters are gradually warming. Snowfall hardly occurs in Daringibadi. The rainfall pattern has been disrupted. The heat wave of 1998 was an indication of climate change which took the lives of more than 2000 people, mostly from coastal area. Since 1998, almost 3000 people have died due to heatstroke. With rising temperatures, pest

population significantly increases because warmer & moist conditions are highly conducive to them. Higher temperatures also speed up the life cycle of both the mosquito & disease organisms they harbor & make adult mosquitoes bite more often. The state accounts for 15 - 22 % of malaria cases in the country & 40 - 50 % malaria related deaths. At 20°C, mosquitoes take 26 days to breed. This period reduces to 13 days when the temperature rises to 25°C.

CHANGE IN RAINFALL :

In Orissa, most years prior to 1950s received normal rainfall which has become more erratic since 1960s; most years recorded below normal rainfall. The numbers of rainy days has come down to around 60 days from 120 days. Low-pressure is becoming a regular phenomenon causing an unpredictable rain pattern across the state. This is true of all 30 districts. Before 1957, between 67-90 % of years recorded normal rainfall for the various districts, while after 1957, only 32 -68 % of years recorded normal rainfall. The percentage of years with normal rainfall has come down from 90 in 1957 to 45 in 1996 in Koraput; and 88 in 1957 to 45 in 1996 in Sundargarh. In 2002, 25 districts had less than normal rainfall. Similar rainfall deficiency is also being experienced in a tribal block namely BAHALDA in Mayurbhanj where monsoon rains have become harder & less predictable.



Source : Minor Irrigation Project (NESA DAM, Bahalda)

The diagram shows that rainfall in Bahalda block has drastically reduced from 2232mm in 2006 to 1860mm in 2007 & 1435mm in 2008. It is a matter of great concern to learn that 797mm rain has been reduced in the concerned block only during the period of last three years. Hence, the Minor Irrigation Project (NESA) could irrigate only 1028ha. paddy field in 2008 whereas in 1976 it could supply water to 1203ha. Analysis of state's rainfall data & temperature variation reveal that the summers are getting longer. "The state is definitely heating up", says Murari Lal, a Lead author of the Inter-Governmental Panel on Climate Change. Lal has concluded that Orissa's weather conditions are warming. "Abnormal weather conditions are already a reality but no body admits it" he says. Our state's economy has been adversely affected by drought due to irregular or less rainfall in 2000, 2002, 2004 85 2006.

CYCLONES IN ORISSA :

Orissa is placed at the head of the Bay of Bengal where weather is formed. So even a slight change in the sea's behavior has an immediate impact on the coast. The Bay becomes the centre of low pressure causing heavy rains 85 cyclones in Orissa. A statistical analysis of 98 years (1891 - 1988) has revealed that global warming in the present country is linked with the increasing frequency of pre 8& post monsoon cyclones in Bay of Bengal. According to IMD's cyclone statistics, of the 964 cyclones that crossed the east coast during 1877 - 1990, four hundred forty two struck Orissa. From 1901 to 1981, there were 380 cyclones, of which 272 resulted from depressions in the Bay of Bengal. Twenty nine of these cyclones were devastating. In 1999, two cyclones hit the state in quick succession. The second one lasted three days 85 ravaged 14 coastal districts. It is still a nightmare to the coastal people of Orissa. Around 15 million people were affected, more than 10, 000 people were killed, 02 million tonnes of rice crop were lost, 17, 000 square kilometer of agricultural land was devastated. Official estimate put the loss at Rs.10,000 crore. Around 2,00,000 trees were uprooted in about 25,000 ha. of reserved forest. The forest cover has been reduced by 50% in Jagatsinghpur & Kendrapara. The micro climate of the region has changed after this loss in vegetation. Change in climate following the super cyclone possibly caused the state's mango 85 mahua trees to flower unusually early. Mango trees in Orissa begin to flower in November while mahua trees flower from February. But in 2000, mango & mahua began to flower in September & December respectively.

FLOOD:

Between 1834 & 1926, floods occurred at an average interval of 3.84 years. Between 1961 & 2008 floods became an annual affair. Climate change has already intensified the Asian monsoon & increased river flows. During 1998 - 2008 the Mahanadi, Brahmani & Subarnarekha have overflowed several times. Twenty of the 30 districts were inundated in 2001 which affected certain areas with no history of floods such as the districts like Kalahandi & Bolangir. In 2005, it rained for 15 days in October, causing major floods in all the rivers. Experts say, Orissa should brace itself for more severe floods in years to come because of deforestation, faulty flood planning & global climate change.

INCREASE IN SEA-LEVEL :

Once proud to have 480 kms. long coast line, people of Orissa are now seeing it as a danger. It is firmly believed that rising sea levels are a result of increasing atmospheric temperature which is linked to the increasing frequency of low-pressure in Bay of Bengal. With sea level rising, many coastal places may experience increased levels of inundation, coastal erosion, sea water intrusion into fresh ground water && encroachment of tidal waters into river systems. Large-scale emigration from coastal zones is expected due to submergence of coast-lines after sea-level have risen. This will create large numbers of environmental refugees in our state. Further more, intrusion of sea water in the ground water can reduce agricultural & fishing incomes of our state. The economic impact of a one-meter sea-level rise on Balasore could be Rs. 360 crore. In a case study of the Orissa & West Bengal region, an international body of scientists estimated that in the absence of protection, a one meter sea-level rise would inundate an area of 1,70,000ha, predominantly prime agricultural land and displace 7 million people. An additional 400 k.m. of dykes and sea walls would be needed to protect the area. A one meter rise would submerge 35% of the land in Bangladesh.

Starting from the Northern coasts to Southern coasts of Orissa, many villages have been the victim of the wrath of the sea. The cluster of 7 villages called 'Satabhaya' near Paradip is a burning example. Five of the seven villages have already been swallowed. Kanhapur, famous for the home of fabled Tapoi' has shifted itself thrice leaving its original location some one k.m. inside the sea. There are some twenty

other affected villages in Astarang, Chilika and Gopalpur where sea has encroached 60% of lands. People of Udaykani, Chhenu & Tandahar from Astarang Block are prepared to shift permanently to a safer place as sea water has taken their home 85 farm land several times. They are forced to live like nomads. Youth of these villages are migrating to other states because agriculture is no more *a* dependable profession for them. On 19th September 2007, tidal waves breached the road along Puri beach. The incident created panic in the religious & resort based city. This would certainly affect coastal tourism of the state. One village in the southern coast at Gopalpur is completely submerged due to rise of tidal waves.

NATURAL CALAMITY AND ECONOMIC LOSS IN ORISSA:

A conservative study of the effects of natural disasters reveals that between 1963 and 1999, Orissa experienced 13 major disasters, which killed 22, 228 people (state government figure; non-govt. figure puts the toll at around 40, 000) and rendered 34, 21, 000 people homeless. During the Ninth Plan Period (1997 - 2002) Orissa was in the grip of ^ series of disasters. During 2002 - 2003 on the eve of the 10th plan, the state was going through a severe drought. The total loss of livelihood and damage to capital stock due to calamities between 1998 - 1999 and 2001 -2002 stands at Rs. 13, 230.47 crore, according to the 10th plan Document, Govt. of Orissa. This is close to 60% of the state's total plan outlay of Rs. 19, 000 crore for the 10th plan.

The impact of disasters on Orissa's economy is evident. The state's per capita income declined fast in the second half of 1990s. Due to calamities in our state an average 9,00,000ha. of agricultural lands lose crop every year. Between 1980 and 2000, agriculture's contribution to state GDP fell by 16%. The coastal paddy fields are vulnerable to inundation and salinization. During the last 30 years, the average annual loss due to disasters has gone up 27 times which is reflected in the following table.

Period	*Average annual Property lost & damaged due to disasters (in Rs. Crore)*
1970s	14.18
1980s	67.33
1990s	383.50

Source : State Human Development Report, 2003.

Economic losses due to disasters are steadily increasing. Recently the government of Orissa has prepared a report which shows that the state has faced flood for 8 times, drought for 5 times 85 super cyclone of 1999 during 1994 - 1995 to 2008 - 2009. This has resulted the economic loss of the state to the amount of Rs. 20, 073 crore.

Period	Name / Type of Calamity	Economic Loss (in Rs. Crore)
1996- 1997	Drought	1000. 00
1997- 1998	Drought	
1998- 1999	Drought	
1999 - 2000	Super Cyclone	6243.96
2002 - 2003	Drought	871.00
2006 - 2007	Flood	2322.43
2008 - 2009	Flood	2687.00

The Government of Orissa has already spent more than Rs. 5, 000 crore to compensate the loss by Natural disasters during the last 15 years, which includes Rs. 827 crore in 1999's super cyclone. The govt. has provided Rs. 1545.78 crore in the current year's supplementary budget to check flood in the coastal districts. Thus, economic loss due to calamities has been a matter of great concern, which has weakened the economy of the state. Such disasters have resulted in a type of poverty known as 'Conjectural poverty'. Disasters have made Orissa the poorest state. Disasters have a long term impact as poor people are forced to spend more of their earnings on basics like home 86 agriculture. With each disaster, their capacity to rebuild is reduced. In this way they have been hit hardest by climate change & many of them are already exposed to its devastating repercussions.

CONCLUSION : (POLICY RECOMMENDATION)

Indian policy makers are reacting to the above threats to the climate by launching 'climate-friendly policies', especially when they serve the country's development agenda. For example, the government would try to meet 20 - 25% of national energy demands from renewable sources in the coming decades. Meanwhile big domestic players in the renewable energy sector, such as 'Suzlon Energy' and Tata - BP Solar are making

big investments in large-scale products throughout the country. However, fighting climate change starts at home, with everyone of us. As a consumer, we can support the reduction of CO_2 emissions by purchasing energy-efficient goods and using fuel efficient modes of transportation. Air-pollution regulations result in higher fuel quality, which in turn lead to reduced GHG emissions. For example, improved gasoline can make vehicle run more efficiently. Biomass is widely used in India for the purposes including fuel, timber & feedstock. Concern for the consequences-degradation of woods and forest and consequent degradation of soils-was expressed as far back as 1974 (Fuel policy Committee, 1974). Recently, programmes for afforestation with support from govt. and NGOs aim not only to halt deforestation but to increase green cover. The nations through United Nations Organization should advocate for the establishment of an International agreement on : -

i) Limiting to 2°C rise in global temperature

ii) Reducing global greenhouse gas emissions by 50% by the year 2050 (from 1990 levels).

iii) Cutting greenhouse gas emissions in developed countries by at least 80% by the year 2050, with 20 - 30% cuts by 2020.

The world needs to come together 8& tackle this crisis in one concerted effort.

REFERENCES :

1. Jyoti K. Prakash and Kirti Parikh : Climate change India's Perceptions, Positions, Policies and Possibilities.

2. State Human Development Report, 2003.

3. R.K. Lekhi & Aaarti Nayar : Development and Environmental Economics – Kalyani Publishers, Kotak

❑❑❑

GLOBAL WARMING: CAUSES, EFFECTS AND SOLUTIONS

Dr. R.C. Mishra[1] **K.C. Mishra**[2]

Climate may be defined as the condition of the atmosphere at a particular location over a long period of time which is dependent upon the parameters like temperature, humidity, atmospheric pressure, solar radiation and wind etc.. In broader sense, climate may be perceived as a part of larger system (instead of a local phenomenon) that includes not only the atmosphere but also the hydrosphere (all liquid and frozen surface water), the Lithosphere (all solid land surfaces), the biospheres (all living beings) and even the extra terrestrial factors as the sun. Climate does not remain unchanged. Rather it changes due to deforestation, pollution and growth of population etc. Thus climate change refers to the variation in the earth's global climate or in regional climate over time. The term describes changes in the variability or average state of the atmosphere over time scales ranging from decades to million of years. The average decade temperature of the globe has augmented more than 1 degree Fahrenheit since 1900 and the speed of warming has been almost three folds the century long average since 1970. This increase in earth's average temperature is called global warming. Thus Global Warming can be described as rise in temperature of the earth due to excessive increase in the concentration of green house gases. Global warming is also known as the green house effect. It is an age-old phenomenon and has now emerged as one of the most burning environmental issues ever to confront the humanity and has become a major scientific political issue during the last decade. Before the industrial revolution, climate change was a gradual process but in the recent past, the rate of change has been triggered due to tremendous increase in pollution which is a consequence of industrialization. It is possible that human beings are altering the environment by causing changes to the climate. While climate and weather patterns naturally

1. H.O.D., Economics, KKS Women's College, Balasore

2. Dept. of Economics, MPC Jr. College, Baripada

change and fluctuate, there have been noticeable differences within the last 150 years that could be the result of human-caused activities. These are gases that are found in the atmosphere called Green house gases. These gases include such things as Carbon Dioxide (CO_2), water vapor, ozone, methane (CH_4), and Nitrous Oxide (N_2O). These gases are capable of staying in the atmosphere and creating a type of blanket that traps the radiant heat of the sun and keeps the earth warm. These gases are a natural part of the atmosphere and are beneficial when they are in balance, but when human-caused emissions cause larger than normal concentrations, problems begin. However, the objectives of the paper are to analyse.

i. The genesis of Global Warming.
ii. Causes and effects of Global Warming and
iii. Measures to curb Global Warming

GENESIS OF GLOBAL WARMING:

The first theory of Global Warming came in 1824 when French Mathematician Jean Baptiste Joseph Flurier discovered that the Earth's temperature was slowly increasing. Fourier argued that the earth's atmosphere traps solar radiation and reflects it back towards the earth.

In the late 19th century Fourier's theory was labeled the 'greenhouse effect' when Nobel Laureate Svente Arrhenius coined the term to explain how carbon dioxide traps heat in the Earth's atmosphere. Arrhenius believed that the green house effect was responsible for the onset of the ice age. In the 1950s, G.S. Callendar warned that the greenhouse effect was true and dramatically impacting the atmosphere of the earth. Callendar's claims were termed the 'Callendar effect' and led to increased research on global warming. Over the next few decades, scientists developed ways to measure the earth's climate and devised mathematical models to better analyse global temperature. This led to a steady rise in the belief that human activity was dramatically affecting the environment. Scientific studies began to predict that increased carbon dioxide emissions, due to increased use of fossil fuels, would trigger an outbreak of global warming. In 1992, at the United Nations Conference on Environment and Development more than 150 nations signed a declaration committing them to reducing carbon dioxide emission in their countries.

However, in 1994, the United Nations panel on climate change asserted that global warming was still a threat and nations needed to enact drastic changes in order to negate the effects of global warming. This announcement sparked the creation of the Kyoto Protocol, an international agreement to fight global warming. The protocol called for countries to reduce their emission of green house gases.

CAUSES OF GLOBAL WAMRING:

There are several causes of global warming.

1. **Electrical Pollution:** One thing that causes global warming is electrical pollution. Electricity causes pollution in many ways. In most cases, fossil fuels are burned to create electricity. Fossil fuels are made of dead plants and petroleum. Some examples of fossil fuels are oil and petroleum. Many pollutants (chemicals that pollute air, water and land) are sent into the air, when fossil fuels are burned. Some of these chemicals are called green house gases. Further, the power plants emit large amounts of carbon dioxide produced from burning of fossil fuels for the purpose of electricity generation. The world's top ten emitters of Co_2 are given below.

Table – 1

World's Top Ten Emitters (2005)

Country	Co_2 emissions in billion tonnes
United States	5.96
China	5.32
Russia	1.70
Japan	1.23
India	1.17
Germany	0.84
Canada	0.63
Britain	0.58
South Korea	0.50
Italy	0.47

Source : Netherlands Environmental Assessment Agency.

Another major source of carbon dioxide in the atmosphere is vehicular emission. About 20% of Co_2 emitted in the atmosphere comes from burning of gasoline in the engines of vehicles leading to global warming.

2. The second major green house gas after carbon dioxide, which causes global warming, is methane. Methane is more than 20 times as effectual as Co_2 at entrapping heat in the atmosphere. Methane is obtained from resources such as rice paddies, bovine flatulence, bacteria in bogs and fossil fuel manufacture. Almost in all parts of the world, rice is grown on flooded fields. When fields are flooded, anaerobic situation build up and the organic matter in the soil decays, releasing methane to the atmosphere. Nitrous oxide, which is a colourless gas with a sweet odour, is another green house gas. The main sources of nitrous oxide include nylon and nitric acid production, the use of fertilizers in agriculture and the burning of organic matter along with emissions from cars fitted with catalytic conveters. Greater emission of nitrous oxides in the recent decades is leading to global warming.

3. Another cause of global warming is deforestation. In other words, destruction of forests or indiscriminate cutting down of trees will lead to global warming because trees and other plants collect carbon dioxide (Co_2), which is a green house gas. Deforestation is to be blamed for 25% of all carbon dioxide release entering the atmosphere, by the cutting and burning of about 50 million acres of trees each year. Trees collect the Co_2 that we breathe out and give away from various other sources, and they give back oxygen that we breathe in. Thus cutting of trees is leading to greater concentration of carbon dioxide in the atmosphere. Greater urbanization, massive industrialization and requirement of timber are all reasons that are leading to deforestation, which in turn is leading to global warming.

EVIL EFFECTS OF GLOBAL WARMING:

The effects of global warming are explained below:

1. The global warming has led to increase in mean earth surface temperature and thus melting of polar ice. There are frequent melt down of glaciers that result in floods and other natural calamities. The melting of ice at the poles had led the mean sea

level. And further increase in temperature may further melt the ice and lead to further increase in mean sea level, which will engulf low lying countries. Thus it is a great threat to the coastal regions.

2. The effect of global warming is very evident on the animal kingdom also. Some animals have become extinct due to loss of their natural habitat or their inability to evolve to the rapid changes in the climate. Also there is a change in their life style because of the changes in the seasons. The migrating birds have changed their time of travel and also their place of migration.
3. The effect of global warming can be felt on seasons too. There is shift in season cycle, as the summers are getting longer than the winters. This has affected the animals and made them change their life style accordingly and those who failed to do so have perished or on the verge of extinction.
4. The global warming is also responsible for the introduction of some new diseases. The bacteria are more effective and multiply much faster in warmer temperature compared to cold temperature. The increase in temperature has led to increase in the microbes that cause diseases.
5. Global warming is also affecting the crop production, as the crops are getting destroyed by the sudden change in temperature or sudden on set of rain. Also the flash floods and other natural calamities affect the crop. Thereby agricultural production will be affected very much.
6. As a matter of fact, because of global warming, the earth's atmosphere is getting more unpredictable with heavy rains in the areas, which have scanty rainfall or drought in the areas, which received good annual rainfall. The months of rainfall is also getting affected.

SOLUTIONS FOR GLOBAL WAMRING OR MEASURES TO CURB GLOBAL WARMING:

The following are the some of the suggested solutions to prevent global warming.

1. Co_2 emissions can be cut by reducing the use of fossil fuels by cutting back on car use, investing in energy efficiency,

implementing energy conservation measures and utilizing renewable resources such as wind, solar and hydropower. Reducing fossil fuel use will coincidentally also reduce emission of methane, nitrous oxide and ozone.

2. Since Co_2 is consumed by plants and trees (known as carbon-sinks), reversing deforestation and implementing afforestation programes may reduce levels in the atmosphere. The need to take such measures was first recognized at the Rio climate change convention in 1992, after which over 160 countries pledged to limit emissions of Co_2 and to protect and enhance natural 'Sinks' of Co_2. Trees play a unique role in the global carbon cycle. They are the largest land-based mechanism for removing Co_2 from the air. Trees are able to store a large amount of Co_2 in their structures. An acre of forest will absorb about ten times the Co_2 amount absorbed by an acre of crop land or grass land. Planting more trees and reducing timber cut world wide will help to restore the balance.
3. Try to cut down demand for electricity when we reduce electric power use, we save money, breathe cleaner air and help to reduce the global warming problem. Every kilowatt hour of electricity saved keeps 1.5 to 2 pounds of Co_2 out of the atmosphere. There are several ways in which we can decrease the use of electricity.
4. Government should also encourage the use of mass transit, provide tax rebates for people who buy low and no-pollution vehicles and subsidies to fossil fuel and the nuclear industries.
5. Green house gas emissions be managed using an incentive based policy, such as market based approach to capping and reducing such emissions. This type of strategy provides clear incentives for changes in business practice and development of new technologies. It assures that economic forces are directed to keeping the cost of reducing emissions as low as they can be. Many industrial nations have now adopted policies intended to limit green house gases.
6. Try to follow the 3R environmental policy of 'Reduce..... Reuse ..... Recycle .....'. Reuse of anything is the easiest and best way to recycle. Save containers, bags, every thing that can be used in the future. Further we can use cloth towels and napkin instead of paper ones, and use rechargeable

batteries instead of disposable ones. Thereby emission of green house gases can be reduced.

CONCLUSION:

Climate change is not only a threat to our environment but also a menace to growth and development. Current assessments suggest that loss to human welfare from climate change is greater than the cost of measures to mitigate the risk and that the 'growth cost' of these measures is small, provided we act soon. Our development policy will also have to take account of a more carbon conscious and carbon constrained world. Hence it is imperative to develop a strong pro-active agenda and at the same time people from grassroot level to global level should be involved in it. Thus a strong determination, dedication and co-operation is required to face the challenge of global warming. Unless and until all the people of the world irrespective of caste, class and creed try to face the challenge with urge and devotion, this problem will not be solved. Hence a target oriented, time-bound and realistic approach in this regard will not only help combat global warming but also go a long way in fostering sustainable development in the country.

REFERENCES:

1. Ahlawat Dr. Sharmila (July,2008); "Global Warming: Causes and Solutions", Kurukshetra, Vol. 56, No. 9, PP. 31-33.
2. Bhattacharya Rabindra N. (2008); "Environmental Economics: An Indian Perspective", Oxford University Press.
3. Desai Nitin (June,2008); "The Challenge. .. ...", Yojana, Vol. 52, PP. 9-13.
4. Lal Ashwini Kumar (June,2008); "Combating Global Warming", Yojana, Vol. 52, PP. 23-26.
5. Mohmed A. Noor and D. Sreemathi (2008); "Climate Change: Needs International Effort", Southern Economist, Vol. 46, No. 17, PP. 41-45.
6. Shivay Y.S. and Anshu Rahat (July2008); "Effect of Global Warming on Crop Productivity", Kurukshetra, Vol. 56, No. 9, PP. 13-20.

❑❑❑

CLIMATE CHANGE & AGRICULTURE IN INDIA-CHALLENGES & COPING STRATEGY: AN EMPIRICAL ANALYSIS

Smt. Babilata Shroff*

CLIMATE CHANGE

There is no doubt that climate is changing. According to Inter-Governmental Panel on Climate Change, the year 1993 has been recorded as the warmest year since the late 1800s, followed by 2002, the second warmest year & 2001, the third throughout the world. There has been a strong warming trend over the past 30 years, trend that has been shown to be primarily increasing greenhouse gases in the atmosphere (due to several natural & anthropogenic factors). During this period, number of cold days, night & frost have become less frequent, while hot days, nights & heat waves have become more frequent. The pattern of monsoon onset has become very unpredictable, uncertain & erratic. The intensity, duration & time of rainy period have changed. Frequent floods & droughts are also visible. The ground water level is continuously depleting. Although its reason might be excess exploitation of ground & surface water for irrigation, drinking & various industrial purposes to meet the exploding human population.

Since independence we progressed a lot. This development emerging from the modern market culture is associated with unsustainable activities & caused depletion of natural resources, environmental degradation & loss of source of living. Protection of the environment as well as provision of livelihood security to the masses has become the major issues at all the economic & political face of the 21st century. Stunned by the dangerous effects of climate change & its influences on water, soil & air; our national & global priorities have been shifted towards a more pragmatic & eco-friendly approach towards the environment.

* Lecturer in Economics, DAV College, Titilagarh,

CLIMATE CHANGE & AGRICULTURE

In the climate change regime new & newer challenges are emerging before the world & human society. The worst affected is agriculture which is closely linked to the natural factors like temperature, rainfall, soil, humidity, etc. Crop yield, duration of crop, soil fertility, weeds, diseases & insect pests, management practices & cropping patterns, etc. are affected by climate change. Rice yield is more affected than other crops. As per the report of R.K. Pachauri, Chairman of the Intergovernmental Panel on Climate Change, agriculture would be hit in the subcontinent with increase in global temperatures. Wheat yields would fall by 5-10% with every increase of 1 degree Celsius.

Productivity of rice would fall by 10% for every 1 degree C increase in growing season mean temperature between 30 & 40 Degree C. (10% loss means economic loss). As a result the poor people suffer first as the rice budget rises. Untimely clouds damage the flowers in mango trees. Heavy rain at the beginning of the vegetable crop develops fungi and diseases. A number of such repercussions of climate change are existing.

OBJECTIVES

This paper aims at studying the effects of climate change on agriculture in the Titilagarh Agriculture District of Bolangir district. Attempts are also made to find out the coping strategies to fight the challenges of climate change.

METHODOLOGY

A set of primary & secondary data is taken. Primary data are collected by direct interview from the farmers, agriculture experts of the District Agriculture Office, Horticulture Department & Watershed Department. Secondary data are collected from the various officials, reports & journals.

REVIEW OF LITERATURE

Sunita Narain (2008) said, climate change is a global challenge. We did not create it and, till date, we contribute little to global emissions. We are in fact, climate victims. Kirtiman Awasthi (2008) pointed out how wine-makers in Spain could soon find themselves scrambling for juicy red grapes & people find olives & cheese missing from their salad

plates. The olive & grape farms that thrived in the balmy Mediterranean could become relics of the past with countries like Spain facing the prospect of desertification. Almost 35% of the country is at risk.

R. S. Sengar & Rajesh Singh Sengar (2008) pointed out in their study that there is likely to be a spatial shift of crop potential due to climate change. Ranjan K.Panda (2008) in his study emphasized that climate change is sure to pose challenges and the increase in Internally Displaced People is one such.

Mario D'Souza (2008) said trees may not have the insurance against global warming. Their ability to store carbon dioxide has diminished due to rise in temperatures & hence they will not be able to act as carbon sinks.

Y. S. Shivay & Anshu Rahal (2008), pointed out trees as a very good bio-indicators of climate change as the flowering in perennial trees takes place as a result of completing the crop-specific required thermal unit/thermal period of degree days. The mango tree generally flower in Oct-Nov in South India, in Dec- Jan in eastern.& central India & middle of Feb-March in north India. But there has been some evidence of flowering of mango trees in Dec. in north India in 2004 due to prevailing of higher thermal regime. In 2004-05 evidences of grasses growing was found in the Antarctica region. Particularly in the hilly mountain areas of Himachal Pradesh some indications of spatial changes in cropping pattern have been found. Successful cultivation of maize in Bihar in place of wheat during winter clearly indicates the possibility of climate change (global warming). It nay also severely affect the special distribution of temperate crops especially chilling requiring crops viz. apple, apricot, cherry, plum, saffron, cauliflower, cabbage, pea, etc.

CLIMATE CHANGE & THE TITILAGARH AGRICULTURE DISTRICT

In recent years the beautiful capital of Koshala kingdom Titlagarh (during 1042-1057 AD), now called Titilagarh is popularly known as **Tatalagarh** due to **its high temperature** (highest in the State). Since 1991 the temperature of the town as well as the spell of hot summer are rising gradually till 2004. Table 1 shows it clearly.'

TABLE 1

The highest Maximum Temperatures in Titilagarh

Year	Highest Temperature (in degree C)	Remarks
1991	47.0(on 8th May)	
1992	45.4(on 2nd April)	
1993	46.6(on 3rd & 5th May)	Very high temperature remained for few days
1994	45.6(on 9th & 10th May)	
1995	46.1 (on 8th June)	
1996	49.6(on 30m May)	Except 5th &7th May the temp, was more than 45° in May
1997	48.1 (on 29th May)	From 21st to 31st the temp, was more than 46° in May
1998	49.8(on 27th May)	From 22nd May to 8th June temp. was more than 48°
1999	48.1 (on 3 0th April)	In 1st week of April & 1st week of May more than 46°
2000	47.6(on 29th &30th April)	
2001	—	
2002	47.6(on 9th & 13th May)	
2003	50.1 (on 5th June)	Long spell of heat during last week of April &17' May to 13th June
2004	—	
2005	—	
2006	45.8(13th May & 11th June)	
2007	45.2(on 4th June)	

Titilagarh was at the top of the list when compared with the temperature of the surroundings.

Other factors like El-Nino effect, presence of 23 small isolated barren inselbergse & hillocks, open cast granite mines & blastings are also responsible for the highest temperature of this place.

Rainfall analysis of TAD indicates that the rainfall pattern of the area is very fluctuating in nature. The average rainfall of this place is 1443 mm, however during the period 1987 to 2002, the annual rainfall has reached 2000mm in three years (1990 , 1994 & 2001), while in the years 1987, 1996, 1998, 1999, 2000, 2002 & 2005, the annual rainfall was recorded below 1000mm (Remote Sensing based Baseline Information on Titilagarh & Bolangir) . It was 947.7 mm in 1999, 710.8 mm in 2000, 1461 mm in 2001, 697 mm in 2002,. 1444.7 mm in 2003, 1140 mm in 2004, 989.2 mm in 2005, 1825.4 mm in 2006 and 1148.6 mm in 2007. Presently Bolangir district is receiving about 18% less rainfall than its normal value.

Water problem was also acute in this place till 2006 when the water supply from Tel river was made due to water layer depletion in this place. The major stream catchments like KOKRANJOR, YAMUNA JOR AND KUNDAJOR including some dendrites micro catchments dry up during the summer. The seasonal small ponds occurring in the region also remain dry up during major parts of the year. Two large water bodies are in extreme north in Tikhari reserve forest (Dumerbahal) and other in central part near Burnei reserve forests (Mathanpala) are situated in Titilagarh range.

Widening of nalas and rising river beds are found recently in rivers of this range like Tel, Under, Bairi, Udanti and Lanth. This is due to massive soil erosion mainly caused by forest degradation.

A PROFILE OF TITILAGARH AGRICULTURE DISTRICT:

Titilagarh Agriculture District (TAD) comes under Bolangir Revenue District under the KBK districts of Orissa. The undivided Kalahandi-Bolangir-Koraput (KBK) or the 8 districts Kalahandi, Nuapada, Bolangir, Sonepur, Rayagada, Koraput, Nowrangpur and Malkangiri districts of the state look like the sick children of Orissa. This area has attracted the attention of international media, politicians, and research scholars due to its recurring drought and flood, chronic and transient poverty, hunger and starvation death, underdevelopment and out migration, distress sale of property and children, and outbreak of epidemics. Though very rich in natural resources this area has a substantial regional disparity in terms of literacy (31.58% which is 63.61% for the state), health & poverty stricken people (74.24% BPL which is 47.17% for the state). This area constitutes a sizeable amount

of tribal population (16.7% SC & 38.95% ST). While 85.03% of our state population lives in rural areas, it is 89.89% for KBK. 90.5% of rural population of this region is basically engaged in primary sector activities.

The TAD covers an area of 342,638.86 ha. spreading over 2 sub-divisions (Titilagarh & Patnagarh), 8 Blocks, 167 GPs, 3 NACs & 1088 villages. It has a hot & moist and sub-humid climate. Its broad soil groups are red & yellow, red & black, brown forest & lateritic. Total cultivated area of this district is 227,165ha out of which high land constitutes 123,419 ha, medium land 47,485 ha. & low land 52,261ha i.e 54.33% **of total land is upland.** Paddy area is 105,890ha i.e. 47%.

121,275ha i.e. 53% of land are under non-paddy crops For Kharif 2005 only 13.8% of land i.e. 31,358ha. of land have irrigation potential. This district has no major IP, 1815ha medium IP, 250 no. of lift IP covering 4438ha, 11661 numbers of dug wells covering 9201ha, 138 minor IP covering 14565ha & 5830ha are irrigated by other sources like WHS, nalas, ponds, etc. For Rabi 2005-06 only 4.5% i.e.10175ha is under irrigation. Medium irrigation points cover 506ha, 12 minor irrigation points cover 815ha, 231 number of lift IP covering 310ha, 12004 dug wells for 3814ha & 1939ha from other sources like WHS, Nalas, ponds, etc.

CHALLENGES OF CLIMATE CHANGE & AGRICULTURE IN THE TAD

Most of the area in TAD falls under Kharif agriculture except a few patches on the bank of Tel River, where double crops are taken. In the absence of irrigation facilities TAD is continuing its agricultural activities. In the low land paddy is cultivated. Productivity is also below the State average. In TAD 70554 agricultural laborers are present. 54868 marginal farmers, 48507 small farmers and 23308 big farmers are present in the TAD.

As a major part of land in this area is upland, generally they are either remaining idle or short duration paddy, millet, etc. are cultivated. In villages like Mahada, Shagunamunda, Kumbhari, Nanajhar, & Mahulpara the farmers have gone for crop diversification in the upland since the beginning of this century. Diversification has made them profitable & secure from the point of view of employment & income.

In Shagunamunda the farmers diverted from short duration paddy & millet to groundnut (25acres), urad (20acres), tomato (5acres), brinjal (6acres), cauliflower (10acres) & sunflower (10acres) out of 80 acres of upland. Out of 165 households 103 are small farmers & 40 landless agriculturists.

In Mahada the farmers diverted from short duration paddy & millet started producing vegetables (mainly cauliflower) in 2003 in 130 acres (out of 200 acres of upland) with intercropping urad & paddy. After 2006 they diverted to groundnuts production which is still more profitable.

In Kumbhari village out of 135 households 121 are BPL households. Out of 200 acres of land 120 acres are upland. 80 acres of land are under cotton with intercropping bhodei-a wild cowpea; 30 acres are under mango with intercropping banana& lady's finger, tomato, brinjal, etc. & 10 acres of still low quality land is used for sweet potato & millet. Since 2001 the farmers started cotton widely, but failure of cotton crop in 2002 forced some farmers (mainly small farmers) to shift to fruits & vegetables.

In village Nanajhar out of 358 acres of land 148 acres are upland. Only in small patches of upland we find crops like moong, arhar, groundnut, mango, lemon, amla, etc. watermelon, vegetables & flower are cultivated by a few farmers in the off season which made them profitable significantly.

In Mahulpara village out of 194.35 acres of land 97 acres are upland where millet is substituted by fruits, vegetables & flowers.

Huge patches of upland are still lying idle & used for grazing purposes, which is mainly due to lack of irrigation & interest among the people. In Sirul village non of the farmers have gone for diversification due to lack of interest & awareness & attraction towards the non-farm sector.

In all the above cases change in cropping pattern is not due to the **climate change,** but due to awareness among the farmers, spread effect & efforts of the Agriculture, Horticulture & Watershed Departments. Provision of institutional finance as well as seed facilities & technical guidance could not be ignored.

Climatic factors like vagaries of monsoon, rising temperature & heat spell, etc. are placing challenges in front of the poor agriculturists. The perching heat creates discouraging work atmosphere (occurrence

of diseases like sunstroke, heat fever, etc.). This could be ignored by the agriculturists. But the factors like **high temperature do not allow the seeds to germinate.** It happened in 1996, 1998 & 2003. The crops are also not in a position to sustain. The soil becomes dry along with the atmosphere & becomes unfit for growing crops. Lack of irrigation along with the high temperature tortures the farmers.

It is also found that gradually the **period of high temperature regime is shifting from** March towards May & then June. The **periods of heat spell is also lengthening.** This severely affects the sowing of paddy seeds. Hence the **cultivation work is delayed.**

Sometimes it also happens that sowing of paddy (the main crop here) is delayed due to high temperature, but continuous & **heavy rainfall afterwards spoils the seedlings & small plants. The main Kharif crop is damaged,** damaging the backbone of the farmers. Now the farmers have to wait for the next crop. Again if the rainfall is as per requirement of the crop then it is alright, otherwise the farmers have to face another crop failure. When during the vegetable crops it rains heavily during the fruit-bearing stage, the vegetable crops also spoil. There is every possibility of being attacked by fungi & other diseases.

Hence in the absence of irrigation & rainwater harvesting, **agriculture is a risky business. Climate change or the uncertain natural factors play a dominant role in crop yield & harvest period.**

COPING STRATEGIES

Food security is a major problem around the world with & without a climate change. In a large country like India where large area of arable lands is still under rainfed agriculture, food security is still uncertain & risky here because of their greater vulnerability to natural calamities & climate change factors. Even in irrigated agriculture high day temperature may be detrimental to production. Hence to keep pace with the growing demand for food it is indispensable to change the crop production strategies while coping with the climate change. The area which is judged to be most suitable today for a given crop or combination of crops, may no longer remain as such after a climate shift. To fight against these climatic change problems the best coping strategy is to go for the adoption of appropriate crop varieties, alternative cropping, and techniques of plant protection. Where ever necessary cultivation

of tuber, root, bulb & rhizomatous crops in place of fruit/grain/seed crops should be chosen as alternate while caring for changing demands, markets & technologies as well as providing employment & income security to the farmers. Just like the trees growing in a nursery, paddy seeds should be germinated protecting the seeds from the high temperatures. If paddy crop fails then immediately care should be taken that short duration paddy is cultivated. If the climatic conditions suit then immediately other Crops likes pulses, vegetables, flowers, etc. should be encouraged. The crop which best suits today may be a worst result provider tomorrow, it should be remembered. So that the farming community will not be attracted towards the non-farm sector. Hence, there is a need for greater adaptation & mitigation research. Weather forecasting System should be more active.

Technology dissemination process that is the land-lab link should be strengthened. Programme of adaptation & mitigation education & awareness should be started widely as a major proportion of the population here is engaged in agriculture.

In places like Titilagarh water harvest systems should be encouraged. So that during the high temperature period also the sub-soil will not dry up. Towards Sindhekela & Bangomunda tree cover is almost nil. Plantation of tree crops as well as fencing the land with suitable trees will provide humus, protect soil erosion, check dryness, etc. Integration of agriculture with forestry, poultry, diary, goatary, bee-keeping, fishery, etc. & some suitable non-farm activities could help a lot including eradication of poverty, breaking stagnation & checking migration (which is widespread in this region). Emphasis should be on local action with a global vision.

CONCLUSION

With the opening of the economy agriculture must transform from subsistence to commercial & horticulture in the upland is the best answer to face the post reform challenges along with sustainable agriculture development & provision of livelihood security to the masses.

❑❑❑

CHALLENGES OF CLIMATE CHANGE IN INDIA : NATIONAL CONCERNS AND HUMAN SUFFERING

DR. SUDHAKAR PATRA*

Climate change is one of the most important global environmental challenges which affect agriculture, health, infrastructure, energy and the entire humanity. Different scientific studies and assessments have revealed that the climate system of the earth has changed demonstrably on both global and regional scales after industrialization. The inter governmental panel on climate change (IPCC) projected that the global mean temperature might increase between 1.4 and 5.8 degree Celsius (c) by 2100. This unprecedented increase in temperature will severely influence the global hydrological system, sea level, crop production and other related process. The impact of climate change will be severe in tropical areas which mainly consist of developing countries including India.

Climate change results global warming which is a larger challenge to sustainable development in India. The social, economic and environmental cost of such climate change is very high, both at global and national level. The direct impacts include the loss of life, livelihoods, assets, infrastructure, health etc. which results from climatic extreme events. The indirect effects are due to the effect on economic growth including the ability of the poor to engage in the non-farm sector as well as increase in consumption level. Climatic variations multiply to vulnerability of the poor people by adversely affecting their health and livelihood and jeopardizing the opportunities vital for poverty reduction. In many poor countries including India, climate change has tremendously aggravated water stress and insecurity. The poorest often have few choices available to adopt to variations in natural conditions.

* Reader in Economics, F.M. University, Balasore, Orissa

They may not be able to live in water stressed regions and disaster resilient infrastructures. Climate change can lock-up substantial future development expenditure into disaster recovery rather than poverty reduction. Degradation of natural resources and erosion of indigenous knowledge system have made the people most vulnerable and difficult for them to fight against the menaces like drought and other climatic disasters. They have to face problems starting from indebtedness to migration.

The impact of climate variability will affect the ability of India to achieve sustainable development goals. The characteristic of different development paths will strongly affect emissions. Change, impacts, capability to adopt and the capacity to mitigate. In this context, the objective of this paper is to analyse the national concerns, impact on Indian agriculture, issues and challenges and different researches of climatic change.

NATIONAL CONCERNS OF CLIMATE CHANGE IN INDIA

India is surrounded by oceans in three sides and great Himalayas in northern side which are more vulnerable to climate changes and global warming. India is a large developing country with nearly 700 million rural population directly depending on climate-sensitive sectors like agriculture, forests and fisheries and natural resources such as water, biodiversity, mangroves, coastal zones, grasslands for their subsistence and livelihoods. The adaptive capacity of dry land farmers, forest dwellers, fisher folk and nomadic shepherds is very low. Climate change is likely to impact all the natural ecosystems as well as socio-economic systems of India .

The latest high resolution climate change scenario and projections for India, based on Regional Climate Modeling (RCM) system have fallowing implications.

(i) An annual average surface temperature will rise by the end of century, ranging from 3 to 5 degree C with warming more pronounced in the northern parts of India.

(ii) A 20% rise in all India summer monsoon rainfall and further rise in rainfall are projected over all states except Punjab, Rajasthan and Tamil Nadu , which show a slight decrease.

(iii) Extremes in maximum and minimum temperatures are also expected to increase and similarly extreme precipitation also shows substantial increases, particularly over the west coast of India and west central India.

Some of the projected impacts of climate change in India on water, agriculture, forest, human beings etc. are as follows.

(a) Water resources :

The hydrological cycle is likely to be altered and the severity of droughts and intensity of floods in various parts of India are likely to increase. Further, a general reduction in the quantity of available run-off is predicted.

(b) Agriculture :

Simulations using dynamic crop models indicate a decrease in yield of crops as temperature increases in different parts of India. However, this is offset by an increase in CO_2 at moderate rise in temperature and at higher warming negative impact on crop productivity is projected due to reduced crop durations.

(c) Forests

Climate impact assessments using a model and climate projection for the year 2085 showing 77% and 68% of the forested grids in India are likely to experience shift in forest types . Indications show a shift towards wetter forest types in the northeastern region and drier forest types in the north-western region in the absence of human influence. Increasing atmospheric CO_2 concentration and climate warming could also result in a doubling of net primary productivity under the A2 scenario and nearly 70% increase under the B2 scenario.

(d) Coastal Zone :

Simulation models show an increase in frequencies of tropical cyclones in the Bay of Bengal; particularly intense events are projected during the post-monsoon period. Sea level rise is projected to displace populations in coastal zones, increase flooding in low-lying coastal areas, loss of crop yields from inundation and salinization.

(e) Human health :

Malaria is likely to persist in many states and new regions may become malaria-prone and the duration of the malaria transmission

windows is likely to widen in northern and western states and shorten in southern states.

(f) Desertification :

Globally, about 1900 Mha of land are affected by land degradation of which 500 Mha each are in Africa and the Asia-Pacific and 300 Mha in Latin America. Climate change leading to warming and water stress could further exacerbate land degradation, leading to desertification. The United Nations Convention to Combat Desertification (UNCCD) aims to address the problem of land degradation, which is linked to climate change.

It is important to note that the climate – sensitive sectors (forests, agriculture, coastal zones) and the natural resources (groundwater, soil, bio-diversity etc) are already under stress due to socio-economic pressures. Climate change is likely to exacerbate the degradation of resources and socio-economic pressures. Thus, countries such as India with a large population dependent on climate-sensitive sectors and low adaptive capacity have to develop and implement adaptation strategies.

IMPACT OF CLIMATE CHANGE ON INDIAN AGRICULTURE :

Climate change will strongly affect agriculture not only in India but also around the globe. The general circulation models have studied the agricultural impacts of climate change by rising level of green house gases. The increase in global average surface temperature by 1.5 to 4.5 degree Celsius (c) over the net 100 years will raise the sea levels and amplify extreme weather events such as storms, hot spells which will shift the climate zones and reduce soil moisture. Most of the research studies have analyzed the impact on agricultural production in specific regions and countries.

The agricultural zones would tend to shift towards the north and south poles due to rise in temperature near the poles. In the mid-latitude regions between 45 to 60 degree latitude, the shift is expected to be about 300 Kms for every degree Celsius of warming. This shift will have a powerful impact on agriculture and livestock production. Some agricultural crops and species will benefit from higher temperature but others will lose from it. A warmer climate will help the germination of seeds at key stages of the life cycle but it will reduce the soil moisture by increasing the evaporation rates. The soil fertility and soil type may

be unable to support intensive agriculture as practised today in many countries. Various climate models suggest that Asia and Africa which are leading grain producing areas will experience more heat waves and frequent droughts by the year 2030. The period of extreme weather condition will be extended which will destroy certain crops. The carbon dioxide fertilization process will be reduced which will negate the potential for greater productivity. The poor soil quality due to climate change will reduce the production in more productive areas. The reduced rainfall and soil moisture will damage crops in India which will also affect the livestock population. India is one of major food exporter which will suffer from serious losses in international trade. The climate change may increase the pests and insects which will damage the agricultural crops in India.

RESEARCH ON CLIMATE CHANGE IN INDIA

India is a large developing country where two-thirds of the population depend directly on climate sensitive sectors such as agriculture, fisheries and forests. The projected climate change is likely to have implications on food production, water supply, bio-diversity and livelihood. So India has a significant stake in scientific advancement as well as in international understanding to promote mitigation and adaptation measures to reduce adverse effect of climate change. This requires improved scientific understanding, capacity building, networking and broad consultation process in India.

India has completed four nationally coordinated assessments of impact and mitigation of climate change. They are as follows –

(i) Climate change studies supported by Asian Development Banks.

(ii) Asian least cost Greenhouse gas abatement study supported by the global environment facility.

(iii) Climate impact Assessment study conducted under the Indo-UK collaborative project.

(iv) The National communications supported by the Global Environment facility.

The fourth coordinated efforts involved 131 teams from research and educational institutions, which studied three aspects of climate change such as

(a) Climate projections

(b) Climate Impacts & adaptations

(c) Mitigations

This National Communication Project has promoted a network of Research team and Institutions in India to address various aspects of climate change. India should have long term research and development groups to work on various aspects of climate change.

ISSUES AND CHALLENGES OF CLIMATE CHANGE IN INDIA :

There are various issues of climate change such as climate projections, impacts and assessments, global warming, adaptation and mitigation. Some of the critical issues and challenges which need to be addressed in India are as follows.

(a) ***Uncertainties*** – These are many uncertainties which limit the ability to detect, attribute and understand the current climate change and to project the future climate changes in India, as well as different regions and states.

(b) ***Linkage between Physical climate and human system*** – The proper linkage between physical climate and human system is an issue and challenge in order to provide better understanding of cause and effect patterns of human and non-human components of earth system.

(c) ***Regional and Local Understanding*** – There is need of improved understanding of the exposure, sensitivity, adaptability and vulnerability of physical, ecological and social systems to climate change at regional and local levels.

(d) ***Evaluation of mitigation option*** – There is need of proper evaluation of climate mitigation options in the content of development, sustainability and equity at regional, national and global level in different sectors.

(e) ***Mechanisms*** – It is necessary to develop sustainable and equitable international mechanisms, protocols and financial arrangements to promote mitigation and adaptation of adverse effect of climate change.

MITIGATION OF ADVERSE EFFECTS OF CLIMATE CHANGE :

There are many adaptive actions to reduce the adverse effect of climate change in agriculture and humanity. The following are few suggestions to lessen negative effects on agriculture.

(i) The introduction of later maturing crop varieties or species which may help in sustaining climate change.

(ii) The soil moisture can be conserved through appropriate tillage methods and improving irrigation efficiency.

(iii) Economic adjustments may be made by shift in regional production centers and adjustments of capital, labour and land allocations.

(iv) The trade adjustments may help to shift commodity production to regions where comparative advantage improves.

(v) Heat and drought resistant crop varieties should be invented by utilizing genetic resources which may be better adapted to new climatic and atmospheric conditions. Such genetic resources should be collected and maintained in germ plasma banks which may be screened to find sources of resistance to changing diseases and insects along with tolerances to heat and water stress.

(vi) Crop variety with higher harvest index should be used to keep irrigated production efficient under conditions of reduced water supplies and enhance demands.

CONCLUSION :

Climate change will lead to global warming, drought and desertification in India which will directly and indirectly affect the human beings. India will experience extreme climatic conditions lending to summer dryness and present drought reducing food grain production. It is difficult to assess the exact impact on net agricultural production of the country but the crops will definitely be affected by increasing pests and insects. There are many uncertainties about the future impacts of climate change in India. The Scientists from the field of physical, biological and social sciences should work together in India to make climate projections, assessment of climate impacts along with adaptation and mitigation resources. Since half of the world's poor live in India, they are likely to be more affected due to climate change. The

government at Central and State level should work seriously to lessen the direct and indirect impacts of climate changes on loss of life, livelihood, infrastructure and human health.

REFERENCES :

1. Bhukta A (2007) : Global Warming, Yojana, March, Vol. 51, PP – 76-77.
2. Kumar R, K et al (2005) : High Resolution climate change scenario for India for the 21st Century, Current Science, Vol. 90, PP – 334-345.
3. Meena, O.P., Charak A.S. and Gour B.L. (2005).: Global warming and its impact on Agriculture, Kurukshetra, June, Vol. 53, No. –8, PP – 37-39.
4. Nambi A.A. (2006) : Impact of climate change, Yojana, August, Vol-50, PP-81-82.
5. Planning Commission India (2002) : Indian Vision 2020, S.P. Gupta Committee Report, New Delhi.
6. Singh A (2006) : Global Warming, Yojana, June, Vol. 50, PP – 45-48.
7. Sukla P, et. al (2003) : Climate change and India : Vulnerability assessment and adoption, University Press, Hyderabad.

❑❑❑

IMPACT OF CLIMATE CHANGE IN INDIA : AN ANALYTICAL PROGNOSIS

DR. KABITA KUMARI SAHU*

The most burning and contemporary issue is climate change which is an environmental challenge facing the humanity. It has direct implication for food production, natural ecosystem, fresh water supply, health and socio economic life of the people. The climate system of the earth has changed significantly both at global and regional level from pre-industrial era to post industrial period. Due to rise in human activities, the world temperature increases by 0.1^0 Celsius per decade. It is projected that the global average temperature may increase between 1.4^0 and 5.8^0 Celsius by 2100. This will have severe impacts on sea level, crop production, eco-system and related processes. The tropical areas which mainly consist of developing countries including India will be more affected. The sustainable development goals of Indian Planning wi l be affected due to variability and change in climate and policy responses. Six green house gases such as Carbon dioxide, Methane, Nitrous oxide, Chloroflorocarbon, Hydroforocarbon and Perfluorocarbon will increase in atmosphere. So, industrialized countries should reduce their green house gas emissions. The adaptive capacity of communities influenced by climatic change is low in developing countries like India.

There are many indirect effects of climate variation on ability of the poor to work in non farm sector, rise in inequality, increase in poverty and reduction in growth. The poor people are more vulnerable to the climatic variation because their health and livelihood will be adversely affected. The water stress and insecurity will aggravate affecting the poor more, many people may not be able to live in water stressed region and disaster resilient infrastructures. The public expenditure may be diverted substantially to disaster recovery rather than poverty reduction. The rising frequency of drought and other climatic disasters will force the people to migrate from one place to another.

* Lecturer in Economics, North Orissa University, Baripada

IMPACT ON PLANT GROWTH, YIELD AND AGRICULTURE :

Climate change and global warming have direct impact on Indian Agriculture, yield rate and plant growth due to changes in rainfall, reduction in soil moisture, changes in temperature and air distribution. Scientific studies have revealed that increase in temperature will reduce crop duration, increase crop respiration rate, change the pattern of pest attack and decrease fertilizer use efficiency. In long run this will signficantly affect plant grcwth and crop yield. The important effects on agriculture due to climate changes are as follows :

(a) Crop Duration :

.The duration of crop from sowing to harvest are directly related to temperature. The rise in temperature due to global warming will provide more agricultural land in high latitudes. The duration between sowing and harvesting will shorten in case of annual crops. The result and effect is lower productivity and low yield rate. The paddy which matures late in high temperature would be better suited in new environmental conditions. The other agricultural crops requiring cold climate will be adversely affected due to global warming.

(b) Productivity and Crop Yield :

The global warming will increase Carbon dioxide concentration in the air which, in turn will increase breaching and leaf area of the crop. So, transpiration and crop yield are expected to increase due to branching effect. On the other hand, the dry land crops will be adversely affected specially during vegetative phase of growth. The low soil moisture during grain period will lead to low productivity. In North India, there may be more loss in yield in winter grain.

(c) Insect, Pests and Plant Disease :

The climate change and higher temperature will develop more fungal diseases. The breeding of more pests and insects will increase the crop disease resulting in significant economic losses in Indian Agriculture.

(d) Agricultural Land Loss :

The rise in sea levels will result in loss of agricultural land particularly in South Asia and India. The soil erosion, submerge of shore lines, salinity of water table will affect agriculture through inundation

of low lying lands. Melting of polar ice caps and in Himalayan ranges will cause flooding in coastal India.

(e) Drought and Storms :

India has faced the problem of drought during last five years due to changes in weather pattern and global climate. The scientists have forecasted that storms and hurricane are likely to become more frequent and stronger as oceans heat up causing more water evaporation.

The above analysis has clear implication that the climate change will affect the agricultural growth and crop production. There are many uncertainties regarding the nature and dimension of impact on agriculture in India. There is an urgent need on the part of the agricultural scientists to do active research on the impact of climate change on Indian Agriculture.

SOCIO-ECONOMIC EFFECTS OF CLMATE CHANGE :

The climate change will affect socio-economic sectors of Indian economy. The physical infrastructure like roads will be adversely affected by frequent floods, landslide, rise in sea level and uneven rainfall. The extreme weather and rise in temperature will lead to large scale human migration from hot places to cold places. This will result into changes in living conditions and over crowded human settlements. More energy will be required for cooling purposes in the area affected by high temperature. More air conditions and coolers will be used by the people at different warm places of India. The global warming will not only lead to loss of life and property but also change the pattern of crop, flora, fauna and human population.

According to report of World Health Organization, the climate change will increase the incidence of respiratory and cardio vascular diseases. There will be more illness due to stronger sunlight and frequent hot spells. Repeated flooding will result more water borne diseases like diarrhea and cholera. The malnutrition will rise among the poor societies and the incidence of diseases like Malaria, Filaria, Dangue fever etc. will increase over time resulting health hazards for human being.

CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT :

Sustainable development has become an important part of climate change policy at the global level, particularly due to adoption of Agenda

21 and the various conventions resulting from the UNCED –1992. It has become an integrating concept embracing economic, social and environmental issues. Sustainable development does not preclude the use of exhaustible natural resources but requires that any use be appopriately offset. This concept is not acceptable to many developing countries since it seems to disregard their aspirations for growth and development. Further, sustainable development can not be achieved without significant economic growth in the developing countries. Three critical components in promoting sustainable development are economic growth, social equity and environmental sustainability. The question often asked is, should the current economic growth be sacrificed for long-term environmental conservation ? Policy makers in developing countries often perceive a trade off between economic growth and environmental sustainability. However, there is a growing evidence to show that environmental conservation for sustainability of natural resources is not a luxury but a necessity when considering long-term economic growth and development, particularly in the least developed countries. The decline and degradation of natural resources such as land, soil, forests, bio-diversity and ground water, resulting from current unsustainable use patterns are likely to be aggravated due to climate change in the next 50 years. Africa, South Asia and some regions of Latin America are already experiencing severe land degradation and fresh water scarcity problems.

There are many ways to pursue sustainable development strategies that contribute to mitigation of climate change. Some mitigation reasons are as follows.

(i) Adoption of cost-effective energy-efficient technologies in electricity generation, transmission distribution and end-use can reduce costs and local pollution in addition to reduction of green house gas emissions.

(ii) Shift to renewable ones, some of which are already cost effective, can enhance sustainable energy supply, can reduce local pollution and green house gas emissions.

(iii) Adoption of forest conservation, reforestation, afforestation and sustainable forest management practices can contribute to conservation of bio-diversity, watershed protection, rural employment generation, increased incomes to forest dwellers and carbon sink enhancement.

(iv) Efficient, fast and reliable public transport systems such as metro-railways can reduce urban congestion, local pollution and green house gas emissions.

(v) Adoption of participatory approach to forest management, rural energy, irrigation water management and rural development in general can promote sustained development activities and ensure long-term green house gas emission reduction or carbon sink enhancement.

(vi) Rational energy pricing based on long-run-marginal cost principle can level the playing field and increase the spread of energy efficient and renewable energy technologies and promote economic viability of utility companies, ultimately leading to green house gas emission reduction.

Several initiatives are being pursued to measure and report an entity's progress on sustainable development. An example is the Leadership in Energy and Environmental Design(LEED) – a US Green Building Council organization. Criteria include sustainable sites, water efficiency, energy and atmosphere, materials and resource use, indoor environmental quality and innovation and design process. As part of this international process, hundreds of buildings have received certification world wide, including several in India. Another example is the Global Reporting Initiative (GRI), which is a multi-stakeholder process and an independent institution whose mission is to develop and disseminate globally applicable Sustainability Reporting Guidelines. These guidelines are for voluntary use by organizations for reporting on the economic, environmental and social dimensions of their activities, products, and services,. Started in 1997, GRI is an official collaborating center of the United Nations Environment Programme (UNEP) and works in cooperation with UN's Global Compact.

The motivation for using the above types of reporting criteria is diverse. In a recent evaluation of GRI, 85% of the reports addressed climate change and 74% of respondents identified economic reasons and another 53% ethical reasons for reporting their company's performance to GRI. India's ITC Limited, for example, has won a platinum LEED rating for its Gurgaon building, and also reports its sustainable development performance to GRI as a carbon positive corporation emits. Over time, as indicators and measurement tools

become available, the pursuit of sustainable development is moving out of academic discourses, and being put into practice increasingly by institutions and private industry. The trend is likely to strengthen globally as nations come to recognize the limits on access to and development of natural resources.

CONCLUSION :

The climate change will affect present and the future generation directly and indirectly in the form of global warming, drought and low agricultural production. India will experience extreme climatic condition leading to summer dryness. The most effective way to address the climate change is to adopt a sustainable development path way by shifting to environmentally sustainable technologies and promotion for energy efficiency. Water conservation, reforestation and increase in renewable energy are also necessary to tackle the climate change. The developing countries and India must try to reduce the vulnerability of their natural and socio-economic systems. India must promote mitigation and adaptation strategies as a part of economic development programme of the country. There is urgent need for assessment of impact of climate change in India where the impact is likely to be more. The central government should establish research institutes and departments to work on mitigation of adverse effects of climate change.

REFERENCES :

1. Bhukta, A. (2007) : Global Dimming, Yojana, March, Vol-50, PP – 76-77
2. Chamaria, A (2006) : Global Warming, Yojana, November , Vol.-- 50-PP-59
3. Nanda, A.P. and Pratihary S (2008) : The impact of Climate Change on Rural Poor in Orissa and India. Action Aid International India.
4. Shukla, P.R, Rana A, Garg, A (2004) : Climate change Assessment for India : Applications of Asia Pacific Integrated Model, University Press, Hyderabad.
5. Sing, A (2006) : Global Warming, Yojana, June, Vol-50, PP –45-48.

❑❑❑

CLIMATE CHANGE, AGRICULTURAL PRODUCTIVITY AND ADAPTATIONS

Dr. Rajan Kumar Sahoo

INTRODUCTION

When some unusual and abnormal changes occur frequently in atmosphere and weather conditions i.e. temperature, radiation, rain fall, water and air we say that there is change in climate. Rise in atmospheric temperature, reduction in the intensity and duration of rainy period, frequency of flood in some dry areas depletion of ground water, shifting and shrinking of cooling period, unpredictable changing pattern of monsoon, occurrence of natural disasters, increasing generation of heat waves are some of the symptoms of the climate change. In these types of changes the loss to the life, property and economy is more in comparison to the gain which arises in certain situations. So at this juncture it is thought pertinent to make an indepth study on the impact of the climate change on the agricultural productivity.

OBJECTIVES

Considering the importance of climate change in the world to-day, expecting its fearful incidence in future the study was planned with the following objectives.

- To study the impact of climate change on the agricultural productivity of the economy.
- To suggest possible adaptations for mitigating the consequences.

METHODOLOGY

The paper was prepared collecting data from secondary sources: Various research reports, journals magazines have been consulted for the above purpose.

* Lecturer (Senior Scale) in Economics, B.S. College, Nuahat, Arakhpur, Jajpur – 754 024 (Orissa)

CLIMATE CHANGE ITS POSSIBLE CAUSES :

The earth has experienced numerous periods of cooling and warming over its long history. For example about 18,000 years ago, the earth was about 5°C cooler than it is to-day. The earth in fact passed through mini-ice age from about 300 to 1700 AD. The rise in globe's temperature is due to variety of factors both natural and anthropogenic. This increase has been between 0.3°C and 0.8°C over 20th century. The analysis of temperature data for last fifty years reveals that there is an increase of 0-7°C in winter and 1.4°C – 5.8°C rise in global temperature by 2100.

Before the industrial revolution, climate change was a gradual process but in the recent past, the rate of change has been triggered due to tremendous increase in pollution, found to be a consequences of industrialization, fossil fuel consumption, technical changes, transport sector changing land use pattern and waste decomposition carried out in the developed countries and the economies in transition.

Climate and weather patterns naturally change and fluctuate. But there have been noticeable differences within the last 150 years that could be the result of human caused activities. Out of the human caused activities the major cause is deforestation. Unabated depletion of forest cover the world over is responsible for about a fifty of Green House Gases (GHG) emissions entering the atmosphere through the cutting and burning of 45,000 Sq. miles of forests across the globe each year.

The Green House Gases include Carbon dioxide Methane, Chlorofluoro carbons, Nitrons Oxide, Ozone etc. These Green House Gases are a natural part of the atmosphere and are beneficial when they are in balance, but when human caused emissions cause larger than normal concentrations, problems begin.

The transport sector accounts for a quarter of the world's energy related output of Green House Gases (GHGs) which are trapping sunrays in atmosphere and causing ice caps to melt, sea levels and weather patterns to shift wildly and other problems relating to climate change. In fact 90% of internationally traded goods are carried by sea and maritime transport is by far the most carbon – efficient mode of transport with only 14 grams of carbon dioxide emissions per ten kilometer. Shipping is followed by train transport, then road transport, Air transport has by far the highest carbon dioxide emissions per ten

kilometer (a minimum of 600 grams) illustrating the high relative climate impact of such transport.

Philip Bagnoli of the Organization for Economic Co-operation and Development (OECD) said increased deliveries of goods such as flowers from Africa apples from New Zealand and shoes from Argentina could compound carbon emissions and counter act the clean energy gains from the WTO talks.

IMPACT OF CLIMATE CHANGE ON AGRICULTURAL PRODUCTIVITY :

Fluctuations of the climate have dramatic effects on agricultural productivity. It affects crops both positively and negatively from region to region. These effects have been described below for making an assessment of the two.

The Positive effect of Climate Change :

Increased concentration of carbon dioxide may boost crop productivity stimulating the process of photosynthesis. Increased carbon dioxide also suppress photorespiration in C_3 plants such as wheat, rice and soyabean making them more water efficient. The C_4 plants such as maize sorghum, sugarcane, millet, pastures and forage grasses at increased carbon dioxide level photosynthesize more efficiently than C_3 plants.

Due to higher temperature while some species benefit others do not. A warmer climate might interfere with germination or other key stages in their life cycle.

Because of changing climate the poleward edges of the mid-latitude agricultural zones – Northern Canada, Scandinavia, Russia and Japan in the northern hemisphere and southern Chile and Argentina in the Southern one – may benefit from the combined effects of higher temperatures and CO_2 fertilization.

Global warming will present an opportunity to enlarge the food basket by including jawar, bajra, ragi and a wide range of millets and pulses. Due to global warming North and East Africa, the Middle East India West Australia and Mexico would be warmer and wetter enabling them to produce more grain. Rice growing season as well as area under rice cultivation could increase. This may not happen as higher

surface temperature will increase the evaporation of water thus reducing grain yield.

In Iceland rising temperatures have made possible the widespread sowing of barley. Global warming could lead to increased rainfall during summer monsoon. With 1°C rise in temperature and increase of 100 mm of precipitation, national yield of rice maize and wheat are estimated to increase by 10 percent.

In cooler regions the yields of most crops are expected to increase with increasing temperature, except when the moisture is a limiting factor. The increase in temperature would induce a greater mineralization (hence lessen) the soil organic matter content) and the atmospheric carbon dioxide concentration would tend to increase it. Even shortening of maturity duration of rice with global warming will be beneficial to maintain proper soil health by adjusting an additional leguminous crop in paddy wheat rotation in Punjab, Haryana and Uttar Pradesh.

b) The Negative Effect of Climate Change

Climate change would strongly affect agriculture. Rising level of green house gases are likely to increase global average surface temperature by 1.5°C – 4.5°C over next 100 years, raise sea levels inundating farm land and making coastal ground water saltier, amplify storm and hot spells; shift climate and agricultural zones poleward. Average temperature are expected to increase more near the poles than near the equator. The shift in climate zones will be more pronounced in high latitudes. In mid-latitude regions (45 to 60 latitudes) the shift is expected to be about 200 – 300 Kms for every degree celcious of warming. A warmer climate also reduce soil moisture, evaporation rates increase in mid latitudes by about 5 percent for each 1°C rise in average annual temperature.

In a new climate zone soil types may be unable to support intensive agriculture. Mid latitude yields may be reduced by 10-30 percent due to increased summer dryness.

Extended periods of external weather conditions would destroy certain crops, negating completely the potential for greater productivity through Carbon Dioxide fertilization. The rugged terrain and poor soil would not be enough to compensate for reduced yields in more productive areas.

As inter-tropical convergence zones may migrate poleward bringing the monsoon rain with them, the greatest rainfall and soil moisture will damage crops in semi-arid regions and that additional heat stress will damage crops and especially livestock in humid tropical regions.

Increase in global temperature will lead to droughts in Asia, Africa and Australia and floods in North America causing decrease in agricultural productivity.

It is anticipated that increase in CO_2 concentration will boost the weed population in tropics leading to considerable decline in food grain production.

Higher evaporation rate owing to increased temperature will lead to shortage of water needed for irrigation purposes – Global warming will alter the rain fall pattern considerably. Monsoons will probably become more intense causing greater flooding. More rain will fall in shorter periods. This is already happening in Southern Africa regions. The change in precipitation will have impact on local agriculture and vegetation. It is expected that by 2020 in some African and Asian countries "yields from rainfed agriculture could be reduced by upto 50%. The problem of drought and desertification will increase in tropical regions while more rain fall may be expected in temperate regions. Due to change in wind pattern the rain-fall will not be uniform. In future traditional agricultural lands will receive less rainfall while deserts will receive more rainfall.

Climate change could result droughts and heavy floods in the Indio-gangetic plains, unseasonal rainfall posing a threat to crops nearing, maturity. Yields of some crops in India like wheat rice and pulses will go down. It would present a major challenge to India's prospects of self – sufficiency in food production. This can affect food security with dare consequences for the poorest societies in the world. Physical access to food can be endangered by such changes while economic access will be further eroded due to damage to livelihood security caused by adverse changes in temperature and precipitation. The rise in prices of staple foods now occurring nationally and globally will further enhance poverty related endemic danger.

ADAPTATIONS

The risks emanating from climate change unless addressed with a sense of compelling urgency, there could be catastrophic consequences for the world as a whole. The worst suffering would be fall on the least equipped especially the poor in developing countries who are unable to cope with such adverse consequences. It is utmost need to check the rise of green house gases in the atmosphere in order to keep the globe temperature stable to avoid catastrophic effect of global warming.

The following adaptive actions may be taken to lessen or over come adverse effects on agriculture due to climate change.

i) Switching cropping sequences
ii) Sowing earlier
iii) Adjusting timing of field operations.
iv) Introduction of later-maturing crop varieties or species.
v) Conserving soil moisture through appropriate tillage methods and improving irrigation efficiency.
vi) A major adaptive response will be the breeding of heat and drought resistant crop varieties by utilizing genetic resources that may be better adapted to new climate and atmospheric conditions.
vii) Crop varieties with a higher harvest index will help to keep irrigated production efficient under conditions of reduced water supplies or enhanced demand.
viii) Genetic manipulation may also help to exploit the beneficial effects of carbon dioxides, enhancement on crop growth and water use.
ix) Production can be improved through judicious use of organic manure, fertilizers, irrigation water, nitrification inhibitors, fertilizer placement and their scheduling.
x) Increase soil organic carbon through minimal till age and residue management.
xi) Improve energy use efficiency in agriculture through better designs of machinery and by resource conservation practices.
xii) Change land use by increasing area under bio-fuels, agro – forestry – but not on the cost of food production.

xiii) Improve management of livestock population especially ruminants and its diet.

xiv) Organic farming and Green Agriculture are environment friendly and will help prevent damage to the basic life support systems of soil, water, bio-diversity forests and the atmosphere.

xv) A Global Climate Change Venture Fund could also help finance transfer of climate friendly technologies to developing countries on concessional terms.

xvi) Developing countries and developed countries should set up a network of R & D institutions which would specialize in technological innovation in the field of climate change, like CLEANNET recommendation of India at the Gleneagles in G8 + G8 summit in 2005.

CONCLUSION :

Climate change is a great threat to the life and economy and agricultural productivity in the globe. Its challenging risk can be mitigated through many adaptive measures. Its real challenge at the national level can be over come by integrating climate related risks in to development policies. The individuals in their day to day life should be more careful to reduce use of fossil fuels, reverse deforestation implementing reforestation, cut down demand for electricity, use compact fluorescent light bulbs, replace windows with double – pane window. If management of climate change becomes every body's business, we can safeguard ecological, food livelihood security and agricultural productivity to the maximum extent possible.

❑❑❑

THE IMPACT OF GLOBAL CLIMATE CHANGE ON HUMAN DEVELOPMENT AND ECONOMIC GROWTH IN INDIA

Dr. L.N.Dash[1] **Dr. J.K.Tripathy**[2]

At the start of the 21st Century mankind is confronted with the crisis of global climate change that links today and tomorrow. Now it is a human tragedy in the making. Global warming is evident that we are overloading the carrying capacity of the Earth's atmosphere. We are recklessly mismanaging our ecological interdependence. The greenhouse gases that trap heat in the atmosphere are accumulating at an unprecedented rate. World temperatures have increased by around 0.7°C since the advent of the industrial era and the rate of increase is quickening. The Earth's capacity to absorb CO_2 and other greenhouse gases is being overwhelmed. Humanity is living beyond its environmental means and running up ecological debts that future generation will find it difficult to repay. Atmospheric concentration of CO_2 is sharply rising. They are increasing at around 1.9 ppm each year. For CO_2 alone the annual concentration growth rate over the past 10 years has been around 30 per cent faster than the average for the last 40 years. The current rates of absorption by carbon sinks are overwhelmed. For example, the oceans naturally absorb 0.1 Gt more carbon dioxide per year than they release. Now they are soaking up an extra 2 Gt a year which is 20 times than the natural rate. This has resulted in serious ecological damage. Oceans are becoming warmer and increasingly acidic.

Countries vary widely in their contribution to the emissions. With 15 per cent of world population, rich countries account for about half of the emissions of CO_2 Emissions from India are on a rising trend. India's total emission of CO_2 increased from

682 Mt in 1990 to 1342 Mt CO_2 in 2004, a rise of 97 per cent. It was 3 per cent of total world emission in 1990 which has gone up to 4.6

1. Reader in Economics, North Orissa University, Baripada – 757003 (Orissa)

2. Lecturer in Remote Sensing and GIS, North Orissa University, Baripada – 757 003

per cent in 2004 (Table 1) China has a similar case. There has been an increase of emission by 109 per cent between 1990 and 2004. China's contribution to total world emission was 10.6 per cent in 1990 which went up to 17.3 per cent in 2004. Despite all these, India's per capita carbon footprint is less than 1/10th of that in high income countries. For example, the United Kingdom with a population of 60 million emits more CO_2 than Egypt, Nigeria, Pakistan, Viet Nam and India taken together. The Netherlands emits more CO_2 than Bolivia, Colombia, Peru, Uruguay and seven countries of Central America combined. The 19 million people living in New York State have a higher carbon footprint than the 146 Mt CO_2 left by the 766 million people living in the 50 least developed countries. It is estimated that carbon footprints of the poorest one billion people in the world stands at 3 per cent of the world's total footprint. Living in vulnerable areas, the poorest people are highly exposed to climate change.

By 2030 greenhouse gas emissions are likely to increase by between 50 and 100 per cent above 2000 levels. Meanwhile, the capacity of the Earth's ecological systems to absorb these emissions could shrink. Warmer oceans absorb these emissions less and rainforests could shrink with high temperatures and reduced rainfall. Atmospheric stocks of greenhouse gases are rising with increase in emissions. Total emissions of all greenhouse gases amounted to around 48 Gt CO_2 e in 2004 which is an increase of one-fifth since 1990. Rising concentration of greenhouse gases mean that global temperatures will continue to rise over time. A doubling of CO_2 stocks in the Earth's atmosphere would raise average global temperature between 4 and 5^0 C. The last two decades of the 20th Century were the warmest since 1860. While the global warming was 0.3 – 0.6^0 C since 1860, the Earth's surface temperature is projected to increase by 1.4 to 5.8^0 C which is greater than that experienced over the last 10,000 years.

EFFECTS OF CLIMATE CHANGE

All development is ultimately about expanding human potential and human freedom. It is about developing the capabilities that empower them to make choices. Climate change threatens to erode human freedoms and limit choice. Sometimes the apocalyptic events go unnoticed in the measurement of GDP or in financial markets. But increased exposure to drought, intense storm, floods and environmental

stress is holding back the efforts of the world's poor to lead a better life. The efforts to deal with climate change will have a direct bearing on human development prospects of a large section of humanity. Failure will consign the poorest 40 per cent of the world's population (about 2.6 billion) to a future of diminished opportunity.

Climate shocks already figure prominently in the lives of the poor. Events such as drought, floods and storms have often terrible experiences for the people who are affected. They threaten lives and leave people feeling insecure. It has been estimated that about 262 million people were affected by climate disasters annually from 2000 to 2004. More than 98 per cent of them are from the developing countries. In the Organisation for Economic Cooperation and Development (OECD) countries one in 1500 people was affected by climate disaster while it was one in 19 in the developing countries. Research in different parts of the world reveals how the various types of disasters push people into low human development trap. It has been found that in the world's most drought prone countries of Ethiopia and Kenya children are more likely to be malnourished if they were born during a drought. In Ethiopia, the drought in 2005 added 2 million additional malnourished children. In Niger, children aged 2 or less born in a drought year were 72 per cent more likely to be stunted. Similarly, Indian women born during a flood in the 1970s were 19 per cent less likely to have attended primary school. Experts around the world have identified India as one of the countries most vulnerable to the ill effects of climate change. Climate change could stall and reverse human development in five ways. First, climate change will affect rainfall, temperature and water availability for agriculture in vulnerable areas. This will give rise to fall in agricultural production and threaten food security. For example, the drought affected areas in India will experience losses in agricultural production undermining efforts to tackle rural poverty. Secondly, about 26 per cent of India's population lives below poverty line who directly depend upon agriculture. Climate scenarios point to huge losses in productivity for food staples linked to drought and rainfall variations.

Global projections of climate change can also have local effects. Most of the states in India are largely dependent on rainfall for irrigation. In India, the drought-prone areas in Andhra Pradesh, Gujarat, Madhya Pradesh and Rajasthan will receive less rain fall. Climate research for Andhra Pradesh shows that because of the rising temperature by 3.5°C

by 2050, there will be decline of 8 – 9 per cent in yields for water intensity crops as rice. In Andhra Pradesh, a survey covering 8 districts in dry-land areas found that droughts occurred on average once every 3 to 4 years leading to losses in output value of 5 to 10 per cent. During the last few years the Chattisgarh region has received less than its share of pre-monsoon showers. Because of temperature rise the coastal regions of Gujarat and Maharashtra will be worst affected. In Rajasthan a 2°C rise in temperature is estimated to reduce production of millet by 10 – 15 per cent. Similarly, with the rise in temperature by 3°C and 3.5°C, Soybean yields in Madhya Pradesh will decrease by 5 per cent compared to 1998. Losses on this scale could result in increased vulnerability in rural households. Falling production would reduce the amount of food grown by households for their own consumption, decline in supplies to local markets and diminished opportunities for employment. This is enough to push many farmers below the poverty line. Impact of climate change for farm income in India as a whole suggests that a 2 to 3.5°C temperature increase could be associated with a net farm revenue reduction of 9 to 25 per cent.

Exceeding the 2°C threshold will change the distribution of the world's water resources. Glacier melting poses threats to more than 40 per cent of the world's population. Glaciers are already melting at an accelerated rate. The thousands of glaciers located across the 2400 kms of the Himalayan range are at the epicenter of the emerging crisis. These glaciers form vast water banks. They store water and snow in the form of ice. The flow of water from these resources sustains river systems that are the life blood of the ecological and agricultural systems. The glaciers in the Himalayans are shrinking at the rate of 10 to 15 meters a year. Though the pace of melting is uneven, the direction of change is clear. The Gangotri glacier, one of the main water reservoirs for the 500 million people living in the Ganges basin, is shrinking by 23 meters a year. A study by the Indian Space Research Organisation covering 466 glaciers found a 20 per cent reduction in size. Accelerated glacier melting creates some immediate human development risks. Avalanches and floods pose high risks to densely populated mountain regions. As glacier water banks are run down, the Brahmaputra and Ganges will be seriously affected. These river systems provide water and sustain food supplies for millions of people in India. If the Ganga retreats at the present level, then over the next 25 years the Ganga

could initially swell in volume because of increased melting, but then dry out as the water supply in the mountains runs low. One-third of India's irrigated land area will face water shortage. This will endanger the lives of about 400 million people who live in the river plains and depend upon it for supply of water. Similarly, projections for the Brahamaputra point to reduced flows between 14 and 20 per cent by 2050. The climate change scenario for glacier melting will interact with the already experienced severe ecological problems and exert pressure on water resources. For example, in India the allocation of water between states for the purpose of using in agriculture and industry is creating tension. Reduced glacier flows will intensify these tensions. Tropical glaciers are retreating even more rapidly than those in the Himalayas. During the last 25 years some glacier systems in the tropics have transformed. The large quantities of water locked in the glaciers (also in the polar ice caps) will be released as a consequence of warming. Their impending disappearance will have disastrous implications for economic growth and human development. This together with an increase in the thermal expansion of the ocean will make the global mean sea level rise by 9 cm to 88 cm.

STRATEGIES FOR MITIGATION AND ADAPTATION

Climate change addresses a threat to the poor and future generations. It raises important questions about social justice, equity and human rights. The dangerous climate change is the avoidable catastrophe of the 21st Century and beyond. The battle against it must be won. Since it is a global public good, efforts to tackle it only at the national level will not deliver the desired result. The common but differentiated responsibility will be more effective to tackle it. Political momentum is gathering pace. Many governments are setting bold targets for cutting greenhouse gas emissions. The dialogue between developed and developing countries is strengthening. But the international efforts fall short of the minimum needed to resolve the crisis. Some countries in the developed world are yet to establish ambitious targets for cutting greenhouse gas emissions. With the expiry of the Kyoto protocol in 2012, developed countries must take the lead. They have the financial and technological capabilities to initiate cuts in emissions. The global mitigation effort could be enhanced if a post-2012 Kyoto framework could incorporate mechanisms for transfer of finance and technology. The Bali Action Plan, decided upon in the UN meet on Climate in Dec.

2007 demanded that the countries work on greenhouse gas mitigation and adaptation to climate change and find the finances and technology to do without altering the existing Framework Convention on Climate Change. It could also incorporate global carbon budgets for climate change mitigation. However, the target should be backed by clear-cut policies. To start with, a price can be put on carbon emissions. There are two ways of putting a price on carbon. The first is to directly tax CO_2 emissions. However, carbon taxation does not imply an increase in the overall tax burden. The revenues can be used in a fiscally neutral way to support wider environmental tax reform. Marginal taxation levels would require adjustment in the light of greenhouse gas emission trend. Fuels that contain more carbon like coal would be taxed more heavily than low carbon fuels. An efficient level of carbon taxes with the benefits of reducing damages from global warming has to be estimated. The second route to carbon pricing is 'cap-and-trade'. According to this method, the government sets an overall emissions cap and issues tradable allowances that grant business the right to emit a set amount. The cap sets quantitative ceiling on emissions. Because of the urgency of achieving early quantitative cuts in greenhouse gas emissions, well-designed 'cap-and-trade' programmes have the potential to play important role in mitigation. A cap-and-trade programme that aims at 20-30 percent cut in CO_2 emissions by 2020 should be adopted. The revenue collected from carbon taxation and cap-and-trade can be utilized to finance progressive tax reform with reduction in taxes on carbon and investments and the development of low carbon technology.

One of the greatest challenges before India is the curtailment of excessive fossil fuel use with regard to the concern for climate change. That is because India faces the urgent and immediate task of providing affordable energy services to the poor. Living without electricity affects many dimensions of human development. Energy services not only play important roles in fastening economic growth, but it also enhances the quality of life of people in the country. The vast deficit in access to basic energy services has to be considered alongside concern over the rise in CO_2 emissions. The number of people in India living without access to electricity is about 500 million which is more than the total population of the European Union. Changing this picture is vital for human development. The challenge is to access to basic energy services while limiting increases in per capita carbon footprint. Enhanced

efficiency in energy use and the development of low-carbon technologies hold the key. The carbon capture and storage (CCS) is important because it hold out the promise of coal-fired power generation with near-zero emissions. With a more active programme of public-private investment aligned with carbon pricing, CCS technologies could be developed and deployed more rapidly. Of late, India has taken steps to save energy. It will have the world's first market for trading in energy savings. Under the National Action Plan on Climate Change, the power ministry has prepared the blueprint for trading in energy by industrial plants that save energy beyond the targets set for them. Under the plan formulated by the Bureau of Energy Efficiency (BEE) under the National Mission on Enhanced Energy Efficiency the government will set mandatory targets to be achieved by each large industrial units and plant in energy-intensive sectors, which include cement, aluminium, steel, power, textiles, fertilizers, railway, paper and pulp industries. Named the 'Perform, Achieve and Trade' or PAT scheme, energy reduction targets would be set for each plant individually. Under the global compact on climate change, there exists an international trade in greenhouse gas emission reduction. India, which has extremely low emissions as compared to the industrialized countries, has taken the lead.

Without urgent mitigation action, the world cannot avoid dangerous change. But the most stringent mitigation will be insufficient to avoid major human development setbacks. The world is already committed to further warming because of the inertia built into climate systems and the delay between mitigation and outcome. For the first half of the 21st century, there is no alternative to adaptation. Many countries are investing in the development of climate defence infrastructures. The UK is spending $1.2 billion annually on flood defences. In the Netherlands, people are investing in homes that can float on water. The developing countries including India face far more adaptation challenges. These challenges have to be met by the governments and by the people themselves. For example, in the Ganges delta, people are erecting bamboo flood shelters on stilts. However, there is a huge gap between the adaptation strategies followed by the developed countries and India. Climate change requires integration of more elaborate adaptation strategies into all aspects of policy development and planning. The stock of information regarding climate risk in India is insufficient. Often the country lacks the capacity and the resources to assess climate risks. It

requires allocation of adequate funds for meteorological research and capacity building.

Sufficient infrastructure need to be built for pre-disaster risk management. It has been estimated that every $1 invested on it can prevent losses of $7. Many countries lack the financial resources required for infrastructural adaptation. Beyond disaster prevention, the development of community-based infrastructure for water harvesting can reduce vulnerability and empower people to cope with climate risk. Partnership between communities and local governments in different states such as Andhra Pradesh and Gujarat provide examples. Climate Change is creating incremental risks in the lives of the poor. Insurance for social protection can help people cope with risks while expanding opportunities for employment, nutrition and education.

SELECTED REFERENCES

Agarwal, P.K. and S.K.Sinha, "Effect of Probable Increase in Carbon Dioxide and Temperature on Wheat Yields in India," *Journal of Agricultural Meterology,* 48(5), 811-814.

Asian Development Bank. 1994. *Climate Change in Asia: India Country Report,* Manila: ADB.

Bhattacharya, Suman. *et al.* 2006 "Climate Change and malaria in India," *Current Science,* Vol.90, No.3, 369-375.

Government of India. 2007. *Eleventh Five-Year Plan, 2007-2012,* New Delhi: Government of India.

Kavi Kumar, K.S. 2003. "Climate Change Impacts on India," in Michael A. Toman, *et al. India* and *Global Climate Change,* New Delhi: Oxford.

Kavi Kumar, K.S. and Jyoti Parikh. 2001a. "Indian Agriculture and Climate Sensitivity," *Global Environment Change*, 11(2), 147-54.

Kavi Kumar, K.S. and Jyoti Parikh. "Climate Change Impacts on Indian Agriculture: The Ricardian Approach," in *Measuring the Impacts of Climate Change on Indian Agriculture*, World Bank Technical Paper No. 402, Washington, D.C.: World Bank.

Lal, M. *et al* .1999. "Growth and Yield Responses of Soybean in Madhya Pradesh, India to Climate Variability ad Change," *Agricultural and Forest Meteorology*, Vol.93, PP. 65-66.

Lal, M. *et al.* 2001. "Future Climate Change: Implications for Indian Summer Monsoon and its Variability," *Current science*, Vol. 81, No.9

Ramakrishna, Y.S. *et al.* Impact of Climate Change Scenarios on Indian Agriculture: Evidences, Hyderabad: Central Research Institute for Dryland Agriculture.

Ravindranath, N.H. *et al.* 2006. "Impact of Climate Change on Forests in India," *Current Science,* Vol.90, No.3, 354-361.

Samuelson, Paul A. and William D. Nordhaus. 2007. *Economics*, New Delhi: Tata McGraw-Gill.

Sathaye, Jayant., P.R.Shukla, and N.H.Ravindranath. 2006. "Climate Change, Sustainable Development and India: Global and National Concerns," *Current Science,* Vol.90, No.3, 314-325.

UNDP. 2007. *Human Development Report 2007/08,* New York: UNDP.

❑❑❑

THE DYNAMICS OF CLIMATE CHANGE AND THE CDM STRATEGY

Dr. Sarita Supkar[1] **Dr. Sanjay Satapathy[2]**

INTRODUCTION:

Global climate change, more precisely global warming is a reality. Changes in the cloud formation and rainfall pattern, rising sea level and melting down of the arctic snow cap, etc. led to an almost unanimous consensus as regards the changing climate. Consumption pattern' of resources and energy of the affluent countries and the poverty syndrome of the poor countries both contribute towards the declining state of planet's health. The human interference with a fragile climate system may trigger irreversible global warming.

Rapid industrialization has resulted in the release of large amount of CO_2, methane, nitrox oxide, hydro fluorocarbon, per fluorocarbon and sulphur hexafluoride etc. Know as GHGs (Green House Gases) into the atmosphere. The anthropogenic activities like fossil fuel burning, cement manufacture, deforestation are instrumental in the increasing concentration of GHGs, CFCs (chlorofluorocarbons) and other ozone-depleting substances, responsible for global warming, 'penetration of harmful radiation to earth's surface etc. The gravity of the situation has sensitized the visionaries to comment, "Climate change is a greater threat to the world than terrorism is. Delaying action for a decade or even just years is not a serious option".

To address the pressing international issue, various forums are constituted and mechanisms are developed. This paper attempts to highlight on the CDM (Clean Development Mechanism) and its operational dimensions in the context of global climate change.

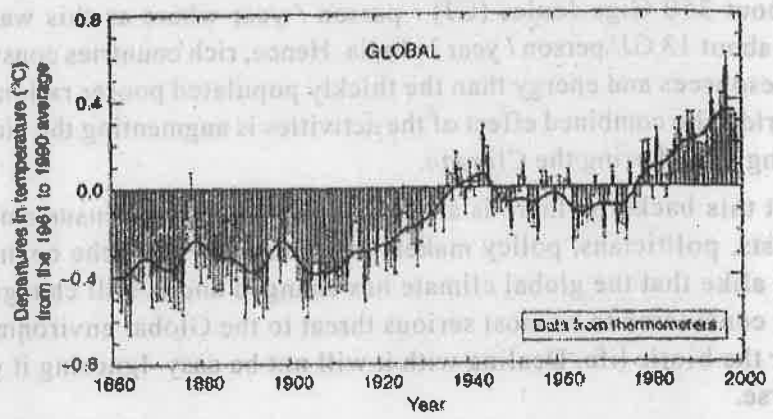
---

1. Reader in Economics, Ramadevi Women's College, Bhubaneswar

2. Reader in Commerce, Ramadevi Women's College, Bhubaneswar

THE GLOBAL CLIMATE CHANGE SCENARIO:

The average temperature of the surface of earth has risen by 0.74°C in a century and half of industrialization. It is expected to increase by another 1.9°C to 4°C by the year 2100.

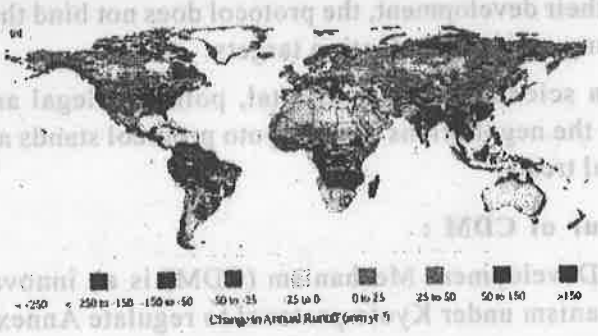


Variations of the Earth's surface temperature for the past 140 years

The average sea level rose by 10-20 cm during the 20th century and an additional increase of 18 to 59 cm is expected by the year 2100. If the higher end of the scale is reached, the rising waters will gallop many areas of the coast line and islands.

Climate change is likely to have an impact in the following ways:

- By the 2080's, substantial dieback of tropical forests and grasslands is predicted to occur, particularly in parts of South America and Africa.
- The availability of water in the rivers of Australia, India, southern Africa, South America, Europe and the Middle East is expected to decrease.



Looking to the near past, the average per capita gasoline consumption in the US during 1992 was 1.26 gallons/ day/ person contributing to a large per capita CO_2 emission of 5.3 metric tons (MT) of C/ person / year compared to roughly 0.3 MT of C/ person / yr in India. The mean commercial energy consumption in the US during 1997 was about 350 Giga Joules (GJ) / person / year where as this was as low as about 13 GJ/ person / year in India. Hence, rich countries consume more resources and energy than the thickly populated poorer rations of the world. The combined effect of the activities is augmenting the global warming and altering the Climate.

At this backdrop there is an almost unanimous consensus among scientists, politicians, policy makers, administrators and the common people alike that the global climate has changed and is still changing. This is considered to be most serious threat to the Global environment and for the biotic life. Dealing with it will not be easy. Ignoring it will be worse.

THE GENESIS OF KYOTO PROTOCOL :

A number of negotiations have been made to control the adverse effects of climate change. On 16th Feb 2005 the Kyoto Protocol came into force without the U.S., the largest emitter of CO_2, QELRCs and the market mechanisms under the protocol became legally binding.

- The Kyoto protocol is legally binding agreement that arose out to UNFCCs to tackle climate change through a reduction of GHGs emissions. Annex-I countries (developed countries) are legally bound to reduce man made GHGs Table-3 emission by approximately 5.2%.
- Recognizing the need for the developing and the least developed countries (called non-Annex-I countries) to have more industries for their development, the protocol does not bind these countries by any emission reduction targets.

From a scientific, environmental, political, legal and economic perspective the negotiations of the Kyoto protocol stands as a landmark international treaty.

The Contour of CDM :

Clean Development Mechanism (CDM) is an innovative market based mechanism under Kyoto protocol to regulate Annex-1 countries

to mitigate there GHG emission, enabling non-Annex-I countries to participate in joint GHG mitigation projects under Kyoto. The developed countries and the economies in transition are required to reduce the GHG emissions below their 1990 levels.

For example, suppose a company in India switched over from coal power to biomass. By doing this the company reduced the carbon dioxide emissions by 1,00,000 tonnes per year and the CDM board certified it. By virtue of this the company is issued with 1,00,000 certified emission reductions (CERs). Under the protocol U.K (an Annex-I Country) has to reduce .the GHG emissions by one million tonnes of carbon dioxide per year. By purchasing this 100000 CERs from the Indian company the target of U.K will be reduced to 9,00,000 million tonnes .

This CERs will playa vital role in the market mechanism of CDM. Certified Emission Reductions or CERs are certificates just like stock. One CER is equivalent to one tonne of carbon dioxide reduced. CERs are given by CDM executives Board to projects in developing countries to certify their reductions of GHG emission.

This CDM is one of the three Kyoto protocol flexibility mechanisms. The other two are joint implementation and international emissions trading.

Joint implementation is like CDM with projects in other Annex-I countries instead of developing countries. Under International Emission's Trading each Annex-I Country has a certified number of emission allowances in line with its Kyoto reduction targets. The reduced emission allowances can be sold to other Annex-I countries. Hence, CDM is the only flexibility mechanism under Kyoto protocol enveloping the developing economics along with the developed ones for the global cause.

Eligibility for CDM:

A project is eligible for CDM benefits if the project will results in a net decrease in GHGs emissions. This is called as 'Additionally'. Technically speaking a CDM project is additional "if anthropogenic emissions of GHGs by sources are reduced below those that would have occurred in the absence of the registered CMD project activity". If the developer has to undertake the project activity because of legal binding, such a project is not eligible for CMD benefits. However, if the law in systematically not in fore or non-compliance is widespread,

then the project can still be eligible. The promotional polices of a country do not disqualify a project from CDM benefits.

The developers have to follow two more steps if the above criteria is fulfilled.

(a) **Outline the alternatives to the CDM activities**: The developer has to outline the possible outcomes of the project if it doesn't get CMD benefits i.e. the base line scenario associated with GHSs emissions. It has to shown that with the CDM project GHGs emissions are reduced. The reduction in the emissions over the baseline in the CERs in the project generates.

(b) Once the possible alternatives are outlined, the developer must show that the CDM scenario satisfies the following.

- Not common practice in the region or sector.
- Is the least financially alternative option available
- Faces barriers preventing implementation if the project was not registered as a CDM project such as either financial, technological and first of its kind.

Annexure A of Kyoto Protocol has categorized 5 major sectors for CDM project eligibility

- Energy
- Industrial process
- Solvent and other product
- Agriculture
- Waste

Baseline for a CDM project: The baseline for a CDM project gives the CHG emissions that would have occurred in the absence of the deposed CDM activities. If a project gets 20,000 CERs it implies that their emissions are 20000 tonnes of CO2 less than the reference point called as base line.

Market mechanism under Kyoto protocol:

The Kyoto protocol has established policies and mechanisms to reduce GHG emission. The mechanism comprises the following:

i. Phasing out subsidy in energy - intensive technologies
ii. Encouraging alternative environment friendly technologies

iii. Taxing CHG emission

The Kyoto protocol has framed a market mechanism for carbon trading between developed and developing economies.

CDM and sustainable development :

While climate change debate has been natural science driven, the sustainable development debate has been framed in a more social and human science oriented approach. Numerous research activities have dealt with a range of issues identifying synergies and trade offs between 'climate change' and 'sustainable development'. An effort is made to formulate climate change as a development problem than an environmental problems as the impact of climate change is felt in vital sectors such as water, agriculture, health and infrastructure. Developing counties are expected to be the worst affected due to poor people/s disproportionate vulnerability because of dependency on rainfed agriculture and their lower capacities to improve is limited. So it is necessary that the vulnerability of these countries is addressed in the CDM and they receive support for economic and social development by the two funds established under UNFCC in 2001. They are the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF). The projects supported under LDCF and SCCF have clear development objectives such as ensuring food security, access to drinking water & irrigation, disaster prevention and control of diseases spreading because of climate change. The purpose of CDM is to assist the developing countries in achieving sustainable development and in contributing to the climate objective of reduction of GHGs emotion in compliance with Annex-I countries. The idea is that the developed countries get some flexibility in emission reductions in exchange for bringing investment in developing countries for project & technologies that reduce green house gases. On the other hand, the Annex-I countries have the option of 'buying' emission reductions from non-Annex-I countries instead of reducing emissions of their own project.

For example - a CDM project such as a company in non Annex - I country switching fuels from coal to biomass results in a reduction of 1,00,000 tonnes of CO_2 per year in the atmosphere. An annex - I country buying these credits can count them for its Kyoto reduction targets.

INDIA AND CDM :

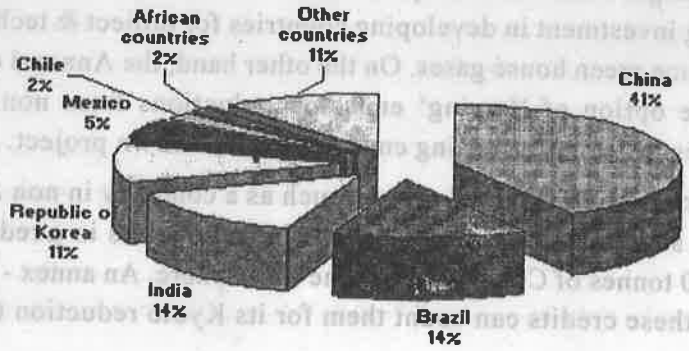
India signed the UNFCCC on 10th June 1992 and ratified it on 1 November 1993. Under the UNFCCC, developing countries such as India do not have binding GHG mitigation commitments in recognition of their small contribution to the greenhouse problem as well as low financial and technical capacities. The Ministry of Environment and Forests is the nodal agency for climate change issues in India. It has constituted Working Groups on the UNGCCC and Kyoto Protocol. Work is currently in progress of India's initial National Communication (NATCOM) to the UNFCCC. India acceded to the Kyoto Protocol on 26 August 2002. Current initiatives in India to improve understanding of climate change, and comply with the requirements of the UNFCCC.

The GHG inventory for the country is being prepared for the base year 1994, and will cover five sectors: energy, industrial processes, agriculture, forestry, and waste.

Support of the Asian Least-cost Greenhouse Gas Abatement Strategy (ALGAS) study, by the Government of India. The study developed a national inventory of GHG sources and sinks, and identified potential mitigation options.

Emissions from paddy cultivation in India were estimated to be about 4 Tg/year (a tenth of United Sates Environmental Protection Agency estimates obtained by extrapolating European and American data to India).

Extensive efforts in conservation of forests and biodiversity. The Participatory Forest Management Strategy of the Government of India secures rehabilitation of degraded areas, conservation of biodiversity, along with sharing of benefits with local people.



Generation of much-needed information about the vulnerability to climate change under the ongoing Indo-UK Climate Change Impacts Programme supported by the Ministry of Environment and Forests, Government of India.

CONCERNS:

CDM is a mechanism with many apprehensions. It has its own grey areas requiring appropriate handling and improvement.

- For a variety of political, practical and ethical reasons the first commitment period of the Kyoto protocol excluded forest conservation/ avoided deforestation for CDM though carbon emission from deforestation covers about 18-25% of all emissions. So far, no international agreement has been stimulated through carbon market towards the projects side tracing the issue of deforestation.
- Carbon capture and storage are the areas of confusion. The monitoring effort required for this is enormous and is yet to be streamlined.
- The extent of domestic emission reduction with-CMD and without-CDM presents a dismal picture. It is apprehended that if the projects that would have happened anyway and are registered as CDM projects then the net effect may be an increase in global emission due to the use of the human assessment driven spurious credits. These credits may also occur because of over stated baselines. The projection may be 'false positive'.
- Some projects may set for high criteria and these will be missed opportunities for emission reduction. This condition can be termed as 'false negative'. In the absence of a comparative cost effective project appraisal considering developed and developing countries alike, on one tonne emission removal project of a domestic power station in a developed country has the milage over the floating in of the same cost project in a developing country with much higher emission renewal potential.
- The large hydro projects have a long gestation period and have been initiated much before the CDM era, the project proponents may window-dress the CDM considerations.
- As the method of accounting for carbon storage in bio-mass are complex there are doubts by many governments and NGOs about

the variations in supply side. There may be the operational requirement of temporary CERs arid long terms CERs. On the other hand the sink projects treatment under CDM does not provide a clear picture.

- Significant volumes of. CERs come from CDM projects at refrigerant, producing factories where the powerful GHG, HFC being by-product. By destroying HFC the factories can have easy carbon credits. Destroying HFC requires a simple and relatively cheap piece of equipment called scrubber. There may be market shift as the HFC emitters can earn more from CDM credits than from refrigerant gases. So checks on product volumes and criteria specification require an inclusion in the policy.

CONCLUSION:

The globe is a conglomeration of uncountable variety of biotic and abiotic mass. The living pattern in the developed and developing shows a through disparity, when nature is forced to find ways and means for its own balance, CDM is a welcome attempt. But theoretically what CDM sounds practically it may be twisted by human interventions. Many developing countries do not see how CDM actually contributes to their sustainable development given its limited transfer of new, low carbon technologies.

One need to think over potential answers to the following questions.

- What are the GHG reducing technologies which may be useful to the developing countries?
- What are the various steps involved in effective technology transfer? How can they result in capacity building in developing countries?
- If technology transferred generated significant capabilities, what are the barriers acting against their widespread diffusion?
- What will be the new market of CER stock and the role of the marketers?

Green technology will be more expensive than brown technology so for their wide adoption incentives are to be introduced. Developing countries may face a constraint in matching their needs with the appropriate technological solutions that reduce GHG emission. Time will have acid test for the policy implication and the reality.

□□□

CLIMATE CHANGE & ITS IMPACT ON AGRICULTURE

Dr. Satyabrata Mishra*

INTRODUCTION :

In the recent years it is contemplated that monsoon rainfall has been erratic. The wider oscillations in asymmetric trend of rainfall throughout India can be attributed to climate change. The survival of life on earth depends on the absorption of incoming solar radiation which warms the surface of the planet. This incoming energy is reflected back into space as low intensity infra red radiation. The atmosphere of earth contains small quantities of carbon dioxide and some other gases collectively called green house gases or GHGs which absorb some of the outgoing infra red radiation and reflect it back to earth and consequently increasing the warming of the surface. This secondary warming leads to further emission of infra red radiation into space. At any given level of concentration of green house gases, the average temperature of the earth settles at a level at which the energy that comes in with solar radiation is balanced by the energy radiated out. In the absence of the effect created by the composition of the atmosphere around the earth, our planet would be a cold orb with an average temperature of minus 18 degrees centigrade and quite inhospitable for life. Our atmospheric blanket raises the average temperature to about plus 14 degrees centigrade. The climate of the earth has also been variable over the centuries and millennia of its existence. This is attributed to natural factors such as fluctuations in solar radiation or large dust clouds created by massive volcanic explosions and changes in the tilt of the earth, relative to sun that affect the average temperature of the earth. The major concerns relate to –

a. The concentration of greenhouse gases in the atmosphere rises sharply and consequently raises the average temperature at which the balance between incoming solar radiation and the outgoing infra red radiation is realized.

* Deptt. Of Economics, M.P.C. (A) College, Takhatpur, Baripada, Mayurbhanj, Orissa

b. The magnitude of change is faster and threatens to be larger than at any time in human history.

c. The change is due in large part to the consequences of human actions and not due to natural causes.

The main green house gas (GHG) is carbon dioxide. The others include methane nitrous oxides and halocarbons. The concentration of these gases in the atmosphere was more or less constant before the industrial revolution and the variability of climate was largely due to natural causes. The concentration of these gases in the atmosphere has increased sharply. The pre industrial concentration of carbon dioxide was 280 (PPM) which has increased to 380 (PPM) in the post industrial concentration. The bulk of this increase is on account of the burning of fossil fuels and deforestation.

The present paper makes an ingenious endeavour to delineate the concept of climate change, causes of climate change, impact of climate change on agriculture, cost benefit analysis of the enhanced green house effect and policy measures to dispense with the catastrophic repercussions.

Causes of Climate Change: Rising temperatures influence the pattern of precipitation, changes in rainfall patterns have already been noticed. The Inter Governmental panel on climate change (IPCC) reports that the frequency of heavy precipitation events has increased over most land areas. This is consistent with warming and increase of atmospheric water vapour. Green House Gases found in the atmosphere cover the earth like a blanket. Although a high concentration of these gases is harmful for the environment, if it were not for these gases, our planet would have been about 31^0 Celsius colder than it is now of all the green house gases emitted into the atmosphere, carbon dioxide and methane are in the largest concentration. Together they make up about 90% of green house emissions. The green house effect was named by French Physicist Jean Baptist Joseph Fourier in 1827. He compared the earth's atmosphere to a closed glass vessel. He identified this green house where plants are kept. He observed that the air around the earth filters in sunlight exactly like a glass roof and hence gave that name to the phenomenon. Carbon dioxide is the major green house gas emitted.

Global warming is also known as the green house effect. If it continues at the current rate, by the year 2100, the temperature of the earth is expected to rise by 1.8° to 4° Celsius.

The main contribution to global warming has been on account of human induced activities such as fossil fuel consumption, industrial activities, agriculture systems changing land use pattern and waste decomposition carried out in the developed countries. Though India is among top ten GHG emitters in the world the present GHG emissions from India as a whole in terms of carbon dioxide and its equivalents were little above 3% of the global GHG emission. Another major cause of global warming is deforestation. Unabated depletion of forest cover the world over is responsible for about a fifth of GHG emissions entering the atmosphere through the cutting and burning of 45000 sq. miles of forests across the globe each year.

Green house effect (GHG): Green house gases are those gaseous constituents of the atmosphere – both natural and anthropogenic that act as a partial blanket that trap some of the thermal radiations from the earth's surface and makes it substantially warmer than it would otherwise be. The phenomenon of trapping of heat reflected infra red radiation by atmospheric gases within the surface – troposphere system and thereby raising Earth's atmospheric temperature is called green house effect. Water vapour carbon dioxide (CO_2), nitrous oxide (N_2O) methane (CH_4) and Ozone are primary green house gases in the Earth's atmosphere. Carbon dioxide and methane are the major contributors to the anthropogenic GHG emission.

Unprecedented climate changes on a global scale during the past one decade resulting from the green house effect out of anthropogenic reasons have serious implications on the natural eco systems. The fast vanishing Arctic's perennial polar caps and the incidence of retreat of Himalayan glaciers lend further credibility to the phenomenon of global warming. Global warming is affecting physical and biological systems of every continent. A major international study has warned that global warming may drive a quarter of land animals and plants to the edge of extinction by 2050.

India is the fifth largest emitter of carbon dioxide, but lacks a credible policy to address human induced climate change. Reluctance to take action is well apparent in a country where per capita emissions are still a fraction of those in the US or Europe. In about 30 years at present growth rates, India's emissions will reach European per capita level. At the Ninth Biennial Conference of the International Society for Ecological Economics, New Delhi, Dec 15 – 18, 2006 the point was repeatedly and forcefully made that India is neither offering self restraint nor claiming a carbon debt by asking for reduction in other countries emissions.

The variability in climate and precipitation predicted from simulation models at the regional level is far greater than that at the global scale. Kattenberg et al commented that considering all models at the 10^4 – 10^6 Km^2 scale temperature changes due to Co_2 doubling varied between $+0.6^0$ C and $+7^0$ C and precipitation changes varied between – 35% and +50% of control run values with a marked inter-regional effects combine numerous positive and negative impacts. Global warming would alter precipitation patterns evapotranspiration and the length of growing seasons, affecting food supplies, changing crop and forest growing regions, raising sea level spreading disease and pests and reducing the number of animal species.

Impact of Climate Change: Climate change would strongly affect agriculture. Most agricultural impact studies are based on the results of general circulation models (GCM_s). These climate models indicate that rising level of green house gases are likely to increase the global average surface temperature by 1.5^0 – 4.5^0 C over the next 100 years, raise sea-level inundating farm land and making coastal ground water saltier, amplify extreme weather events such as storms and hot spells shift climate zone pole ward and reduce soil moistures. Impact studies consider how these general trends would affect agricultural production in specific regions. Most studies have assumed that agricultural technology and management will not improve and adapt. New studies are becoming increasingly sophisticated. Adjustments experiments now incorporat assumptions about the human response to climate change.

Increased concentrations of CO_2 may boost crop productivity. In principle higher level of CO_2 should stimulate photosynthesis in certain

plants, a doubling of CO_2 may increase photosynthesis rates by as much as 30 to 100% Laboratory experiments confirm that when plants absorb more carbon they grow bigger and more quickly. This is true for C_3 plants (so called because the product of their first bio chemical reactions during photosynthesis has three carbon atoms). Increased carbon dioxide tends to suppress photo-respiration in these plants, making them more water efficient. C_3 plants include such major mid-latitude food staples as wheat, rice and soybean. The response of C_4 plants on the other hand would not be as dramatic although at current Co_2 level these plants photosynthesise more efficiently than C_3 plants, C_4 plants include such low-latitude crops as maize, sorghum, sugarcane and millet, plus many pastures and forage grasses.

Climate and agricultural zones would tend to shift towards the poles, because average temperatures are expected to increase more near the poles than near the equator, the shift in climate zones will be more pronounced in the higher latitudes. In the mid-latitude regions (45 to 60 latitude) the shift is expected to be about 200-300 KM for every degree Celsius of warming, since today's latitudinal climate belts are each optimal for particular crops. Such shifts could have a powerful impact on agricultural and live-stock production. Crops for which temperature is the limiting factor may experience longer growing seasons. While some species would benefit from higher temperatures, others might not. A warmer climate might for instance interfere with germination or with other key stages in their life cycle. It might also reduce soil moisture, evaporation rates increase in mid-latitudes by about 5% for each 1^0C rise in average annual temperature. Another potentially limiting factor is that soil types in a new climate zone may be unable to support intensive agriculture as practised today in the main producer countries.

The impact on yields of low-latitude crops is more difficult to predict while scientists are relatively confident that climate change will lead to higher temperatures, they are less sure of how it will affect precipitation – the key constraints on low latitude and tropical agriculture. Climate models suggest that the inter tropical convergence zones may migrate poleward, bringing the monsoon rains with them. The greatest risks for low latitude countries are that reduced rainfall and soil moisture will damage crops in semi-arid regions and additional heat stress will damage crops and especially livestock in humid tropical regions.

The impact on net global agricultural productivity is also difficult to assess. Higher yields in some areas may compensate for decreases in others – but again they may not, particularly if today's major food exporters suffer serious losses. In addition it is difficult to forecast to what extent farmers and Govt. will be able to adopt new techniques and management approaches to compensate for the negative impacts of climate change.

Cost & Benefit Analysis (CBA): Concerted efforts are aimed at global cost benefit analysis of the enhanced green house effect. In this context the contribution of Nordhaus has been unique. Rowlands refers to the earlier work by Nordhaus as a prescription to the U.S. administration to avoid cooperative action which commanded significant respect in that country. His work has indeed supported the US position in international negotiations against emission reduction. Nordhaus presents an optimization model that is purposefully designed to run on a personal computer, which is in stark contrast with the scientific approach employing cray super computers to run GCMs. While GCMs are still criticized for being too abstract and simple. Nordhaus rejects complex models in favour of transparency. The transparency is rhetorical and the reported outcomes conceal the manipulation of quantitative uncertainty and value commitments. His approach requires developing the scientific information to obtain highly simplified aggregate relationship. The way in which uncertain future events are characterized is particularly revealing. The main treatment of uncertainty is sensitivity analysis. The way in which revenues from a carbon tax are used (recycled) has significant impacts on welfare and GDP estimates. For example introducing carbon taxes while reducing distortionary taxes e.g. on labour can cause gains of consumer and producer surplus (changes in deadweight loss) and their size determines the welfare impact of revenue recycling Nordhaus found annual GDP gains of $137 thousand million (1989 dollars) when taking this into account and that the optimal emissions reduction rose from 8.8 to 32% which was associated with taxation moving from $5.24 to $59.00 per tonne Co_2 equivalent. These results were for a deadweight loss of $0.3 per dollar of revenue, although Nordhaus notes estimates for the US are $0.5 to $1.0 and the welfare gains would be much higher. Hence the entire

outcome of the model is reversed from GDP losses to GDP gains by having carbon taxes replace existing taxes.

Another aspect of uncertainty is the discussion of the difficulty to calibrate catastrophic scenarios, which might be equivalent to the damages from a major war or from a half century of communist rule. Nordhaus pointed out that such catastrophes are treated as known threshold events at which large losses of GNP occur. The states are assumed to be known, can be avoided and while large are bounded. There is considerable optimism concerning the ability to assess the risk of future events and the belief is expressed that many of the uncertainties can be resolved by the passage of time. This is a classic example of strong uncertainty being ignored and weak uncertainty being super imposed. Stern report reveals that the overall cost and risk of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever. If a wider range of risks and impacts is reckoned, the estimates of damage could rise to 20% of GDP or more. In contrast the cost of action-reducing greenhouse gas emissions to avoid the worst impacts of climate change can be limited to around 1% of global GDP each year.

Challenges Ahead: Some of the problems facing economic evaluation of the enhanced green house effect are –

a. multiple baseline scenarios making cost assessments non comparable

b. large scale long term changes simply fail to hold so, there is no basis for comparison of winner and losers

c. control measures being in conflict with actions under business as usual

d. use of GNP figures bounded by historical estimates ignoring the impact of climate change on relative prices.

e. Numerous adhoc assumptions to cover partial ignorance

f. Value transfer out of time and place

g. Excessive aggregation.

The cost of reducing CO_2 emissions may be quite high or there may be net gains depending upon the options chosen by the analyst. Economic assessments of the enhanced green house effect fail to address environmental and social complexity. Specific problems are the treatment of uncertainty in the estimation of benefits and cost, the value of morbidity and mortality, the distribution of costs and benefits the moral standing of future generations and marginal welfare analysis loses its theoretical basis.

Another challenge is how to treat long term damages incurred by future generations. Implicitly the regard given to future generation plays an important role in the value placed upon climate change projections because future generations are expected to suffer the worst consequences and delaying action is largely justified by this intergenerational externality. The way in which regional impacts are expected to materialize influences international negotiations on the control of GHGs, the timing nature and extent of those controls.

Policy Implications: The international efforts to address climate change formally began with the adoption of United Nations Frame Work Convention on Climate Change (UNFCCC) in 1992. The convention divided world's nations into two groups – the industrialised and the developing countries. The former agreed to non-binding commitment to return emissions of carbon dioxide and other green house gases to 1990 levels by 2000. This was followed by Kyoto Protocol, an amendment to UNFCCC adopted at the Third Session of the convention of the parties to UNFCCC in 1997 in Kyoto, Japan. The protocol contained legally binding commitments in addition to those included in UNFCCC. Most of the OECD countries, developing countries agreed to reduce anthropogenic green house gas emissions by at last 5.2% below 1990 level in the commitment period 2008-12 with a shift to cleaner energies such as wind and solar powers. The protocol covers 174 countries globally including India and over 55% of global greenhouse gas emissions. Even though India has no mitigation commitments under Kyoto protocol, it has largest number of projects under the clean Development Mechanism of the Kyoto Protocol mooted to encourage investment in developing countries by promoting the transfer of environment friendly technologies. Till November, 2007, 828 CDM projects have been

registered in 48 countries. Three waste to energy projects to be undertaken shortly at three of Delhi's sanitary landfills at Timarpur, Okhla and Ghazipur are fine examples of green power projects under CDM. Projects in developing countries can earn saleable certified emission reduction credits by reducing green house gas emission. India is currently one of the largest suppliers of carbon credit card in the world with a whopping 29 million carbon credit cards and another 139 million in the pipeline. Carbon credit cards are generated by enterprises in the developing world that shift to cleaner technologies and thereby save on energy consumption, consequently reducing their green house emissions.

Adaption: A wide variety of adaptivc actions may be taken to lessen adverse effects of climate change on agriculture. At the level of farms, adjustments may include the introduction of later-maturing crop varieties or species, switching cropping sequences, sowing earlier, adjusting timing of fields operations, conserving soil moistures through appropriate tillage methods and improving irrigation efficiency. Some options such as switching crop varieties may be inexpensive while others such as introducing irrigation especially high efficiency, water conserving technologies involve major investments. Economic adjustments include shift in regional production centers and adjustments of capital labour and land allocations on the basis of comparative advantage.

A major adaptive response will be the breeding of heat and drought resistant crop varieties by utilizing genetic resources that may be better adapted to new climatic and atmospheric conditions. Collections of such genetic resources are maintained in germ plasm banks which may be screened to find sources of resistance to changing diseases and insects as well as tolerances to heat and water stress and water compatibility to new agricultural technologies. Crop varieties with a higher harvest index will help to keep irrigated production efficient under conditions of reduced water supplies or enhanced demands. Genetic manipulation may also help to exploit the beneficial effects of Co_2 enhancement on crop growth and water use.

Future Strategies: Future green house gas emissions depend on the development pathways driven by economic, demographic, land use, agricultural and energy drivers. The interactions among these key driving

forces are very complex and have profound regional specificity. The galloping population growth of many countries acts as an important catalysts to the emission of GHGs, India which has only 2.5% of the total global land area supports population of about 1.15 billion. There is tremendous population pressure on the limited resources within the country, be it the land availability for agriculture, water resources or energy for consumption. Developing countries must exert genuine efforts to contain the unbridled population growth to ensure sustained development of the society.

There is a need for greater promotion of use of renewal and solar energy. India is the fourth largest producer of wind energy with total wind power potential of over 45000 MW. Wind Mills operating in Tamil Nadu generate electricity to cater to power needs of the local industries. Simple measures such as switching over to compact florescent lamp from the conventional light bulb and larger use of solar energy for household consumption will go a long way in creating awareness about the need for conserving energy and thereby slackening GHG emissions.

Pollution curbing measures such as compliance of Euro/ Bharat emission norms for the different categories of vehicles, banning use of leaded petrol, reduction of sulphur in diesel vehicles and court-mandated conversion of all commercial passenger vehicles – buses, three wheelers and taxis to CNG (Compressed Natural Gas) in Delhi and else where in the country have brought about significant improvements in vehicular emissions in many urban centers in India. There is exigency to ensure strict compliance of the emission norms for different categories of vehicles to curb the vehicular pollution in towns/ cities across the country.

No doubt climatic change has consequential repercussions on erratic monsoon rainfall which is a constraint to buoyant agricultural production as well as to agro-based industries. Accordingly the agriculturists in anticipation of weather forecast and climatic change should transform the pattern of food crops and cash crops to offset the vagaries of oscillating climatic change.

❑❑❑

CLIMATE CHANGE IN INDIA - A FUTURISTIC VIEW

Dr. Padma Charan Dhal[1] **Mr. Gyanindra Dash**[2]

INTRODUCTION

Of late the climate change discussion has moved from controversial to conventional position and economists expect the world to lose a mammoth 2.6% in terms of GDP this year due to extreme weather events. Infact, the loss in regions GDP will be as massive as 6% for the developing and South Asian Nations by 2100. The challenges of climate change and the effects of global warning have galvanised huge public environmental awareness world wide. Finally, it seems humankind is recognising that when we speak about environment we are not speaking about external environment about a nature separate from ourselves, but about ourselves as well. We are recognising that we humankind are not separate from nature, but are a part of the environment and with climate change we are all in it together. There is no escaping the fact. There is an ongoing political and public debate regarding what action should be taken to reduce or reverse future warming or to adapt to its expected consequences.

CLIMATE CHANGE - A HISTORICAL PROFILE

There are numerous indications that our planet is getting warmer. Although, many scientists still believe that there is not enough proof to prove it. Kyoto Protocol under the United Nations Framework Convention on climate change sets reduction targets for a basket of six green house gases linked to global warming, the most abundant being carbon dioxide (CO_2). CO_2 is generated by a multitude of processes ranging from plant and 'animal respiration to the burning of any kind of fuel containing carbon including coal, oil wood and cowdung. For a long time, human activities that generated CO_2 caused only a small amount in the natural cycle of the gas. However, since the Industrial revolution

1. Dept. of Economics, Kharasrota Mahavidyalaya, Singhpur, Jajpur
2. Dept. of Economics, Kendrapara (Auto) College, Kendrapada

when our usage of fossil fuels increased dramatically the contribution of CO_2 from human activities has grown large enough to constitute a significant change of the natural carbon cycle. Since the early 50's as regular measurement of the atmospheric concentrations of CO_2 were started, it has been conclusively established that these concentrations are increasing rapidly driven by human activities. The concentration of CO_2 in the earth's atmosphere was about 280 Parts Per Million by Volume (PPMV) in 1750 before the Industrial revolution began. By 1850, it was roughly 280 PPMV and by 1994 it was 385 PPMV. By 2006 it has increased to 380 PPMV.

It is against this backdrop of knowledge that the Inter Governmental Panel on Climate Change (IPCC) concluded in its second assessment report in 1995 that the current state of knowledge now points towards a discernible human influence on global climate. In this assessment report, the IPCC consisting of 2500 scientists from 130 countries confirmed that man made climate change is threatening life on earth. It bemoaned that under the exiting scenario of economic growth and development leading to green house gas emissions, on a world wide average temperatures would rise by 1 to 3.5° Celsius by the year 2100 and global mean sea level by about 15 to 95 centimeters. It is likely that changes of this magnitude and rapidity could pose severe problems for many natural and managed ecosystems as well as important economic sectors such as agriculture and water resources. Indeed for many low laying and deltaic areas and small islands , a sea level rise of one meter could threaten complete loss of land and extinction of habitation . Climate model projection summarised by the IPCC indicate that increasing global temperatures would cause sea level to rise further and expected to increase the intensity of extreme weather events and to change the amount and pattern of precipitation. Other effects include glacier retreat, species extinction and increase in the ranges of disease vectors. Other scientific speculations include the amount of warming expected in the future and how warming and related changes will vary from region to region around the globe.

IS CLIMATE A DETERMINISTIC SYSTEM ?

A deterministic system evolves out of an initial state according to a specific laws. The evolutionary process is defined by a system of mathematical equation which needs initial and boundary conditions for

complete solution. But one of the recent discoveries the existence of certain system where a small change in the initial conditions could lead to large changes in the subsequent development. This is known as 'Butterfly effect' popularised by Lorenz (1993) of the MIT, USA and Rouella (1999) of France. This effect implies that even miner flaps from the wings of a butterfly could create large disturbances elsewhere. This implies that even a deterministic system could become unpredictable to a certain extent. To measure the predictability of a system we need to define a "phase space" and an 'attractor' but since attractors can not be identified, the predictability of the climate is indeterminate. It is because of the fact that the forcing functions for climate are affected not only by earth's atmosphere, but also by the oceans and the earth's interior.

IMPACT OF CLIMATE CHANGE IN INDIA : A FUTURISTIC VIEW

India measures 3214 kms. from North to South and 2933kms. from East to West with a total Land area of 32,87,782.sq.kms. and a coastline measuring 7516.5kms. plus 1197 islands. It is the 7th largest land owner in the world after Russia, Canada, China. The USA, Brazil and Australia in that order. It is a vast country and has considerable strategic significance on account of its location, size and economic resources. Inspite of its vast natural resource base, it is considerably vulnerable to the impact of climate change. The average temperature change in India is predicted to be in the range of 2.33 to 4.78°C with a doubling of carbon dioxide concentrations. It is also likely that there will be an increase in the frequency of heavy rainfall events in South and South East Asia. Temperatures would rise more in Northern India than in South India. The average number of tropical disturbance days could increase from 17 to 29 a year. In the Indian context, climate change could represent an additional stress on the ecological and socio-economic system that are already facing tremendous pressure due to rapid urbanisation, industrialization and economic development .A study conducted jointly by the Indian Agricultural Research Institute, New Delhi and Central Institute of Dryland Agriculture, Hyderabad reveals that in the current scenario of global climate charge, the effect of khariff season is expected to be less than the rabi season. Rain fall in Rabi season will have wider uncertainty. Khariff rain fall is likely to increase by as much as 10%

The futuristic view of climate change in India may conveniently be discussed under four heads such as on agriculture, water resources, forestry and coastal Zones.

Indian agriculture is fundamentally dependent on weather and agricultural productivity is sensitive to two broad classes of climate induced effects such as (i) direct effect from changes in temperature, precipitation on carbon dioxide concentration and (ii) Indirect effects through changes in soils, distribution and frequency of infestation by pests, insects, diseases and weeds. The vulnerability of agricultural production to climate change depends not only on the physiological response to the affected plant but also on the ability of the affected socio-economic systems of production to cope with changes in yield as well as to changes in the frequency of droughts and floods. Scientists believe that after accounting for farm level adaptation, the loss in the farm level net revenue would range between 9% and 25% for a Temperature rise ol 2°C - 3°C. An assessment in 1998 reveals that a 2°C rise in mean temperature and a 7% increase in mean precipitation would reduce net revenue by 12.3% for the country as a whole. Agriculture in the coastal regions of Gujurat, Maharastra and Karnataka is found to be the most negatively affected . Small losses are indicated for the major food grain producing regions of Punjab, Haryana and Western UP. On the other hand West Bengal, Orissa and Andhrapradesh are predicted to benefit to a small external farm warming.

So far water resources are concerned India receives about 4000 cubic kms. water annually through precipitation, but it is not evenly distributed . The per capita warier availability in the year 2000 was estimated to be 2100 cubic metres. The availability of water for the two years 2025 and 2050 has been estimated as 1700 cubic metre and 1236 cubic metre respectively. The single largest demand for water comes from irrigation. Irrigation consumes more than 80% of the available water. The IPCC in its third Assessment Report predicts that the global temperature will rise by about 1.4 to 5.8°C by the year 2100. This change would be much larger than any climate change experienced over the last 10000 years. Water resources will be affected as precipitation and evaporation patterns change around the world. Reduced water supplies would place additional stress on people, agriculture and environment.

Climate is an important determinant of the geographical distribution, composition and productivity of forests. Therefore changes in climate

could alter the configuration and productivity of forest ecosystems. These changes could have profound implications for traditional livelihood, industry, biodiversity soil and water resources and hence in agricultural productivity. These climate change induced effects would aggravate the exiting stresses due to non climatic factors such as land use changes and the unsustainable exploitation of natural resources. Scientists predict that increased temperature and rainfall could result in increased productivity of forests, migration of forests types to higher elevations and transformation of drier forests types to moisture types.

So far the impact of climate change on coastal zones is concerned, it is found that the United Nations Environment Programme identifies India among the 27 countries that are most vulnerable to sea level rise. The impact of any increase in the frequency and intensity of extreme events could be disproportionately large not just in heavily developed coastal areas, but also in terms of the paralysing devastation in low income rural areas. A case study of Orissa and West Bengal estimates that in the absence of protection, a one metre rise in the sea level would inundate 1700 sq.kms. of predominantly prime agricultural land. The Energy Research Institute, New Delhi provides a districts level ranking of vulnerability to one metre sea level rise by constructing a weighted index. The study also assesses the economic implications of such a rise on the most and least vulnerable districts in order to provide the range of projected economic impacts on the Indian coast. In present value terms the results range from Rs. 2287 billion in the case of Mumbai to 3.6 billion in the case of Balasore.

CLIMATE CHANGE AND ENERGY CRISIS - THE INDIAN SCENE

Today India is at an energy cross road. Either she will build on its multiple renewable energies comprising of cultural energy, peoples energy, solar energy, animal energy embodied in its biodiversity and biomass or will be consumed by by the fossil fuel addition. There are two paradigm conflicts converging in this debate. One paradigm activity is about development. In a period of climate change, should development be equated with more emissions and more ecological vulnerability or should it be equated with less emissions and high levels of adoption and resilience to climate change. The second paradigm wans related to equity in the context of climate changes. Should equity be defined within a non sustainable paradigm in terms of equality in right to pollute or should

it be defined with in a sustainability paradigm in terms of equity in non pollution ? The consequences of the first paradigm are increased CO_2 emission, relocation of polluting activity, displacement of the poor for industry, running high ways and power plants robbing the poor of their right to work and creative work of human energy. The consequences of the second paradigm, the reduced carbon dioxide emissions world wide, the poor get both economic justice and energy justice having their rightful place in an economy with dignity and sustainibility.

CONCLUSION

The solutions to climate change and solution to poverty are the same. Protecting, enhancing and rewarding livelihoods, work, production and consumption patterns centred on people not on fossil fuels. In the case of food, economic justice, and energy equity implies more small farms not less because small farms are people centred and large farms are machinery and chemical centred, which contribute to green house gases.

We need to recognise that even if countries undertake immediate and rapid action to reduce their emissions, some degree of climate change is inevitable. There is an urgent need to significantly improve our ability to plan and adapt to extreme events such as floods, droughts, cyclones and other meteorological harzards. Any robustness that we build into the system in this regard will always stand us in good stead, no matter what climate change actually transpires.

References:

1. Pandey, Mohendra, Global warning and climate change. Dominant publisher and Distributers and New Delhi 2005.
2. Das Gupta, S.P - Environment issues for the 21st century, A Mittal publicaton, 2003.
3. Patwardhan, Ananda, Global warming and India in the seminar issue No. 486, Feb. 2000. p63 - 65.
4. N. Sen Roy (1990) Climate Research in India. A National status report, Indian National Science Academy, New Delhi, India.
5. Intergovermental pane! on climate change 1995. The science of climate changes Eds. J.T Houghton etal. University of Cambridge press, UK PP 195.
6. Shiva, Bandana, Globalisation and climate change in the Business & Economy 14 June 2007. p.120.

□□□

CLIMATE CHANGE AND SUSTAINABILITY OF AGRICULTURE: EMERGING SCENARIO AND STRATEGIES

Ranjita Kumari Mohanty*

ABSTRACT

The impact of Weather and climate on human communities is varied and all pervading and they naturally become the most important component of our physical environment. There are certain climatic phenomena such as droughts, floods, violent tropical storms of hurricane intensity, heat and cold waves which endanger life and property and disrupt even the most sophisticated system.

In climatology the terms 'Weather' and 'Climate' have different connotations. Weather refers to the state of atmosphere at any given time denoting the short term variations of atmosphere in terms of temperature, pressure, wind, moisture, cloudiness, precipitation and visibility. It is the condition of air or atmosphere at a certain place and at certain moment. Climate on the other hand is the sum total of the variety of weather conditions of an area or a place from day to day. Thus, climate may be defined simply as average weather over a long period of time. Climate represents a composite of day to day weather conditions and of the atmospheric elements within a specified area over a long period of time. Climate is an integration of weather and weather is the differentiation of climate. The distinction between weather and climate is therefore, mainly one of time.

Climatic changes are defined as variations and shifting in weather condition over time and space of different scales and magnitude resulting in to change of climate type from warm and moist climate to warm and dry climate or to cool and moist climate. Climatic changes refer to drastic or secular changes in heat balance of the earth atmosphere system, moisture, cloudiness and precipitation caused by external

* Lecturer in Economics, Govt. Women's College, Keonjhar.

factors. The causes and theories of climatic changes are viewed in terms of periodicity of climatic changes which are generally of two types.

(i) Short term climatic changes, ranging from few years to thousands of years.

(ii) Long term climatic changes, those persist thousands to millions of years and are exceed by slow and are always caused by natural factors.

The phenomenon of global climate change has caused agrarian crisis, resulted in Farmers suicide and has become a grave threat and challenge to the livelihood security of the resource poor farmers. Climate change is expected to influence cropping pattern and productivity livestock production, hydrologic balances, input supplies and other components. Our economy is highly vulnerable to climate change due to its geographical location, agro-climatic conditions, high dependence on agriculture and incidence of mass poverty. The climate variations during the last two decades have been visible with observed increase in temperature, greater variability in rain fall, rise in sea level and increased frequency, intensity and duration of natural disasters such as drought flood, cyclone and storm. They have increased the uncertainty and agricultural risk and posed a formidable threat to the sustainability of the ecosystem and agricultural development. Frequent natural calamities have resulted in repeated crop failures and caused catastrophic risk weakening the economic backbone of the farmers. It has posed a formidable challenge to sustainable development of Agriculture.

Rise in mean temperature above a threshold will cause a reduction in yield. However, change in minimum temperature is more crucial than that of the maximum temperature.

High temperature has detrimental effects on crop production of both Kharif crops (July to October) and Rabi crops (November to March).

CLIMATE CHANGE AND CRISIS IN AGRICULTURE :

(i) On cropping pattern and productivity :

Climate change reduces yield of different crops and changes the cropping pattern.

(ii) Decline in Soil fertility

At high temperature, through nutrient availability will increase in the short run, the organic matter content diminishes in the long run resulting in decline in soil fertility. Rain although increases soil moisture causes a fall in actual soil fertility. Interaction of rainfall and temperature has a very profound affect on the vegetation and soil of a place.

(iii) Irregularities of Monsoon:

Rain water is the source of soil moisture and rainfall is one of the most important factors influencing the vegetation of a place.

(iv) Increased need for Irrigation:

With increase in temperature and consequent water shortage there is increase in need for irrigation.

(v) Sea Level Rise

Climate change has also caused a rise in sea level resulting in direct loss of land due to salt water intrusion and soil stalinization and other concerns for agricultural productivity endangering food supply.

(vi) Plant Diseases Pests and Weeds

Climate change is likely to alter the balance between insect pests, their natural enemies and their hosts. Rapidly changing climate, environmental instability and incidence of extreme and unstable weather may reduce the effectiveness of pesticides on targeted p

(vii) Adverse Impact on Natural Ecosystem

Climate change threatens the basic elements of life adversely affecting the natural ecosystem such as forests and socio-economic systems such as access to water, food production and, health, use of land, fishing and environment.

ADAPTATION AND MITIGATION STRATEGIES TO CLIMATE CHANGE:

Coping strategies are the strategies of adaptation and adjustment in agriculture in response to the actual or expected climate stimuli or

their effects which moderates the hams or exploits the beneficial consequences. In the backdrop of adverse effects of climate change following potential adaptation strategies, policy imperatives need to be adopted to mitigate the adverse effects of climate change for a sustainable development of agriculture and enhancing social and economic well being the people.

1. Crop Diversification :

Appropriate crop management holds the key to rural incomes. It will ensure food security, provides livelihood support and check migration form rural to urban areas. Crop diversification can be the answer to the problems caused by extreme weather conditions for the farmers.

2. Development of Dryland Farming:

Development of Dry land farming in India is the suitable way to the sustainability of agriculture for food security and livelihood security. It is 'area-specific' 'region specific' and 'crop specific'. It is realised that 'irrigated farming is for survival' while 'dryland farming' is for equity for a majority of the farmers those are small and marginal.

3. Change in land-use management practices :

The strategy of adjusting the cropping sequence including the changing timing and sowing, planting, sowing and harvesting is needed so as to take advantage of the changing duration of growing seasons and associated heat and moisture to suit the changing environment.

4. Change in the Cropping Calendar :

Negative effects of increased climate variability .reduced by changing the cropping calendar to take advantage of the wet period and to avoid extreme weather events during the growing season.

5. Relocating crops in to Alternative Areas:

There is need to identify the crops and regions that ate more sensitive to variability of climate and relocate them in most suitable areas.

6. Harnessing Water Management Technology:

The vulnerabilities of climate can be mitigated by constructive of more water Harvesting Structures (WHSs) productive utilization of rainwater and management to restore and utilize the run off water.

7. Improving and Restoring Soil Fertility:

Efforts are to be made to increase the availability of soil nutrients maintaining soil structure, improving cropping system and balanced application of organic and inorganic fertilizers:

8. Crop Insurance:

crop insurance schemes should be put in place to help the farmers in reducing the risk of crop failure. Micro finance for the poor should be encouraged through participation of banks, NGOs and Micro finance institutions. Both formal and informal, as well as private and public insurance programmes need to be put in place to help reduce income losses as a result of climate related impacts.

9. Indigenous Technical Knowledge for the Farmers:

Farmers of South Asia mostly poor and marginal experiencing climatic variability for centuries should be educated in developing technologies to overcome climate vulnerabilities.

10. Improved pest Management:

Since changes in temperature and variability in rainfall affects pests some of the potential adaptation strategies could be integrated pest management, pest forecasting, alternative production techniques etc.

11. Drought Proofing:

There is need to call for a proactive Government to work on drought resistant crops and improve productivity of land, water and human resources

The Prime Minister Dr. Manmohan Singh released the National Action plan and listed Eight priority mission to combat climate change and bring down India's emissions in the long run.

These priorities are :

(i) Solar Mission

(ii) Energy efficiency

(iii) Sustainable habit

(iv) Water Mission

(v) Sustaining Himalayas

(vi) A Green India

(vii) Sustainable Agriculture

(viii) Strategic Knowledge

Environment friendly strategies should be incorporated in all future development. Raising consumer awareness will be the key to arresting climate change globally with local action that permits its mitigation and the adaptation to its impacts. The need of the hour is to change the value system so as to incorporate the concept of sustainability into our daily life. Let us conclude with the campaign. Heal the Earth, Heal the Human beings which can pave saving ailing agriculture at distress

❑❑❑

CLIMATE CHANGE INDIA - A HARSH REALITY

Dr. Surjendu Kumar Dash

ABSTRACT

India is among the hotspots identified by the UNO for extreme weather events. Climate change in India is not an isolated phenomenon rather it is an offshoot of global climate change that is fast taking place. Rapid transformation of developing countries like India from an agriculture based country to and industrial one, from simple to consumerist life styles and the resulting emission of green houses gases have contributed to the climate change. It is observed that the climate change has adversely affected our agriculture and led to natural disasters. Since climate change is gaining momentum and becoming dreadful it is necessary to manage it with heightened awareness among the masses, development and application of clean technologies, and drawing up a National Action Plan to deal with the problem.

❑❑❑

* Department of Economics, MPC (Auto) College, Baripada.

ANALYTICAL STUDY OF CLIMATE CHANGE IN INDIA

Surendra Swain

ABSTRACT

Climate change is related to global warming when carbon dioxide (CO_2) and other gases increase due to human-caused emissions.

There is evidence of climate change as green house gases have increased, decreasing rainfall and depleting ground water, drastically shortened the cooling period, uncertain prediction of monsoon, increase in natural disasters, early blossoming of trees, melting of glaciers at an increasing rate and some cooling states in India are gradually becoming warmer.

The main causes of climate change are use of more durable electronic and electrical goods, destruction of forest, industrial growth after 1850 and consequent population growth brining higher human activities and increase in the level of green house gases.

The negative impacts of climate change will reduce arable land coming under sea water due to melting of glaciers, economic and GDP loss, reduction in production of agricultural output, change in cropping pattern, food insecurity, enhance poverty related endemic hunger, increase in temperature related infection diseases etc.

Climate change and global warming can be reduced by reducing use of fossil fuel and electricity by increasing use of renewable resources, increase plantation and aforestation, provision of tax rebate and subsidies to encourage consumption and production of no-pollution durable goods, development of GHG reducing technologies and following 'Reduce, Reuse and Recycle' environmental policy.

Human actions are causing global warming. So management of climate change should be everybody's business. We should adopt Gandhian ideas that there is enough for everybody's need but not for everybody's greed. The real challenge of climate change at the national level is to integrate the management of climate related risks into development policies and programmes because economic development and sound environmental policies go hand in hand.

❑❑❑

* Depatment of Economics, K.K.S Women's College, Balasore

CLIMATE CHANGE : A NEW THREAT TO MANKIND

Santanu Kumar Nayak*

ABSTRACT

Climate change is a new problem for human civilization. Due to global warming it is a serious matter not only for India but also through out the world. It has now emerged as the most burning environmental issues ever to confront the humanity. The main causes are environmental pollution, deforestration, rising industrialisation, and population growth. It is possible that human beings are altering the environment by causing changes to the climate. While climate and weather patterns naturally change and fluctuate, there have been noticiable differences. The effects of climate are basicaly the existence of human civilization. It affects agricultural productions, rainfall, cooling period, monsoon etc. Due to such changes, natural disasters such as flood, cyclone drought, earthquakes are increasing. Trees are early blossoming, there is changing of croping pattern, sea levels are changing and new diseases are occuring. There are some changes in thermal expansion, mountain glacier melting, Greenland ice sheet melting. The earth receives short wave radiation from the sun, it can easily pass through the atmosphere. Human activities during the few decades of industrialisation and population growth have polluted the atmosphere to the extent that it has begun to seriously affect the climate. The carbon dioxide in the atmosphere has increased by 31% sinc pre-industrial times, causing more heat to be trapped in the lower atmosphere. It is a great challange to the mankind. Gradual wrmaing of our climate is underway and will continue. If this continues, there will be a great challange to the palnet. There must be scientific and technological solution for the change in climate.

❑❑❑

* Lecturer in Economics, Regional College, Rambag, Jajpur,

ECONOMICS OF CLIMATE CHANGE IN INDIA WITH SPECIAL REFERENCE TO ORISSA

Dr. B. Eswar Rao Pattnaik[1] **Sri Simanchal Mishra**[2]

Sir Dinesh Chandra Dash[3]

The temperature, rainfall, of the Globe is rising along with a fall in the productivity in food crops. This is owing to climate change which is caused by both natural as well as human efforts. Polar Ice is meting along with the disappearance of Glaciers. The composition of Gases in the atmosphere is changing fast. Changing climate is having its impact In agricultural production, Weather conditions etc. It has its impact on Orissa too. Steps are on since 1970's to find out the reason for climate change and to find a solution. The present paper is an attempt to find out the economic impact of climate change and is an effort to suggest practicable measures to stop climate change such as creating public awareness about the evil impacts of climate change through a change in the behavior patterns. There are a few measures which can be practicable to slow down the climate change. Like buying efficient household appliances a well ventilated houses use of sodium Vapour light, proper maintenance of car minimization in the use of vehicles, plantation above all the proper environmental policy.

❑❑❑

1. Reader in Economics, SBR Govt. Women's College, Berhampur, Ganjam
2. Lecturer in Economics, Kesinga Mahavidyalaya
3. Lecturer in Economics, Govt. Auto. College, Bhawanipatna

Economic and Social problems of the Non-Farm Sectors of Orissa

Economic and Social problems of the
Non-Farm Sectors of Orissa

Rural Non-farm Sector

APPROPRIATENESS OF EQUITY HYPOTHESIS IN ORISSA

Kishor C. Samal*

The non-agricultural activities in rural areas are defined as rural non-farm sector (RNFS) by most of the scholars. In the process of economic development, agriculture and the modern formal industrial sector are not able to absorb the growing labour force in the developing countries. Since the agricultural sector in the rural areas is oversaturated, the growth of RNFS is seen as a promising sector for creation of sustainable employment and as the solution to the problem of poverty and unemployment in rural areas. The RNFS has positive role to play in promoting growth and welfare (Lanjouw and Lanjouw: 1995).

In India, after independence, the state had a declared policy of reducing or eradicating rural poverty by land reform measures. But this policy barring a few exceptions was a failure. The dissatisfaction and disgust of the rural mass was expressed in the violent form of Naxalbari movement starting from ,Naxalbari, Siligudi and Jalpaiguri against the feudal system and unequal distribution of land and rural assets in the late 196050 Against the backdrop of this violent movement in rural areas against jamindars, jotedars and landlords, the Union Government started various rural development programmes such as FWP, IRDP and others in 1970s and 1980s to attack rural poverty, underemployment and unemployment. However, due to improper implementation and various leakages, these programmes are also not successful. Against the background of failure of land reforms and improper implementation of various rural development programmes, RNFS is seen as a sector with a potential to alleviate rural poverty and reduce unemployment.

I. CONCEPT AND FEATURES OF RNFS:

In the background paper for the World Development Report 1995, RNFS is defined as the sector which includes all economic activities in

* Professor, B. R. Ambedkar Chair on Social Change and Development, IGNOU, Maidan Garhi, New Delhi- 110068

rural areas except agriculture, livestock, fishing and hunting. It is not in any sense a homogeneous sector. The RNFS may include: (i) activities undertaken by farm households as independent producers in their home, (ii) the subcontracting of work to farm families by urban-based firms, (iii) non-farm activities in villages and rural town enterprises, and (iv) commuting between rural residents and urban non-farm jobs (Lanjouw and Lanjouw: 1995).

The, RNFS includes a wide range of economic activities whose composition may vary from country to country. The most common convention *is* to include animal husbandry, hunting and tapping, forestry and logging, fishing, etc., in agriculture and, accordingly, all other economic activities in rural areas would constitute RNFS (Chadha: 1993). Thus, RNFS comprise all non-agricultural activities, mining and quarrying, household and non-household manufacturing, processing, repairs, construction, trade and hotelling, transport and communication, and community, personal and other services in rural areas.

II. INTER-LINKAGE HYPOTHESIS AND INDIA

The linkages between agriculture and the rest of the economy have drawn the attention of the economists from the time of Physiocrats. However, some studies (e.g., Mellor: 1976) show that agriculture has the capacity to stimulate new economic activities in the rural non-farm sector (RNFS) through consumption-expenditure linkages. Various other types of growth linkages such as (i) backward linkages, (ii) forward linkages, (iii) capital flow linkages, (iv) labour flow linkages of agriculture are also recognised (Haggblade et al: 1989; Harriss: 1987).

In the mid-1970s, John Mellor (1976) stated the role of RNFS in a set of proposals for India. The growth of farm and non-farm sector would be mutually reinforcing with employment and income increasing in a dispersed pattern. In his view, geographic isolation and tastes of rural population combined to make demand for locally produced goods increase with income. It is argued by Mellor that due to growth in productivity in agriculture, income from agricultural sector rises which consequently expands the consumption demand of farmers for labour-intensive goods and hence stimulates the growth of RNFS.

According to the argument of Mellor, technological innovation which brings increased food supply normally distributes the initial benefits largely to already more wealthy and prosperous class. This

initial increase in rural income sets in motion a sequence of multiplier effects which can stimulate expanded production and employment in other sectors of the economy including consumer goods industries and small-scale units in RNFS which are likely to be labour-intensive. The expanded income due to higher employment of lower-income labouring class, who spend larger portion of their increased income on food, provides the demand for additional foodgrains production. In this way, the inter-sectoral linkages between farm and non-farm sectors in rural areas are established which are beneficial to each other and stimulate both sectors.

So, the focal theme of Mellor's argument (the inter-sectoral linkage hypothesis) is that without having any equal distribution of rural income and assets, there can be growth through inter-sectoral linkages between farm and non-farm sectors in rural areas which can only be achieved by development of capitalist agriculture through introduction of technological advance.

Agricultural Development as a Stimulant?

Some studies (eg., Bhalla: 1990, 1993; Dev: 1990; Papola: 1987, 1992) in India suggest that the growth in agricultural production is likely to stimulate the growth and development of RNFS. On the other hand, the assumption that the growth of RNFS is led by agricultural development is not observed in various empirical studies in India (eg., Basant: 1994, Chandrasekhar: 1993). Thus, it is difficult to say whether RNFS expands or contracts due to rise in agricultural productivity. It is sometimes observed that the growth of RNFS is due to various factors including agricultural growth (Eapen: 1994, 1995; Unni: 1991).

Traditional RNFS:

While discussing or analysing the RNFS and its linkages with farm sector, the dichotomy in it should be recognised. The RNFS can be classified as follows (Samal: 1997a): (1) informal, and (2) formal; and informal INFS into (a) modern, and (b) traditional. Modern informal RNFS may be further classified into (i) establishment sector, and (ii) non-establishment sector; and traditional informal RNFS into (i) artisans (caste-based), and (ii) service workers (caste-based).

If we classify in this manner, the growth pattern will be different for different sectors. It is more likely that agricultural development

may have an adverse effect on traditional RNFS, particularly on artisans. Traditional service workers (e.g., barbers, washer-men, etc.) may not be adversely affected, through jajmani system is more likely to be replaced by market mechanism (Ibid).

While growth of agricultural production generally accounts in a more than proportionate increase in demand for non-agricultural inputs, it does not necessarily lead to an increase in demand for locally made inputs as a whole (Vaidyanathan: 1994).

In our study (Samal: 1997b) of village Pahadasigida, one of the eight villages having concentration of artisans of the most prosperous agriculturally developed block of Orissa, viz., Attabira, it is observed that there is a fall in the sale of products of traditional RNFS consisting of three categories of artisans, viz., blacksmith, carpenter and potter, which is either due to the availability of substitutes produced by modern formal industry, mostly located in urban areas (40 per cent of cases) or due to availability of similar products of big formal industry at cheaper price (30 per cent cases). Moreover, in the past, a sizeable portion of the demand for the product of artisans (traditional artisans) in the block was coming from large farmers but it has come down sharply (from 60 per cent to 37 per cent) at present. The main portion of demand (46 per cent) for artisans' products at present is from small farmers. But none of the respondent artisans has changed his occupation over the last 30 years.

Thus, though there may be a rise in the number of people engaged in traditional informal RNFS, the sale and income of this sector have declined over time validating the inference that there is rise in disguisedly unemployed by the traditional RNFS. But it is not correct to presume that the disguisedly unemployed of the agricultural sector have moved out of it and joined as disguisedly unemployed in the traditional RNFS (Ibid).

On the other hand, in the industrial belt of Talcher-Angul of Orissa, we found that income from agriculture *and allie*d sector as a percentage of total income has declined from 45 per cent in 1983 to 20 per 'cent only in 1994; while the importance of RNFS as a source of household income has been growing, the proportion of this income increasing from 55 per cent to 71 per cent during the same period (Ibid.). However most of these incomes are from modern formal sector. This is because

of the rise in number of service holders in public sector undertakings and government sector, particularly in NALCO, since the affected persons of these villages are employed in NALCO under rehabilitation policy and some others in other non-farm activities coming out due to linkage effects.

Inequitable Distribution of Land: A Constraint:

We have observed that the growth of agricultural development has led to decline in traditional RNFS, particularly in manufacturing, in most of the rural areas of India. That does not necessarily imply that it led to the growth of modern RNFS everywhere. However, the growth of labour-intensive RNFS is seen as the solution to the problem of rural unemployment and poverty. So, it is argued that inter-sectoral linkages between agricultural sector and RNFS would generate the growth of RNFS by generating productive employment (e.g., Mellor: 1976).

But this argument does not realise that the inequitable structure of rural economy and inequitable distribution of land and rural assets are constraints to the growth of RNFS. Even modern technology in agriculture and commercialisation of agriculture accentuate the inequality in income distribution of rural society by adversely affecting the sub-group rural poor and this inequality, in turn, hardly stimulates RNFS as a whole through consumption-expenditure linkages.

In reality, technological innovation and commercialisation of agriculture have accentuated the inequality in the rural society which, in turn, may not facilitate the growth of RNFS. In the real world experiences, the poor have failed to reap the benefits or even lost from the technological change or commercialisation. Where these benefits have occurred, it is found that they are mostly attributable to inelastic demand or adverse institutional features (Binswanger and Braun: 1991).

Even the income of the wealthier farmers who gained from the rise in agricultural production may not help in growth of RNFS. The consumer products such as cosmetics and toiletries, etc., and, agricultural inputs like fertilizers, pesticides, implements, etc., are produced by large industrial firms including multinationals in the formal sector mostly situated in urban centres. Even if these goods are produced by the non-traditional RNFS, they may not find market among the rural wealthier class who has a psychological preference for products produced in big cities by formal sector units. Thus, the rise in

consumption demand for these products emanating from the increased income arising out of the agricultural sector generates demand for the products of mostly urban-based, capital-intensive formal manufacturing sector including multinationals.

As mentioned earlier, similar is the case with the traditional RNFS. Due to rise in agricultural income, the tastes of the people change and they prefer the substitutes for these RNFS products produced in urban centres such as cement, iron rods, corrugated iron sheets, plastic pots, aluminum and stainless steel utensils, factory-produced synthetic and cotton clothes, cycles, wristwatches, radio, bicycle, etc., in place of khaparali and tiles, pottery and bell-metal utensils, hand looms, bullock carts, etc. Thus, the competition from the formal sector mostly situated in urban areas may lead to decline of traditional RNFS whose products may not get a ready market with large capitalist farmers (Samal: 1997a). This is what is happening in Orissa.

Liberalisation and Neo-Colonisation:

Mellor's (1976) assumption that both geographic isolation and the unchanged tastes of the rural people will stimulate the demand for locally produced goods may not be fully correct in this age of privatisation and liberalisation leading to imperialistic globalisation. Under liberalisation and globalisation, some of the RNFS activities in developing countries may decline.

With the advent of either direct colonial links or neo-colonialism through entry of multinationals and liberalisation of imports and exports, two trends are observed: (i) emergence of new opportunities for exporting cash crops and natural resources and, (ii) availability of cheap and higher quality manufactured goods from foreign countries. Both, the competition from imports and drawing off of labour into the growing cash crop sector, would stifle RNFS activities.

At present, as a result of liberalisation, and transition to market-determined economy and the consequent entry of multinationals and transnationals in India, there will certainly be a very dampening impact on traditional RNFS due to flooding of cheap substitutes and similar products and change in tastes and preferences of both the rural and urban consumers on account of aggressive advertisement in both print and multichannel electronic media of their products (Samal: 1997a). Thus, the rise in agricultural productivity, if any, may not expand RNFS

activities under the regime of liberalisation and implementation of WTO regulations.

III. RESIDUAL SECTOR HYPOTHESIS:

Another view is that RNFS is a residual sector since the workers in the rural areas who are not able to find employment in the agricultural sector are to join the RNFS. It is also argued that factors responsible for the growth of RNFS do not lie wholly in agriculture or in rural areas. It is argued that the growth of RNFS is caused by overall development. It is stated that the rural workers who are not able to 'find employment in the agricultural sector are forced to join the RNFS. So, the RNFS is regarded as the residual sector. However, some empirical studies (eg., Vaidyanathan: 1994) in India strongly belie the residual sector hypothesis while others (eg., Singh: 1994) support it.

The most important effects of distress condition in the rural areas is neglected by the residual sector hypothesis. Due to unfavourable conditions in rural areas, such as prevalence of capitalist production in agriculture, decline of rural handicrafts, inadequate income, poverty, unemployment, underemployment, seasonal employment, loss of property and sources of income due to natural calamities, etc., the landless agricultural labourers, small marginal farmers and artisans are pushed out of the rural areas and move mainly to urban centres in search of jobs in the informal sector (Samal: 1997a).

IV. URBANISATION HYPOTHESES:

The process of urbanisation also influences the growth of RNFS and sometimes exercises a positive impact on RNFS employment (eg., Basant: 1994; Kundu: 1991; Singh: 1994; Unni: 1991). The role of locational factors is also emphasised in the determination of rural non-farm employment possibilities.

Other Factors:

Besides the residual sector hypothesis and urbanisation hypothesis, there are also other arguments which mention various factors that influence the RNFS activities (as observed by the various empirical studies *in India) such as: (i) change*s in the tastes of the rural consumers, (ii) competition from factory sector (Visaria and Basant: 1994), (iii) administrative, development and social services, (iv) rural

electrification (Singh: 1994), (v) literacy rate of the population (Basant: 1993), and others.

V. RNFS IN ORISSA: SOME TENTATIVE FEATURES:

First, there are regional variations in the importance of RNFS to the local economy within Orissa. There is also an element of sub-sector-specific clustering in RNFS, the region (Samal: 1997a, 2008). Second, major portion of RNFS workers are engaged in household manufacturing and other services. There has been increase of rural main workers in household manufacturing sub-sector of RNFS in Orissa. But, manufacturing in the non-household sector increased slowly.

Third, a large number of artisans and cottage level producers in traditional RNFS use traditional technology while a small number of large units like rice mills use modern technology. Fourth, availability of credit for both fixed capital and assets and for working capital is the major problem for most of the sub-sectors of RNFS in Orissa. A large majority of RNFS producers had to rely on informal credit sector due to inadequacy of loan amount, unnecessary delay and excessive paper work in getting a loan from formal s*ector financial institution* (NABARD: 1994).

Fifth, the sustained growth in both domestic and export demand is found to be an important factor determining the growth of a sub-sector of RNFS in Orissa. The domestic demand seems to have helped the growth of sub-sectors such as spice processing, cotton textiles, minor mineral processing, handicrafts, repair and rural transport. On the other hand, the growth of textile products, cut flowers, handicrafts and handloom products is influenced by the export demand. But, there is constraint in the growth of sub-sectors like pottery and wood products due to lack of demands.

Sixth, there is dominance of artisan-based units like filigree, bell-metal, stoneware, sawai-rope making in the traditional industrial profile. In the traditional RNFS, the government policy in protecting the employment of handloom weavers is quite prominent. Most of the handloom weavers are part-time and do not get gainful employment round the year. The demand for handloom has been declining. Most of the traditional RNFS industries are facing the same challenge (Samal: 1997a).

VI. DETERMINANTS OF RNFS IN ORISSA: APPROPRIATENESS OF EQUITY HYPOTHESIS:

It is observed that though the percentage of rural families below poverty line was highest in Mayurbhanj district, the district ranks ninth in terms of percentage of rural main workers of the district engaged in RNFS. Hence, the presumption of residual sector hypothesis that the poverty of the people due to agricultural distress forces them to join RNFS may be open to question (Samal: 1997a, Samal: 2008).

Land Distribution:

The rank correlation coefficient between the percentage share of RNFS workers to rural main workers (RMW) and equal distribution of land is positive and significant in Orissa. This implies that more is the equal distribution of land, larger is the percentage share of RNFS workers in RMW of the district.

This may be due to the fact that a more equitable distribution and *rural* assets, say, under an effective land reform policy, imply the transfer of rural assets and thereby the income and purchasing power from the wealthier peasants to landless and marginal farmers. This, in turn, may transfer the rural consumption demand from non-local products, produced by large industrial houses including multinationals mostly in the urban formal sector, to local products produced in RNFS, considering that the wealthier, capitalist farmers gaining from agricultural productivity due to improved technology and commercialisation of agriculture are not the major source of demand for RNFS products.

Thus equal distribution of land and rural assets including common property resources and water for irrigation and RNFS activities are positively related through consumption expenditure linkages (Ibid). However, whether inequality in distribution of income increases or decreases due to participation in RNFS activities, is not easy to say.

Poverty, Agricultural Productivity and Urbanisation:

It is found that coefficient of correlation between the percentage share of RNFS workers (RNFSW) in RMW and the percentage of rural families below poverty line are negative and significant. It implies that districts having lower percentage of families below poverty line have higher percentage share of RNFSW in RMW (Ibid.). Thus, the RNFS in Orissa is not a residual sector. On the other hand, RNFS activities might have helped in alleviating poverty in the rural sector.

It is also observed that the agricultural productivity has little to do with RNFS activities. Therefore, it is not possible to predict a priori whether RNFS employment expands or contracts with agricultural productivity. On the other hand, the percentage of urban population in the district positively affects the share of RNFSW in RMW (Ibid).

Literacy and Education:

Most important observation from the study (Ibid.) is that the districts with high literacy rate have comparatively larger percentage share of RNFS workers in rural main workers. Except some extreme cases, the districts with high percentage of urban population have high literacy rate. This may be due to comparatively better availability of educational facilities in urban centres, the benefit of which accrues to both urban and nearby rural areas. Thus, urbanisation may positively influence the literacy rate and educational attainment, which in turn may positively influence the share of RNFS workers in rural main workers. On the other hand, the districts with higher percentage of rural families below poverty line have lower literacy rate.

Thus, literacy rate is positively influenced by the level of urbanisation and negatively by poverty in Orissa. However, the RNFS is strongly influenced by literacy rate and educational attainment.).

Education, Income Distribution and Employment:

Education and literacy might help in growth of RNFS since it improves the skill of a person which is required to start a modem RNFS enterprise with new technology or high labour productivity activities. Moreover, any education, at least beyond seventh standard may discourage a person to work as agricultural worker or owner-operator cultivator, since agriculture is regarded as dull, monotonous and low-status job by the educated in Orissa - to plough as bullock driver or transplant in muddy water. So, an educated person after completion of his education joins RNFS, rather than working in agriculture, after his waiting period, during wh*ich he se*arches for a better job in RNFS, either as self-employed or wage worker or in a traditional activity under market mechanism (Ibid.).

Education has a large and significant impact on productivity growth. That is, literacy and educational attainment help in skill formation which, in turn, expands the growth of RNFS. Moreover, educated and literate men have more access to information and available facilities including

inputs and assistance from public institutional systems which helps to start and expand a RNFS enterprise. The RNFS enterprise requiring modern technology is easily adopted by the educated and literate.

Since education has strong impact on individual's earnings, the net effect of the expansion of schooling has been a reduction in the dispersion of earnings and hence a more even distribution of income. However, this equity effect depends on the level of schooling expansion. The basic and primary education has the highest impact on distribution of income favourable to equity, while equity impact of expansion of post-graduation may actually be negative (Ibid.). This is because low level of earnings of otherwise illiterate workers are raised to the overall mean by imparting to them primary education, while post-graduate education received mostly by high-income groups in society will raise their incomes further away from the mean.

Thus, reduction in both, the dispersion of landholding even by direct measures like land reform and in the dispersion of earnings through spread of primary education will bring about less unequal distribution of income and may help to boost rural income and assets and thereby RNFS activities through consumption-expenditure linkages.

Thus, education (primary and secondary) not only helps directly in the growth of RNFS activities by diverting workers from farm to non-farm sector and helping skill formation but also helps indirectly through consumption-expenditure linkages by bringing about less unequal distribution of income in rural society (Ibid.).

VII. CONCLUSION:

The three past well-known hypotheses argue that the level of RNFS is either determined by agricultural development, or urbanisation or forced expulsion of labourer out of agriculture. But is it correct to presume that coming up of a large-scale non-agro-based industry or mining activities or public services in rural area is determined by these factors?

It is imperative to think of dualism in RNFS. RNFS can be classified as formal and informal, and a further distinction can be made between traditional and modern within informal RNFS. If at all, the factors mentioned in the hypotheses determine the level of RNFS, these may influence the informal sub-sector rather than formal component of RNFS, except of course agro-based industrial units.

In spite of the limitations and difficulties in the methodology, it is observed from our field study that income from RNFS as a percentage of total household income has increased rapidly in the industrially developed region of Orissa. On the other hand, agricultural development in a region has adversely affected the sale and income of the traditional informal RNFS, though the number of persons engaged in this sub-sector has increased implying the incidence of disguised unemployment in it.

In our analysis of RNFS as a whole in Orissa, we come to conclusion that more even distribution of land and rural assets including water from irrigation and equal access to common property resources as distinct from subsidisation of mechanisation of agriculture and, expansion of primary and secondary education rather than subsidisation of higher education, may help the growth and expansion of RNFS activities by increasing rural income and improving distribution of such income. Moreover, education and literacy help in increasing the productivity and skill of workers which, in turn, mostly stimulate the growth of modern informal RNFS with new technology.

Thus, more even distribution of land and rural assets, as also literacy and education are the two most important factors determining the level and growth of RNFS activities, particularly the informal component of it. To alleviate rural poverty and unemployment, the growth of RNFS is desirable which is possible by reducing both dispersion of land and rural assets by land reforms and dispersion in rural income by expansion of primary and secondary education.

References:

Basant, Rakesh (1993); "Diversification of Economic Activities in Rural Gujarat: Key Results of a Primary Survey", The Indian Journal of Labour Economics, Vol. 36, No.3, July-September, pp. 361-86.

Basant, Rakesh (1994); "Economic Diversification in Rural Areas: Review of Processes with Special Reference to Gujarat", Economic and Political Weekly, Vol. 29, No. 39, September, 24, pp. AI07-16. .

Bhalla, Sheila (1990); "Employment in Indian Agriculture: Retrospect and Prospect", Social Scientist, Nos. 192 and 193, pp. 3-21.

. Bhalla, Sheila (1993); "Trends of Some Propositing About the Dynamics of Changes in the Rural Workforce Structure", Indian Journal of Labour Economics, Vol. 36, No.3, July- September, pp. 428-39.

Binswanger, Hans P. and J auchim V on- Braun (1991); "Technological Change and Commercialisation in Agriculture: The Effect on the Poor", The World Bank Research Observer, Vol. 6, No.1, January, pp. 57-80.

Chadha, G. K. (1993); "Non-Farm Employment for Rural Households: Evidence and Prognosis", Indian Journal of Labour Economics, Vol. 38, No.3, July-September, pp. 296-327.

Chandrasekhar, C. P. (1993); "Agrarian Change and Occupational Diversification: Non- . Agricultural Employment and Rural Development in West Bengal", Journal of Peasant Studies, Vol. 20, No.2, pp. 205-70.

Dev, S. Mahendra (1990); "Non-Agricultural Employment in Rural India: Evidence at a Disaggregate Level", Economic and Political Weekly, Vol. 25, No. 28, Julyl4, pp. 1526-36.

Eapen, Mridul (1994); "Rural Non-Agricultural Employment in Kerala: Some Emerging Tendencies", Economic and Political Weekly, Vol. 29, No. 21, May 21, pp. 634-53.

Eapen, Mridul (1995); "Rural Non-Agricultural Employment in Kerala: Inter-District Variation", Economic and Political Weekly, Vol. 30, No. 12, March 25, pp. 634-53.

Haggblade, S., P. Hazell and J. Brown (1989); "Farm-Non-Farm Linkages in Rural Sub Saharan Africa", World Development, Vol. 17, Nos. 8 and 13, pp. 1173-1201.

Harriss, Barbara (*1987); "Regional Growth Linkages From Agr*iculture and Resource Flows in Non-Farm Economy", Economic and Political Weekly, Vol. 22, Nos.1 and, January 19, pp. 31-46.

Kundu, Amitabh (1991); "Growth of Non-Agri*cultural Employment - A Hypothe*sis on Rural-Urban Linkages", IASSI Quarterly, Vol. 10, No.2, October-December, pp.

Lanjouw, Jean O. and Peter Lanjouw (1995); R*ural Non-Farm Employ*ment: A Study, Policy Research Working Paper 1463, World Bank, Washington.

Mellor, John W. (1976); The New Economics oj Growth- A Strategy Jor In*dia and the Developing World, Cornel*l University Press, Ithala.

NABARD (1994); The Rural Non-Farm Sector in Orissa, Report oJthe Study Group of the Rural Non-Farm Sector, National Bank for Agriculture and Rural Develo*pment, Bombay.*

Papola, T. S. (1987); "Rural Industrialisation and Agricultural Growth: Case Study of India", in R. Islam (ed.), Rural Industrialisation and Em*ployment in Asia, ILO(ARTEP), New De*lhi.

Papola, T. S. (1992); "Rural Non-Farm Employment: An Assessment of Recent Trend", Indian Journal oj Labour Economics, Vol. 35, No.3, pp. 238-48.

Samal, Kishor C. (1997a); "Features and Deter*minants of Rural Non-Farm S*ector in India and Orissa: A Survey", Journal of Indian School of Political Economy, Vol. 9, No.1, January.- March, pp. 65-93.

Samal, *Kishor C. (1997b); "Rural Non-*Farm Activities in Specific .Regions of Orissa", Journal of Rural Development, Vol. 16, No.3, July-September, pp. 457-464.

Samal. Kis*hor C. (2008); Informal Sector: C*oncept, Dynamics, Linlages and Migration, Concept Publication Company, New Delhi; Chapter -2.

Singh, Ajit Kumar (1994); "Changes in *the Structure of Rural Workforce* in Uttar Pradesh: A Temporal and Regional Study", in P. Visariaand R. Basant (eds.), NonAgricultural Employment in India: Trends and Prospe*ctive, Sage Publica*tions, New Delhi.

Unni, Jeemol (1991); "Regional Variation in Rural Non-Agricultural Employment: An Exploratory Analysis", Economic and Political We*ekly, Vol. 26, No.3, January 19*, pp. 109-22.

Vaidyanathan, A. (1994); "Employment Situation: Some Emerging Perspectives", Economic and Political Weekly, Vol. 29, No. 50, Decembe*r 10, pp. 3147-5*6.

Visaria, Pravin and Rakesh Basant (eds.) (1994); Non-Agricultural Employment *in India: Trends and Prospective, Sa*ge Publication India Pvt. Ltd.

❑❑❑

ANALYSIS OF INCOME DIVERSIFICATION OF FARMERS IN RAINFED RICE BASED FARMING SYSTEMS OF COASTAL ORISSA

Parshuram Samal*

During the pre and early independence era, agriculture was the main source of livelihood for majority of the rural families. With passage of time, due to increase in population, declining land-man ratio and increasing mechanization of farm operations, agriculture alone could not provide employment to the increasing population and meet the growing requirements of farm families. An increase in non-farm employment has become essential for improving the income and standard of living of rural population (Chadha, 1993 and Kumar et al, 2003). This has been well documented from other village level studies using panel data (Hayami and Kikuchi, 2000). People have often devised their own adjustment mechanism in response to the emerging situations. A diversification of the pattern of economic activities pursued by the rural families has played key role in this process.

The increase in non-farm employment of the rural work force has been due to both developmental (pull) and distress (push) factors (Shylendra and Thomas, 1995; Vaidyanathan, 1986; Verma and Verma, 1995). In rainfed areas, the distress factors play dominant role in search of non-farm activities in comparison to irrigated areas. The distress factors like poverty, unemployment and frequent natural calamities have tried to push the rural youths to migrate in search of various non-farm activities to supplement their farm income. However, a wide regional variation in the nature and composition of such labour force exists (Elumalai and Sharma, 2003). A farmer necessarily undertakes a large number of diverse activities in the course of his operation of the farm enterprise to supplement his income from crop enterprises. It is important

* Principal Scientist (Ag. Economics), Central Rice Research Institute, Cuttack - 753 006

to conduct micro studies to identify the pattern of employment and income, so that appropriate policy support may be provided as per regional needs (Visaria, 1995 and Vaidynathan, 1986).

There is a significant change in income share from different sectors of the economy in Orissa over the period 1950-51 to 2007-08. The primary sector (comprising of sectors like Agriculture and Animal Husbandry, Forestry and Logging, Fishing, Mining and Quarrying) which was contributing two-third of total state income during early independence era has come down to second position and contributing only about 32 percent of net state income. The secondary sector (comprising sectors like Manufacturing-Registered and Un-registered, Electricity, Gas, Water supply and Construction), which was contributing 9 per cent of total income during the quinquennium average ending 1954-55 has doubled its share and contributed 18 per cent of total income during the quinquennium ending 2007-08. The tertiary sector (comprising sectors like Trade, Hotel and Restaurant, Railways, Transport, Storage, Communication, Banking and Insurance, Real Estate, Business Services, Public Administration and Other services), which was contributing one-fourth of total state income during the quinquennium ending 1954-55 has also doubled its share and presently it contributes almost half of the total state income. Though all the sectors have grown in absolute terms, but, tertiary sector has grown much more than other sectors. Among the different primary sector income" sources, Agriculture and Animal Husbandry sector accounted for 70 percent. The above observation in structural changes in the state economy calls for micro level studies to know the occupational diversification and income sources at individual farm level.

Rice cultivation is the main crop production activity in rural Orissa as it covers 76 per cent of gross cropped area. The rural population accounts for 85 per cent of total population of the state and the productivity of rice in the state (1.7 t/ha) is below the national average (2.2 t/ha). The state faces frequent natural calamities making the agricultural production too risky and unstable over years (Reserve Bank of India, 1984 and Samal, 2004). Coastal Orissa accounts for 48 per cent of total population and 26 per cent of total geographical area of Orissa. This region accounts for 38 per cent of total rice area and about 40 per cent of the total vegetables and fruits area of the state. The region harbours 40 per cent of total animal population and accounts

for 75 per cent of total fish production. The present study is an attempt to analyse the nature and extent of occupational diversification and the sources of non-farm income and employment in rainfed villages of coastal Orissa. A study like this assumes additional significance, when considered from the angle that such areas are not only characterized by uncertain rainfall and low crop productivity but also have the bulk of the poor and unemployed population. The specific objectives of the paper are i) to analyse the pattern of employment and income diversification among the farmers of coastal Orissa, and ii) to identify the sources contributing to inequality in income among farming community.

DATA AND METHODS

Two rainfed districts Balasore and Kendrapara were selected in the first stage by eliminating the irrigated districts using the criteria of 40 per cent area under irrigation. In the second stage, the irrigated blocks were first eliminated from each district using the same criteria and two blocks from the remaining blocks in each district were selected using the random sampling technique. In the third stage, two villages from each block were selected using the random sampling technique. The farmers were then classified in each selected village into 4 groups according to the land owned by them such as marginal (up to 1 ha), small (1-2 ha), medium (2-4 ha), and large (> 4 ha). In the last stage, 25 farmers from each village were selected using the technique of stratified random sampling with probability proportion to size. Data collection was completed from each village with the help of schedules and questionnaires. The sample consists of 98 marginal, 53 small, 28 medium and 14 large farmers making a total of 193.

The employment of each farmer in various on-farm, off-farm (working as agricultural labours in others' farm) and non-farm (other than farm works) activities were collected. The incomes from crops were computed after deducting paid-out costs from the gross income of that crop. The cropping year for which data were compiled was 2000-2001. The non-farm income of each family member was computed after deducting pocket expenses from total non-farm income of each family member. The income and employment thus computed were analysed in this paper.

The Ginni coefficient was computed using the formula discussed by Nagar and Das (1983) and illustrated below.

$$G=1+\frac{1}{n}-\left\{\frac{2}{n^2 z}\right\}\left[ny_1+(n-1)y_2+.....+2y_{n-1}+y_n\right]$$

where,

G represents the Ginni coefficient,

n is the number of households,

z is the mean income,

y_1 is the lowest income,

y_2 is the second lowest income,

.

.

Y_n is the highest income.

Decomposition of the Ginni coefficient to find out contributions by different income sources is useful to identify the relative contribution of each income source to the overall inequality (Pyatt, Chen and Fei, 1980). The pseudo-Ginni coefficient is based on the formula for a Ginni coefficient but, using the ranks of total income of the farmers in the computation. The head-count ratio of poverty was calculated using the income level of Rs. 3887 per capita per year as fixed by the Planning Commission, Government of India for rural Orissa for the year 1999-2000.

RESULTS AND DISCUSSION

The farm and family size of different categories of farmers are presented in Table I.

On the whole, the family size in coastal villages was eight and the size increased with increase in farm size. The average family size varied from seven with marginal farmers to nine with large farmers. The average numbers of male, female, female and children available are 3.0, 2.3 and 2.5 respectively in the study area. The male and female workers in each farm size category increased with increase in farm size. The average owned farm area of marginal, small, medium and

large farmers was 0.45 ha, 1.36 ha, 2.63 ha and 6.29 ha respectively with an overall average of 1.44 ha. The educational level of farmers and their family members by farm type, adult and children and by gender is presented in Table 2. It is observed that the average years of schooling of male and female persons were 6.4 and 4.1 years respectively. The year of schooling of adult members of family was 7.6 and 4.3 for male and female respectively. Further, it was observed that the number of years of schooling increased with increase in farm size for both adult and children and also when gender was considered. The educational level has a bearing non-farm income. The correlation between number of years in school of adult male members and non-farm income were considered and it was found out to be 0.35 and significant.

Table1 : Average Family and Farm size of different categories of farmers in coastal Orissa

Farm Category	Male	Female	Children	Total
Marginal	2.51	2.00	2.37	6.88 (0.45)
Small	3.32	2.57	2.53	8.42 (1.36)
Medium	3.46	2.71	2.79	8.96 (2.63)
Large	3.71	2.86	?-.57	9.14 (6.29)
All	**2.96**	**2.32**	**2.49**	**7.77 (1.44)**

Figures in parenthesis indicate average owned farm size in ha.

Table 2. Years of Schooling of different categories of farmers in coastal Orissa

Type of	Adults(18 & above)		Children (<18)		All	
farmer	Male	Female	Male	Female	Male	Female
Marginal	6.2	3.5	5.2	3.5	5.4	3.3
Small	8.0	4.0	6.3	4.1	6.6	4.0
Medium	8.9	5.5	7.4	5.3	7.7	5.2
Large	10.8	7.0	7.4	5.6	8.2	5.9
All	7.6	4.3	6.0	4.1	6.4	4.1

In coastal Orissa, rice is the single important crop during both the seasons. Kharif season was entirely covered by rice (99.7 per cent) as no other crop can be grown in the season due to excess water conditions in the fields. Besides rice (8.9 per cent), in rabi/summer season, some farmers had grown pulses, oilseeds and vegetables, but to a very limited extent, wherever limited irrigation was available. In general, the fallow land was more (90.1 per cent) in rabi/summer season.

The occurrence of natural calamities like drought, flood, and cyclone in the state are presented in Table 3. It is observed from the table that out of 43 years (1965-2007) drought has occurred in 18 years, flood in 14 years, and cyclone in 5 years. Even in the same year, one natural calamity was superimposed on the other. Therefore, agriculture is a risky proposition in this part of the country and income from other non-farm activities is essential to sustain family income and to improve the standard of living of the rainfed farmers.

Table 3 : Occurrence of Natural Calamities in different years in Orissa

Natural Calamities	Years of Occurrence
Drought	1965,1966,1972,1974,1976,1979,1980,1981,1982, 1984,1987,1989,1992,1996,1998,2000,2002,2004
Flood	1969, 1970, 1973, 1975, 1977, 1982, 1985, 1990, 1992, 1999,2001,2003,2006,2007
Cyclone	1967, 1968, 1971, 1982; 1999

EMPLOYMENT ANALYSIS

The employment of different categories of farmers in broad activities like non-farm, on-farm (working on own farm area) and off-farm (working as agricultural labours in others' field) activities are presented in Table 4. The table revealed that females are much less employed than the male workers. The females are mostly engaged in household works (indoor), the data for which have not been collected during our survey. Females are less employed due to two reasons. First, the availability of salaried employment, which they prefer is much less. Second, due to social customs and traditions, they prefer household works. On the average, female workers are engaged for one month in

a year in on-farm works and 16 days in non-farm works. The major chunk of employment was by male workers. On the whole, the male workers were engaged for 490 days per family per year in different works. Out of the total male labour employment, 62 per cent of the days were employed in non-farm works. The non-farm activities include construction work (roads, buildings etc.), transport operation, Small Scale Industry (SSI) works, repairing activities, shop keeping, salaried employment and fishing in the sea. On-farm works absorbed only 32 per cent and the rest 6 per cent labour days were in off-farm works. When the employment pattern of different farm categories were considered, it was observed that the per cent engagement in non-farm and on-farm works increased with increase in farm size up to medium category of farmers and decreased thereafter (Table 4). The off-farm works, which constitute mainly agricultural labours, were carried out exclusively by marginal and small farmers and accounted for 6 per cent of total employment. It was also observed that the average level of employment was 55 per cent of the man days available with them, thus indicating underemployment.

Table 4. Employment Pattern (in man days) of different categories of farmers in broad activities in coastal Orissa

Activity	Marginal		Small		Medium		Large		All	
	M	F	M	F	M	F	M	F	M	F
Non-farm	264 (60)	4	325 (62)	20	369 (67)	58	388 (66)	0	305 (62)	16
On-farm	128 (29)	34	171 (33)	32	183 (33)	33	204 (34)	8	154 (32)	31
Off-farm	47 (11)	0	26 (5)	0	0	0	0	0	31 (6)	0
Total	439 (100)	38	522 (100)	52	552 (100)	91	592 (100)	8	490 (100)	47
Potential*	753	-	996	-	1039	-	1114	-	888	-

M: Adult male; F: Adult female

Figures in parentheses indicate percent of total male labour employment.

** Potential labour employment of male workers per family was worked out @ 300 man days per person per year.*

INCOME ANALYSIS

The livelihood systems of the people of coastal Orissa are presented in Table 5 under eight broad heads. They are income from rice cultivation, other crops including perennials, livestock, agricultural labour, salaried job, remittances, fishing in the sea, and other non-farm activities (NFA) like construction, transportation, small scale industries, repairing and shop keeping etc. The income shares from various sources are presented in the same table. On the average, the income of the farmers per family per year was Rs 39,004. Non-farm incomes are presented under the heads salaried job, remittances, fishing in the sea and other NFA. These four group of income sources accounted for 7 1 per cent of the total income. The income earned from other NFA accounted maximum to the total family income followed by remittances. Due to distress factors like poverty, unemployment and frequent occurrence of natural calamities, migrations have occurred to urban areas of other states and districts. The migrant workers remitted around one fourths of total income of the farm families. Rice, which was traditionally the main source of income of the farmers, has taken the third position. Salaried jobs near the village area contributed about 11 per cent and fishing in the sea 6 per cent to the total income of the farm families. On the average, agricultural labours accounted for 5 per cent of the total income. Livestock and income from other crops accounted for 2 per cent each of the total income.

Table 5. Income Share from different farm and non-farm activities in coastal Orissa

Farm type	Rice	Other crops	Live-stock	AL	Salaried Job	Remit-tances	Fishing	Other NFA
Marginal	19.38	2.13	0.77	9.49	7.74	19.19	6.41	34.90 (29039)
Small	19.53	0.80	0.82	3.47	17.43	28.68	4.75	24.52 (42984)
Medium	24.77	2.24	2.93	0	11.08	30.29	4.89	23.78 (52582)
Large	24.08	2.82	4.33	0	7.08	25.67	7.73	28.28 (66543)
Average	21.06	1.83	1.65	4.64	11.25	25.03	5.77	28.77 (39004)

AL: Agricultural labour; NFA: Non-farm activities;
Figures in parentheses indicate total income in rupees;
Other NFA include construction, transportation, shop keeping, Small Scale Industries work and repairing etc.

When different groups of farms were considered, similar trend was observed with respect to income from various sources except agricultural labour and livestock. The earnings from agricultural labour contributed 9 per cent of total income of marginal farmers and 3 per cent of total income of small farmers. The livestock earnings were comparatively more for larger group of farmers than smaller groups. Rice contributed about one-fourth of total income of larger farmers, while it contributed about one-fifth of total income of smaller farmers. On the average, the total income of larger farmers was more than two times than that of marginal farmers. In general, it was observed that the earnings from non-farm income was about 3 times more than on-farm income within the smaller group of farmers and two times more within the larger group of farmers.

The income distribution within the farmers was observed to be quite skewed, when all the farmers were considered (Table 1). The income per family per year ranged between Rs 6,038 to Rs 1,82,378. The income of top 10 per cent richer farmers was 9 times more than the bottom 10 per cent poor farmers. Even the richer 20 per cent farmers' income was more than 6 times than the bottom 20 per cent poor farmers. The middle 40 per cent of the farmers earned about 33 per cent of the total income. The incidence of poverty was computed to be 41.5 per cent in the study area.

Table 6. Income distribution pattern in different income classes in coastal Orissa

Decile group of Households	Percent share of total income	Average income (Rs)
Bottom 10%	2.78	11,000
Bottom 20%	6:62	13,115
Middle 40%	32.94	31,386
Top 20%	42.85	84,884
Top 10%	26.23	1,03,907
Incidence of poverty	41.50	--
Range of Income	--	6,038 - 1,82,378

Ginni Coefficient and Sources of Inequality in Income

The Ginni coefficient of income taking all the farmers into consideration was computed to be 0.36. The lower the coefficient, the better is the distribution of income within the population. The coefficient was further decomposed to find out the sources of inequality in income. Out of the eight sources studied (Table 7), it was found that four sources of income were the main causes of income inequalities. They are income from rice, remittances, salaried job and other non-farm activities. These four sources accounted for 95 per cent income inequality. Among these four sources, remittances contributed maximum to inequality in income followed by other non-farm activities. Salaried job contributed one fifth to total income inequality in both the years. Rice contributed 12 per cent to the income inequality during the period under survey. When different farm categories were considered, it was noticed that other non-farm activities, remittances and salaried job contributed maximum to the inequality in income of marginal and small farmers. Remittances and other non-farm activities contributed maximum to the inequality in income of large farmers, whereas remittances alone accounted for more than 50 per cent of inequality in income of medium farmers.

Table 7 : Percent Contribution to Income Inequality from major sources

Sources	Marginal	Small	Medium	Large	All
Rice	9	2	8	22	12
Remittances	39	36	59	32	41
Salaried job	15	37	17	11	20
Other NFA*	33	24	9	20	22
Total	96	99	93	85	95

**Other NFA include construction, transportation, shop keeping, Small Scale Industries and repairing etc.*

CONCLUSION

The analysis revealed that out of the total male labour employment, 62 per cent were employed in non-farm and 32 per cent in on-farm works. Females are much less employed than male workers. There is widespread unemployment prevalent in coastal Orissa as only 55 per cent of the days in a year, the male workers get employment. Non farm

income accounted 71 per cent of total income of farmers. Rice, which was traditionally the main source of income of the farmers has taken third position after remittances and income from other non-farm activities like construction, transportation and shop keeping. Hence, it was found that the employment and income earnings of the farm families are quite diversified. In general, it was observed that the earnings from non farm income was about 3 times more than on-farm income of smaller group of farmers and 2 times more within the larger group of farmers. Four sources of income like remittances, salaried job, other non-farm activities and rice were found to contribute more than 95 per cent of the income inequalities. The three non-farm sources mentioned above contributed more than 90 per cent of income inequality for marginal and small farmers.

As non-farm income contributed maximum to the total income of farmers, there is need to develop small scale industries in coastal areas and undertake more public work programs to create durable assets like roads and tanks etc. under food for work programs, which will not only improve the income of farmers but also alleviate poverty situation in the area. In the long run, investment in human capital formation such as formal and vocational education would help in raising income of the poor farm families and reduce income inequality, as the present availability of qualified personnel among those farm families are very less. Rice is important from the point of food security. Therefore, rice income stabilization can be done through development of varieties, which will tolerate abiotic stresses like salinity, submergence and drought. The drought effect can be mitigated through installation of deep tube wells in saline areas with government support and shallow tube wells in other rainfed coastal areas to provide irrigation at critical crop growth stages.

REFERENCES

Chadha, G. K. (1993), 'Non-Farm Employment for the Rural Households: Evidence and Prognosis', Indian Journal of Labour Economics, 38(3):296-327.

Elumalai, K. and R. K. Sharma (2003), 'Non-farm Employment for Rural Households in India' , Agricultural Economics Research Review, 16(Conference Issue): 1-19.

Hayami Y. and M. Kikuchi (2000), A Rice Village Saga: Three Decades of Green Revolution in the Philippines. Barne and Noble, New York and International Rice Research Institute, Philippines.

Kumar, R., N. P. Singh and R. P. Singh (2003), 'Non-Farm Employment for Rural India: An Analysis of Shifting Paradigm', Agricultural Economics Research Review, 16 (Conference Issue) : 20-30.

Nagar, A. L. and R. K. Das (1983), 'Measurement of Economic Inequality' in Basic Statistics, 2nd Edition, Oxford University Press, New Delhi, pp. 362-393.

Pyatt, G., C. Chen and J. Fei (1980), 'The Distribution of Income by Factor Components', Quarterly Journal of Economics, 95: 451-473.

Reserve Bank of India (1984), Report of the committee on Agricultural Productivity in Eastern India. Vol. 2, Part III, pp. 139-40, Reserve Bank of India, Bombay.

Samal, P. (2004), Rice Production in Orissa: Achievements and Challenges in Reviving Orissa Economy - Opportunity and Areas of Action edited by R. K. Panda, A.P.H. Publishing Corporation, New Delhi-2, pp.5-15.

Shylendra, H. S. and P. Thomas (1995), 'Non-Fame employment: Nature, Magnitude and determinants in a Semi-Arid village of Western India', India Journal of Agricultural Economics, 50(3): 410-416.

Vaidyanathan, A. (1986), 'Labour Use in Rural India: A Study of Spatial and Temporal Variations', Economic and Political Weekly, 21(52): A130-AI46.

Verma, R N.' and N. Verma (1995), 'Distress Diversification from Farm to Non-Farm Rural employment Sector in the Eastern Region', India Journal of Agricultural Economics, 50(3): 422-429.

Visaria, Pravin (1995), 'Rural Non-Farm Employment in India: Trends and Issues for Research', India Journal of Agricultural Economics, 50(3): 398-409.

❑❑❑

GROWTH AND EMPLOYMENT OF NON FARM SECTOR IN ORISSA

DR. SUDHAKAR PATRA[1] DR. KABITA KUMARI SAHU[2]

INTRODUCTION:

The world development report 1995, defines the rural non-farm sector as all economic activities in rural areas except agriculture, livestock, fishing and hunting. The rural non-farm services include handicrafts, mining, quarrying, household and nonhousehold manufacturing, processing, repairs, construction, trade, transport and communication, community and personal services in rural areas. The rural non farm sector consists of a heterogeneous set of activities in terms of income and productivity level. There exists a duality in the non-farm sector consisting of two sub sectors. The first sub-sector includes those activities which are administered on a steady basis for generating surplus and growth using hired labour and sophisticated technology. The second sub-sector includes activities which are seasonal and managed exclusively with the help of unpaid family labour catering to the local markets. However, the development of non farm sector in the content of Orissa is essential, particularly in western Orissa where farming activities are less. So the objective of this paper is to analyse the nature and importance of non-farm activities with determinants, diversification and employment.

SIGNIFICANCE OF RURAL NON FARM SECTOR IN ORISSA:

The rural non farm sector is important in Orissa because it can provide sufficient employment opportunity to seasonally unemployed and surplus labour. In recent years this non-farm sector is recognized as a potent instrument for alleviating rural poverty through income

1. Reader in Economics, F.M. University, Balasore, ORISSA
2. Lecturer in Economics, North Orissa University, Baripada, ORISSA

generation. There are a number of factors for growing significance of rural non-farm economy as stated below.

(i) The employment growth rate in the farm sector is very low which is between 1 percent to 2.5 percent in Orissa. The average annual employment growth in agriculture increased at 1.8 percent during last 10 years. So farm sector alone can not sustain growing rural communities.

(ii) The people in rural Orissa derived their incomes from multiple sources of livelihood in which the rural non farm activity has significant income shares. Approximately 30 percent of rural income comes from non farm activities.

(iii) Rural non-farm development strategy of Orissa will prevent many rural people from migrating to urban industrial and commercial centres. So, localisation of employment in Orissa in rural non-farm activities will reduce urban congestion and slums.

(iv) The economic base of rural economy of Orissa will extend beyond agriculture which will reduce the rural urban economic gaps. So, development of rural non farm sector can be an important mechanism for reducing rural urban disparities.

(v) Rural income distribution is less unequal where non farm avenues of employment exist. So, lower strata of the rural societies can participate more intensively in non-farm activities.

(vi) Rural industries are less capital intensive and more labour absorbing. So the objective of higher employment and output gains can be achieved through a chain of rural industrial activities, particularly cottage industries.

(vii) Non farm sector growth and rural industrialization have positive impact for agricultural development due to strong industry - agriculture linkages.

(viii) The female rural workers can be more employed in non-farm sectors which can bridge gender inequality in employment.

(ix) The rural non farm sector uses local resource and rural labour which are available at less cost.

The rural non-farm sector is an integral component of rural economy of Orissa which has significant contribution in rural development. So in a poor state like Orissa, there is an urgency of expanding rural non-farm activities for accelerating the pace of rural development through better employment and higher earnings. The transfer of rural workforce from agriculture to non-farm activities will reduce heavy dependence on agriculture in Orissa.

DETERMINANTS OF NON-FARM ACTIVITIES:

The non farm activities emerged in rural area due to many factors. The important determinants of non farm activities are analyzed below under 2 important points.

(i) Inter linkages between agriculture prosperity and non-farm employment:

The concentration of land in the hands of a few households can facilitate the growth of non-farm employment because the surplus generated from agriculture is invested in non-farm activities in rural areas. On the other hand landlessness and predominance of small holdings lead to non-availability of agricultural work which can result in a distress diversification to non farm activities. Since agriculture is subsistence in nature and heavily depends on rainfall, the seasonally unemployed people prefer to work in non farm sectors.

(ii) Backward and Forward Production linkages:

The second important determinant of rural non-farm sector is the backward and forward production linkages of non-farm sector with agriculture. The forward linkage refers to the use of rural non farm output as inputs for agriculture such as manufacture and repair of agricultural implements, transport, distribution of fertilizer etc. On the other hand, the backward linkages arise when the non-farm sector provides a demand for the output from agriculture. For example, processing of sugarcane, Tobacco, flour and cashew nuts.

LINKAGES OF NON-FARM SECTOR WITH RURAL EMPLOYMENT AND DEVELOPMENT

There are plethora of growth linkage models of rural non-farm sector with development which should bring about significant changes

in the structure of production and workforce particularly in rural area. The rise in per capita income due to non-farm sector results in increased demand for manufactured goods & services of diverse sorts. The share of agricultural labour force reduces due to growth of non-farm sector. In a less developed state like Orissa, the promotion of non-farm sector will result in a shift in the allocation of labour from primary to secondary and from secondary to tertiary employment. This will bring basic changes in domestic demand. Kuznets used time series and cross section data in 1959 and authenticated the hypothesis that the proportion of workers in agriculture and allied activities decreases significantly with rise in per capita income. Thus, development of non-farm activities will influence the structure of economic activity both in rural and urban areas of Orissa. The linkage between farm and non-farm sector is one of the fundamental concerns in development economics and policy making. The agricultural sector in Orissa has the potential to stimulate new economic activity in rural non farm sector through consumption expenditure and production linkages. An initial increase in rural income through non-farm activities has multiplier effect on expansion of production and employment in the economy. So there is good prospect of raising rural development and employment through non-farm activities.

GROWTH OF NON-FARM SECTOR IN ORISSA:

Table 1 shows the growth rate of non-farm sector in Orissa.

Table -1 : Growth rates of NSDP in Non-farm sectors of Orissa (at 1980-81 prices)

Sectors	1980-90	1990-2000	1980-2000
Mining & Quarrying	8.72	12.70	11.95
Manufacturing	15.16	-19.15	-0.46
Construction	3.55	0.49	4.27
Electricity, gas and water supply	5.17	-2.92	3.52
Transport	11.90	6.71	7.8

Communication	7.89	13.69	8.82
Tourism & Trade	5.66	6.75	5.48
Banking and Insurance	14.54	9.78	11.26
Railway	12.81	4.69	10.63

Source - Orissa Human Development Report, 2005

The analysis reveals that the performance of rural non-farm sector was better during 1980-90 compared to 1990-2000. So the economic reforms have adverse effect on non-farm sectors of Orissa because the growth rates have declined in many sectors after introduction of liberalization policies.

RURAL NON FARM SECTOR EMPLOYMENT IN ORISSA

Employment is one of the important economic objectives of planning. The non-farm sector in Orissa can provide substantia employment to the rural labour force. Since the employment growth in farm sector is not adequate in the state the non-farm sector must expand rapidly to absorb the surplus labour. Economic Survey of Orissa reveals that the number of workers in mining and quarrying increased from 72 thousand in 1981 to 101 thousand in 1991 which further increased to 1 lakh 40 thousand in 2001. In construction sector the number of workers was reduced but there was substantial increase in employment in trade and commerce from 3 lakh 55 thousand in 1981 to 5 lakh 58 thousand in 1991 and above 8 lakh in 2001. Similarly the employment increased in manufacturing and processing industries along with transport and communication.

The gender inequality is quite apparent in non-farm employment in Orissa. The employment of rural female is higher in manufacturing sector and low in tertiary sector which has a reversal trend in rural male employment. The rural female employment decreased from 7.89 percent in 1983-84 to 4.60 percent in 1999-2000 whereas it slightly increased from 12.18 percent in manufacturing sector in 1983-84 to 12.30 percent in 1999-2000. So, the analysis shows female rural employment in tertiary sector and declining proportion of male employment in manufacturing sector.

CONCLUSION:

The non farm sector has tremendous potentially for development and employment in Orissa. The backward and forward linkages of non-farm sector is very strong with agricultural sector. The people in rural Orissa derive income from multiple sources in non-farm sector which has heterogeneous activities. The growth rate of rural non-farm sector was above 10 percent from 1980-90 but it was below 5 percent in 1990-2000. So the economic reforms of India and liberalization policies have not yielded the desired results in rural non-farm sector in our state. The sectoral contribution to NSDP of Orissa has not changed significantly from 2000 to 2006 in comparison to other states. The rural males are more employed in manufacturing sector but the percentage of employment of rural females is more in tertiary sector compared to manufacturing sector. In a less developed state like Orissa, the rural non-farm sector should be promoted by the State Govt. to generate employment and higher income. It can reduce rural urban migration of labour and heavy dependence on agriculture in rural Orissa.

□□□

RURAL NON-FARM EMPLOYMENT

A CASE STUDY OF RURAL INDUSTRIES IN BHADRAK DISTRICT

Kartik C. Dash*

1. INTRODUCTION:

An important objective of Indian planning since its inception has been to reduce the extent of dependence on agriculture, An increase in non-farm employment was seen as essential for improving the income and standards of living of the rural population. The actual relevance of these concerns has exceeded the initial conceptualization because the annual rate of growth of population has been substantially above the rate observed when the initial plans were formulated, The increase in the non-farm component of the rural workforce has been attributed to both development and distress factors which sometimes have been operating in a mutually reinforcing way.

1.2 The framework

At present, it is argued that in a situation of rural workforce growing faster than the employment potential of agriculture RNFS has a positive role to play in promoting growth and welfare.

This is supported by a case study of Bhadrak district of Orissa, which is not rich enough in industrial raw materials as compared to the Hilly districts of the state. The study clearly shows that agriculture could not develop its potential with agro processing or any other value addition mechanism. The study observes that there exists potential to establish agro and food processing units including those for sugarcane processing, bakery, milk processing, marine-based industry and saw mills. Also there is enough scope to use agricultural by-products/wastes like straw and rice-husk for manufacturing cardboard, paper and fuel-briquette. Several constraints are observed in the promotion of non-farm activities in the rural areas. The main problem is lack of entrepreneurial skills among the rural poor. The finding of the study

* Reader in Economics, B.J.B. (Auto.) College, Bhubaneswar.

therefore, reinforces the need to impart vocational training to rural population in the state in general and the study region in particular.

1.3 Concepts and characteristics of RNFS-

The RNFS defined as a sector which includes all rural economic activity except agriculture, livestock, fishing and haunting. Nonfarm activity may take place at home or in factories or be performed by itinerant traders. It includes small and large scale activities of widely varying technological sophistication. Here nonfarm activity are nonagricultural productions including mining and manufacturing as well as utilities, construction, commerce, transport, finance and personal services.

RNFS may include the followings- (i) activities undertaken by farm households as independent producers in their home, (ii) the subcontracting of work to farm families by urban based firms, (iii) non-farm activities in villages and rural town enterprises, and (iv) commuting between rural residents and urban non-farm jobs. Thus RNFS comprises of all non-agricultural activities, mining and quarrying, household and non-household manufacturing, processing, repairs, construction, trade and hotelling, transport and communication, personal and other services in rural areas. RNFS is a heterogeneous sector having a number of sub-sectors.

1.4 Employment generation by rural industries of Bhadrak district

Despite considerable industrial development since Independence, the district lags behind compared to many other districts of the State. There is only one large scale industry FACOR, and the Small Scale Industries (SSI) next to agriculture are providing employment to the majority of population, who are mostly from rural areas.

A comparison of SSI sector with large scale manufacturing sector covered in our survey of industries reveals that the SSI sector is a better employment generating sector. Our study reveals that the employment generated by the 551 sector per rupees one lakh investment is 1.39 as against 0.20 in the large scale sector. This means that the large scale sector requires an investment of Rupees five lakhs to generate employment of 7 persons, whereas the SSI sector generates employment of 7 persons with the same amount of investment. With

regard to investment output ratio also, the 551 sector fared almost at par with the formal sector in the district.

The district has 1.97 percent of the total SSI's of the state in 2000-01, which has increased to 2.27 percent in 2004-05. Majority of these industries are located in rural areas. A detailed distribution of the SSI units in the district and the state by sector and nature of activities wise are given below in Table no. 1

Table No. 1 : Percentage distribution of SSI units by sector and nature of activities.

Name	Manufacturing		Repair& maintenance		Services		total
	Rural	Urban	Rural	Urban	Rural	Urban	
Bhadrak	53.49	1.06	0.02	6.56	28.10	10.77	100
Orissa	56.54	1.25	5.83	8.74	20.522	7.12	100

In 1990-91, the percentage share of food and allied, agro-processing, chemical and allied, and repair shops were among the top four categories of SSIs present in the district. In 2004-05 also the same trend continues. Looking into the sectorwise distribution of SSIs and Small Scale Service and Business Enterprises (SSSBE) in the unregistered sector, the rural concentration is quite evident in the district. Our study revealed a tardy industrial growth in the region in comparison to state's performance in the industrial sector.

Employment generated by SSIs in Bhadrak district was 1.95 percent of state's total in 1990-91. It fell to 1.38 percent in 2000-01 and has marginally increased to 1.47 percent in 2004-05. This implies that the percentage of employment generated by SSIs of Bhadrak has decreased during the time period of our observation. In the district, Women employment in 551 sector was 3.24 percent that of SC-14.45 percent, 5T-1.47 percent and OBC-56.65 percent and children's share was 37.42 percent. So the share of OBC in the employment provided to different categories of population is the maximum and it is even higher than the percentage of OBC employed by the SSIs at the state level. (Ibid).

1.5 Major findings and constraints:

The principal findings of our study about the employment generation of SSIs in the Bhadrak district' are the following–

Bhadrak district is bestowed with better facilities in terms of physical infrastructures like transport and communication, power, water, land and market and also the institutional infrastructure in comparison to other districts of the state. As a result the district under study is placed in an advantageous position for the development of industries as compared to other part & of the state. Despite having tremendous industrial potentialities the district is considered to be industrially backward. However this backwardness may be attributed not only to its late start of industries but also to its slow progress of industrial growth before independence.

The dominance of food and allied industry is found in the district which is of greater concern as it leads to concentration in certain locality and with regard to fewer activities. During the period 1991-2001, a number of industrial policies had been announced in the state, offering promotion of SSIs and khadi and village industries. However, those have been essentially adhoc and piece meal measures and lacked any intelligible 'vision' for the future industrialization. Probably, the industrial policy resolution of 2001 was the most explicit in its objective to bring about rapid industrial development in the state. It provided for a large number of subsidies, procedural relaxations and various concessions to the intending entrepreneurs. Special concessions were offered to women entrepreneurs and technically qualified SC and ST entrepreneurs. These facilities were just marginally availed by the designated entrepreneurs due to whom there was some marginal increase in the number of industrial units after 2001 in the district.

The point, however, is that the absence of proper integration between the industry and agricultural sectors, with the latter languishing, could eventually thwart the effectiveness of even those policy measures giving major thrust on industrial development through various instruments and incentives. Further, within the state there was a tendency to concentrate the units and capital in advanced districts adding to intra-regional distortions in growth. A number of criticisms have been made regarding the project reports which were based on faulty data, improper analysis and escalating cost estimates. Given that a majority of the units had been started during 1980-85 and were at various stages of implementation, the 'new' package of incentives and concessional finance was to be made available to units started in or after 1986, rendering the earlier units deprived of the advantages. Such irrational

policy measures have contributed to the growing industrial sickness in the state as well as the region under study. Though the policy towards high-tech industries establishment was pursued, there was no proper integrated framework of coordination between these industries and the state of infrastructure, technical skill availability and resource generation position within the state.

Shortage of raw materials and finance for both fixed and working capital appears to be the major problems faced by SSI and informal units. The other problems faced by them are the lack of modern machinery, shortage of skilled labour and the lack of positive assistance from government agencies. Thus, the SSI and informal manufacturing units are found to be constrained more by external factors than by internal ones. Small scale units face greater problem in marketing their products. In spite of the price preference given by the state government to these units, it is not easy on their part to sell their products to the government because of its shrinking financial capabilities.

The economic reforms have resulted in intensified competition for the small industries both in the domestic market and in exports particularly in consumer goods in recent years.

❑❑❑

PROBLEMS IN NON-FARM SECTORS OF ORISSA

- A VILLAGE LEVEL STUDY -

Dr. Sridhar Behera*

INTRODUCTION:

The occupational pattern in India is primarily dominated by farm employment. The rural occupational framework is broadly comprised of farm and non-farm employment. But farm sector takes a lions share. However, in the reforms era there was paradigm shift in growth of rural employment in non-farm sector. This was due to sluggish agricultural growth during the second half of the 1990's. In rural Orissa, agricultural labourers prefer to work in non-farm sector due to more availability of employment at higher wages instead of lower wages in agricultural work. This causes imbalance and lopsided growth. We have to maintain a balance between the farm and non-farm employment for a favourable occupational structure.

In the light of the problem stated above, the present paper examines the implications of the shift in employment from farm to non-farm sector through a case study of two villages in Kendrapara district. The paper attempts to review the problems and pattern of rural non-farm sectors' and relevant policy issues relating to rural employment.

GROWTH OF FARM EMPLOYMENT IN ALL-INDIA LEVEL

All India figures (as per NSS round data) show that there is a continuous increase in non-farm employment since 1972-73 (27th Round) to 2004-05 (61st Round) where it was 14.30 per cent (male 16.70 per cent and female 10.30 per cent) in the year 1972-73 in 2004-05, the percent age increased to 27.40 per cent (Male 33.50 per cent and female 16.80 per cent). It was mainly due to the fact that the

* Reader in Economics, Ravenshaw University, Cuttack-3

agriculture could not provide adequate employment opportunities and the wage in non-farm sector were higher than in agriculture both in pre-reform of post-reform period. There was increase in non -farm employment. Bhaumik (2007) has given a detailed analysis of state-wise annual growth rates of non-farm employment both during pre-reform period, post-reform period and differential growth rates between two periods. He has given sectoral distribution of rural non-farm employment. We therefor directly come to our case study.

CASE STUDY AND IMPLICATIONS

An interview was made by- the author on two villages of Kendrapara District to find out the implications of the policy. The two nearby villages chosen are Palasingha which is dominated by marginal farmers and labourers and Dobandha which is dominated by medium and large farmers relying on agriculture as their main source of income. The agricultural labourers of the village under study work in construction of road, building, bidi binding and also in agriculture these non-farm types of work are also available in agricultural season. The labourer & used to get alternative employment even in the rainy season. It is revealed from the interaction that these labourers prefer to work in non-farm sector for higher wages. When labourers opt to work in non-farm sector, the farmers relying on them for agricultural work fall short of labourers. So the agricultural production is negatively affected.

The shortage of labour during the khariff season is due to heavy demand for labour and availability of non-farm employment at a higher wage. A shift in employment from farm to non-farm sector is desirable but from the view point of agricultural growth it is a negative factor. Lower farm wages in relation to non farm wages induce diversion of agricultural labour which leads to shortage of labour for agricultural work. The big and medium farmers even keep their fertile lands uncultivated as they can not timely pursue the work due to labour shortage during agricultural season. So the investment made by the farmers becomes less profitable and retards agricultural growth.

The diversion in the rural occupational structure is favourable in the post reform period but there was sluggish agricultural growth at the same time. The shift in occupational pattern during the post reforms period has improved the income and employment. But the other side is gloomy as there is increase in the number of work force and poor people

and hence less favourable impact on poverty. This implies that even though the occupational pattern has improved, we have not achieved the required growth in agriculture. The study reveals that the labourers in non-farm sector get higher wages and their income-consumption pattern has shown an improvement. Increasing trend in their income pattern has got a positive impact on equity and well-being. The increase in non-farm sector especially for females has improved the social framework and standard of living of the poor household.

Even though the farmers are affected by the diversion of labour from farm to non-farm sector, it can be compensated by investment of capital and farm mechanisation. However, both big and medium farmers of the village under study are unable to pursue farm mechanisation as a substitute for higher farm wages. Moreover, the investment capacity and willingness of the farmers have not developed and they are also not willing to invest and consider agriculture as a risky business.

FINDINGS AND CONCLUSIONS

The growth of non-farm sector in the post-reforms period has improved the occupational structur in India and Orissa. Occupational shift in the post reforms period was due to low agricultural growth in 1993-94. It is important to note that in Orissa the low growth of farm employment induced high growth of non-farm employment in pre-reforms and post-reforms period. The growth rate of non-farm employment is high when growth of farm employment is low. The implications of this finding is that even if employment prospects in the farm sector were promising, rural workers would still opt for non-farm employment. It is also obvious that when employment growth in the farm sector becomes sluggish, rural workers would not but fall back upon the non-farm sector for sheer survival.

It is established from the case study that the shift in employment from farm to non-farm sector has got favourable impact on equity and also well-being of the rural labour households. The shift in occupational structure is a negative factor for agricultural production. It is because labourers in the non-farm sector get higher wages and hence their supply becomes less for farm sector. The diversion of labour to non-farm sector can be compensated by farm mechanisation through capital investment. But the large farmers consider agriculture as a risky business. Thus, in the context of Orissa a balance between farm and non-farm sector is

suggested for efficient agricultural growth along with fruitful social justice and equity.

The main findings and suggestions are as under.

1. The non-farm sector improvement has got positive impact on equity and well-being of rural households.
2. The shortage of labour due to diversification affecting agricultural growth should be compensated by farm mechanisation.
3. The non-farm sector should be reorganised further to make more provision of employment and at the same time farm sector should be improved by government intervention for required growth with social justice.

REFERENCES:

Bhaumik, S.K. (2007). *Growth and Composition of Rural Non-farm Employment in India in the Era of Economic Reforms,* Indian Economic Journal, Vol.55, Oct-Dc.

❑❑❑

EMPLOYMENT GENERATION IN ORISSA : CHALLENGES AND POLICY OPTIONS

Dr. B. Eswar Rao Patnaik[1] **Simanchal Mishra[2]**

INTRODUCTION :

While the labour force in Orissa indicates an increasing trend, the employment opportunities in both public and private sectors have reached a saturation point. So, there has been a sharp decline in the employment opportunity in public and private sectors from 789 thousands in 2000 to 741 thousands in 2006-07. It is likely that, workers are pushed out from the organized sector the unorganized sector. And the people who are working is unorganized sector have very little chance of getting employment throughout the whole years. Whenever they have a chance to get some employment, the amount of wages they receive is not in consonance with to wages fixed by to government. Orissa condition is very peculiar. We do not have adequate opportunities for productive employment. Two people for different types of employment is negligible. Many of them take up some arduous jobs to maintain their livelihood.

The scholar studied the conditions of Rickshaw pullers **Berhampur** town to study their economic condition. The scholar interviewed 80 rickshaw pullers in Berhampur town.

The average size of population per family was 4.5 and literacy rate was 3rd class in 40 cases, and nil in other cases. In 75 cases, rickshaw pullers didn't own rickshaws, while 5 workers owned rickshaws. The rent payable to owner for hiring the rickshaw per day was Rs.15 (for 8 hours a day). The maintenance expenses of rickshaws were the responsibility of owners. The average earnings made by a rickshaw puller per day stood at Rs.80-90 for workers in the age group of below 50 years and Rs.50-60 in case of rickshaw pullers in the age group 50 years and above. There was shrinkage in the earnings of rickshaw pullers during periods of crisis, like health breakdown or death of family members. Social security measures like pensions were the

1. Reader in Economics S.B.R.G. Women's College, Berhampur (Gm.)

2. Lecturer in Economics, Kesinga Mahavidyalaya, Kesinga, Kalahandi

privilege of 3 rickshaw pullers, who hailed from constable's family. A sum of Rs.2000 per month was received by them as pension.

POLICY PRESCRIPTIONS :

In consonance with the fact that, the employment generating impact of self-employment schemes, like I.R.D.P. and P.M.R.Y. and wage employment schemes, like J.R.Y. and N.R.E.G.S. on the economy are limited, the line of action of public authorities in employment sphere may be in the following thrust areas. There are three elements to a strategy to employment through macroeconomic policy : a) redistribution of income in favour of the low income group, b) creation of public investment, c) provision of incentives to private investment.

RURAL NON-FARM SECTOR (RNFS) :

This sector is important in generating productive employment and combating poverty in rural areas as agriculture and urban areas cannot absorb the increasing work force. Within agriculture and allied activities, it seems that, there is some scope for developing horticulture, agriclinics, seeds production, regeneration of degraded forests, watershed development, minor irrigation, wasteland development, and food processing,

Service Sector

In Service Sector, areas like education, health, nutrition, information technologies, housing in private sector and Indira Awas Youjana, tourism, road transport and road construction, hotelling and construction and real estate development are largely employment intensive.

Plugging the loopholes in self-employment and wage employment schemes.

In schemes like N.R.E.G's focus may be laid on transparency in implementation, involvement of people in the programme at all stages of implementation, minimization of the role of contractors in wage payments, social auditing, avoidance of issue of multiple job cards to beneficiaries, proper maintenance of muster rolls and sensible administration. The quality of construction materials in road works needs improvement.

Social security cover in unorganized sector

The National Commission for enterprises in the unorganized sector (2007) under the chairmanship of Arjun Sengupta states that "There is no doubt the shining India has expanded in the post reform period but this picture is spoiled by virtually stagnant consumption expenditure

and miserable working and living conditions of the 77 percent of our population who are poor and vulnerable. Some of the noteworthy recommendations by NCEU's are provision of life Insurance for Rs. 30,000, old age pension for BPL workers @Rs. 200 per month, Health Insurance (sickness cover for family upto Rs. 15,000, maternity benefit cover for Rs. 1000/ delivery, Accidental death/permanent disability Rs. 75,000 and disability allowance during hospitalization Rs. 50 per day upto 15 days) and provident fund for APL workers.

As regards the operational mechanism for giving effect to the aforesaid policies, the organizational structure at national and state levels as follows.

At National level, National Social Security Board and National Security Fund will be created. Efforts may be made to create Social Security Board and Social Security Fund at Satc Levle. At District and Social levels, District Committee and workers, facilitation centres, like NGO's, Trade Unions and PRI's may be activated.

The Bill which was introduced in the Parliament on 7.9.2007 has recommended higher diversification towards non-cereal crops. Diversification to vegetables, fruits, food processing, vegetables, fisheries and animal husbandry may widen thee employment base of the economy.

Agriclinies, seed production, agro-forestry on private agricultural holdings and private sector plantations on government lands lying barren/ waste lands may generate more employment opportunities in the economy. Public as well as private investment on irrigation, roads and power may be stepped up by reducing subsidies on power, water and fertilizers.

Khadi and village industries need focused attention of public authorities.

Small and medium industry is a vibrant source of industrial dynamism and growth of employment, as it is labour intensive. So, action-oriented programmes may be taken to encourage the small scale sector by fiscal incentives may be taken to encourage the small scale sector by fiscal incentives, Efforts may be made to set up primary processing of agricultural products, develop rural community assets, floriculture and sericulture.

To sum up, a higher output elasticity of employment without sacrificing labour productivity ensures that growth is egalitarian.

❑❑❑

RURAL NON-FARM SECTOR (RNFS) IN ORISSA: OPPORTUNITIES AND OPTIONS

Dr. Surendra Nath Behera*

INTRODUCTION:

Rural Non-Farm sector (RNFS) holds the key to faster economic development of the country. It has the potential and promise for generating employment and increased income in rural areas. The role of Rural Non Farm Sector in the State is very high as the capacity of Agricultural sector to absorb growing population is shrinking in the wake of farm mechanization and shifting of cropping pattern in favour of labour saving crops. The SSI sector with emphasis on cottage industries, village industries, rural artisans and rural handicrafts have contributed in a significant way for the development of rural areas in the state by providing employment and income to a large section of the population. There is ample scope for development of sericulture activities.

II. THE CONCEPT OF RURAL NON-FARM SECTOR (RNFS)

There are three dimensions to the definition of Rural Non-Form Sector.

1. **Subsectoral**:– The Census definition of economic activities include 9 main categories viz. (i) Cultivators, (ii) Agricultural Labourers, (iii) Workers engaged in Livestock, Forestry, Fishing, Plantations, Orchards and allied activities, (iv) Mining and Quarrying, (v) Manufacturing, processing, Servicing and Repairs (vii) Construction, (viii) Trade and Commerce (viii) Transport storage and communications (ix) Other services.
2. **Spatial Dimension:**– On the basis of population limit of 50,000 in villages & towns.
3. **Definition on the basis of Scale**:– Own account enterprises (OAE) employing family labour/owner worker.

* Professor of Economics, Khallikote Autonomous College, Berhampur

III. RATIONALE OF RURAL NON FARM SECTOR (RNFS)

The imperative necessity of the Rural Non-Farm Sector is felt on the following grounds.

(i) Labour intensive, use of both hired and family labour.

(ii) Located in Rural areas.

(iii) Utilization of local resources, raw materials and inputs.

(iv) Use of simple but Appropriate Technology.

(v) Cost-effective. Creation of jobs in RNFS sector costs only 10% to 20% of what it would cost in a large industry:

(vi) Region and area specific in approach.

(vii) Use of local talents and artistic skill.

(viii) Larger development of entrepreneurship abilities among Rural masses.

(ix) Increase in the standard of living of the rural poor by self-employment through promotion of income generating activities in the process of inclusive growth.

(x) Facilitates savings, and productive activities through greater linkage with institution credit.

(xi) Realize the plan goal of balanced regional development through its focus on rural industrialization.

(xii) Environmental friendly and helps in sustainable development.

IV. RNFS ACTIVITIES:

The role of industrialization is of paramount importance as far as optimum utilization of natural resources and generation of gainful local employment are concerned.

Various activities in the non-form sector include cottage, village and Tiny industries, Rural-agro industries, Traditional industries like handloom weavers, Handicrafts, coil, Sericulture, Crafts, self employed persons, service sector personnel and other micro entrepreneurs.

Promotion of small enterprises remain the crucial mechanism not only to generate large scale employment and ensure a high degree of

self sufficiency but also to actually help reducing inter district disparities in growth. The Orissa State Cooperate Handicrafts Corporation is engaged strengthening the production base, enlarging market opportunities, encouraging exports and introducing new design and technology in the handicraft sector. There are a number of craft pockets dispersed throughout the state. A few of the crafts like stone, carving, wood carving, patta painting, terracotta, silver filigree, applique, tribal jewelry, dhokra casting, wooden painted item, cane and bamboo products brass and ball metal products, golden grass product etc. have potential to grow into serious commercial venture.

In the globalization times there is an increasing demand for the handicraft product and in the rise in the handicraft sector of the economy. The production base is much unorganized in the handicraft sector. The craftsmen use traditional tools and techniques for which the production base is very weak.

Handloom sector, next to Agriculture provides massive employment to the rural artisans. The handloom industry in Orissa is the largest cottage industry, Providing employment and sustenance to 4% of the population of the state. However, in the face of competition in the open market, the strengthening of the industry along with its diversification is the continuous need for its survival.

V. PROMOTION OF RURAL NON-FARM SECTOR BY NABARD

The National Bank for Agriculture and Rural development (NABARD) has taken various promotional measures for expansion and modernization of the Rural Non Farm Sector through different loan schemes for promoting Rural Entrepreneurship and Rural Industrialization. Recognizing the importance of RNFS for faster economic development of the rural areas, NABARD has taken a number of initiatives with the refinance support and promotional assistance for development of this sector.

(1) Rural Entrepreneurship Development Programmes (REDP):

It aims at developing entrepreneurial activity and skill to those who are willing to setup micro enterprises for creation of sustainable employment and income opportunities in rural area in a cost-effective manner.

(2) Refinance Facilities Through Different Loan Schemes.

The Refinance facilities are broadly classified into two categories (i) Investment credit, (ii) Production credit.

Under investment credit NABARD provides refinance to Commercial Banks, Regional Rural Banks (RRBs) and Co-Operative banks for a wide spectrum of manufacturing, processing and service sector activities under RNFS. Various refinance scheme formulated are

- Composite Loan Scheme
- Integrated Loan Scheme
- Small Road and Water Transport Operators Scheme. (SRWTOS)
- Schemes based on Pre sanction procedure.
- Soft Loan Assistant for Margin Money

Rural artisans, craftsmen, small entrepreneurs, and NGOs are covered under the refinance scheme for expansion, diversification, modernization, under renovation through SHG - Bank linkage through Informal Credit delivery system.

(3) Swarojgar Credit Card Scheme (SCS Scheme) :

NABARD is committed to rural prosperity. Its Swarojgar Credit Card Scheme was introduced by the Govt. of India in 2003 in consultation with NABARD and RBI. It was formulated as a special Credit Card Scheme benefiting the rural artisans and small entrepreneurs. The Scheme is normally valid for 5 years subject to satisfactory operation and renewed on a yearly basis through simple review process. The normal limit under the skill is 25.000. The Scheme is to be implemented by all commercial Banks, RRBs, State Cooperative Banks, DDCBs, PACS, SCARDBs, PCARDBs and Scheduled Primary Co operative Banks. Beneficiaries under the scheme would automatically be covered under the group insurance scheme and the premium would be shared by bank and the borrower equally.

VI. POLICY FOCUS

Keeping in view the crucial role played by the Rural Non-Farm Sector, following issues deserve priority attention calling for thrust areas of policy measures needed for a radical transformation of the rural economy.

(i) A dynamic small enterprise promotion policy for the state is a crucial need for future industrial development. Focusing' on industrial clusters, especially supporting their technology upgradation and promoting external orientation shall be a potential area of intervention.

(ii) Necessary support need to be extended and encouragement should be provided to the potential entrepreneurs and rural artisans for skill upgradation, and acquisition, capacity building, design development of handicrafts and marketing of products.

(iii) Prospective entrepreneurs should be encouraged through periodic awareness campaigns of NFS potential in the area.

(iv) Entrepreneurial involvement would be more attractive and viable by encouraging local demand base. Dismal performance of the industrial structure can be avoided by local entrepreneurial drive.

(v) Lack of proper infrastructure has severally impaired the growth and diversification of industries in the state. Emphasis need to be given on infrastructure development, especially transport and power. The road condition and power supply need to be improved substantially. The railway network need to be fully operationalised for both goods and passenger traffic connecting depressed regions.

(vi) There is a need to build up entrepreneurial and managerial skill and encouragement to higher skilled entrepreneur venture to utilize the huge potential in different districts in industries, services and business sector. Skill development is the key to quality and productivity and employment of local people in various industries.

(vii) Marketing support can be strengthened through construction of retail outlets for handicrafts at tourist places productivity.

(viii) Training programmes on processing technology, quality control, accounting pricing and market support are necessary for village industries. Setting up vocational training institutes may be promoted in Govt. and private sector to cater to the manpower requirement of the industrial sector. Investment of NGOs in this respect will be more fruitful.

(ix) Large number of Orientation meets and gender sensitization needs by NABARD to promote financing under NFS will improve the ground level credit flow to women.

(x) Since a sizeable population are earning their livelihood from handicraft and cottage industries focused attention for their upliftment is to be made Adequate and consistent efforts of various agencies like KVIC / KVIB and the Govt. deserve special attention. The industrial, Handloom, Weavers and Handicraft cooperative societies need to be activated to facilitate procurement of raw materials, access to credit and marketing.

(xi) Adequate coordination between the Govt. agencies and banker will avoid delay in processing of proposals for the potential entrepreneurs. Govt. agencies like ITDA, DRDA, DICs, should have greater coordination among them.

There is a sharp positive linkage between the Rural and Non-form sector and development of the rural economy. Necessary mechanism need to be developed to put great emphasis on institutional finance, training, and marketing support, rural entrepreneurship development and greater integration between the people, Govt. and NGOs for a sustainable development.

❑❑❑

EMPLOYMENT & INCOME IN THE NON-FARM SECTORS OF ORISSA

Dr. Satyabrata Mishra*

ABSTRACT

Orissa's economy is predominantly agrarian as 85% of the population still live in rural areas. The economy continues to be predominantly agrarian in terms of the share of population and workforce. Agricultural development in Orissa is not in conformity with Kaldor– Kuznets long term dynamics of agrarian economy as the share of agricultural sector in NSDP declined perceptibly whereas its share in workforce decreased marginally during 1951-91, which constitutes a major constraint to the development process in Orissa. Diversification of rural economy and rural labour market through the development of (RNFS) Rural Non Farm Sectors is the desideratum to shift surplus of manpower from agriculture to non-agricultural activities in Orissa. For slackening the magnitude of disguised unemployment RNFS has a preponderance role in recent years. The yawning rural unemployment, low growth of over all employment, shrinking labour force further provides rationale for the development of RNFS. The diversification of rural economy not only in terms of output but also in terms of employment is imperative for the sustainability and development of rural towns (agropolis) is important to develop RNFS and check migration (rural urban exodus). The development of RNFS particularly in the agrarian economies has been the catalyst of rural development strategy. This is imperative to slacken the gap between urban India an rural Bharat to maintain socio-economic stability.

The present paper makes an endeavour at examining the gender composition of workers employed in non-farm sectors income earned by the workers in RNFS, relative share in NSDP and policy measures

* Reader in Economics, M.P.C. (A) College, Takhatpur, Baripada Mayurbhanj, Orissa

undertaken by the Govt. to improve the employment and income of the people absorbed in RNFS.

Amelioration of poverty and reduction in unemployment continue to be one of the objectives of development planning. For the attainment of twin objectives several self-employment and wage employment programmes have been launched both in rural and urban areas particularly for the economically backward and socially vulnerable target groups. Employment in non-farm sector has marginally increased which reveals that transformation of main workers from agriculture to RNFS has been slow and incommensurate with that of developed states.

As the shift of workers to RNFS was largely due to the push effect, RNFS would have to be developed in such a way that it could generate a strong pull effect. The activities of RNFS must focus on the level of per capita income of the state and the aspirations of the unemployed rural, especially youth. Then only RNFS would have the necessary and critical minimum pull effect.

In view of low and low quality of education of the rural unemployed youth, there is a need for initiating short term skill oriented relevant training programmes to enhance their employability in RNFS. A holistic approach towards the development of rural economy is sine qua non for this. It comprises efforts to raise both farm and non-farm rural income through rural industrialization. Conscious efforts at the policy level must be made to mitigate rural urban inequalities in terms of income and opportunities.

Organized efforts by the Govt., educational institutions, PRIs and NGOs should be expedited to raise the level of awareness and motivate rural youth towards non-farm employment, especially in the informal sector.

Rural growth centres and SEZs would promote employment and income of workers in RNFS.

❑❑❑

DO RURAL NON-FARM SECTOR WORKERS MIGRATE TO URBAN INFORMAL SECTOR?

CASE STUDY OF A CAPITAL CITY (BHUBANESWAR)

Dr. Sheshadev Mohapatra*

ABSTRACT

In the process of economic development, agriculture and the modern formal industrial sector are not able to absorb the growing labour force in the developing countries. Since the agricultural sector in the rural areas is oversaturated, the growth of RNFS is seen as a promising sector for creation of sustainable employment and as solution to the problem of poverty and unemployment in rural areas.

In our study covering ten slums of Bhubaneswar some of them working in RNFS it is observed that, lack of employment in the rural areas is the main reason for their migration to the capital city at so much cost, hardship and labour. Some of them are reported to have been forced to come to the city after semi-starving for many days due to want any type of employment in their area. For some others, it is the prospect of better wage that attracts them to the city. In their villages it is very difficult to even the minimum wage whereas in the town they are able to earn almost the double. Some of the daily wage workers are seasonal migrants. Whenever agricultural operation starts they go back to their villages and during the off– season, they comeback to the city in search of work. The havoc caused by the natural calamities to agriculture, life flood and drought particularly, the last years severe drought in almost all over the state and this years flood in some parts have worsened the conditions of the rural poor forcing them to migrate to the cities.

According to a report of the Government of Orissa, the other main reason for migration is the advance taken from labour contractors of their agents and repayment of household loans. One of the reasons for migration that has been revealed during the interaction with the labourers is the hesitation of the educated youths to do manual jobs. Some of the

* Faculty of Economics, D.A.V. Public School, Chandrasekharpur, BBSR-21

young labourers are educated youths to do manual jobs. Some of the young labourers are educated up to matriculation or even beyond. A few are even technically trained and skilled.

DETAILS OF THE STUDY

Majority (55%) of the sample RUM (Rural Urban Migration) workers in the IS (Informal sector) of Bhubaneswar have migrated due to their poverty, inadequate income, unemployment and under employment in their native places. The pull factors had also a role to play since around one-fifth of the RUM workers have been attracted towards the town by economic motives. Thus, the push factors are more important for migration of workers from rural areas to the capital town's IS. Besides the push and pull factors, certain proportions of RUM workers (19 per cent) have migrated from rural areas following the primary migrants.

In Bhubaneswar also, it is the higher current money income in the town (in 19 per cent cases) compared to that in rural native places rather than more expected life-time income (only in 3 per cent cases) has significant role to play in the migration process of workers from rural areas to the town's Informal Sector. Though only 19 per cent of RUM worker's motive of migration was higher current money income, it is observed from the field data more than one-third of the RUM worker's current money income in the town at the time for migration was higher than in the rural areas. Therefore, the expected life-time income hypothesis seems to have no validity in case of the IS of Bhubaneswar. The choice of the town's IS by the migrants is mostly due to the presence of their family members or relatives in the town.

Activities before migration

More than 47 per cent of the UM (Urban Migrant) workers were employed either in rural farm or non-farm activities before their migration to the IS of the capital town of Bhubaneswar. The migration of employed to the town's IS has increased up to the first half of 1980s and then declined. On the other hand, the migration of unemployed in search of jobs has increased since late 1970s.

CONCLUSION

The percentage of RNFS workers migrating to city is less than that of all informal workers. However, the motives and causes seem to be similar for both.

❑❑❑

the issue of growth of incomes. But the subject also encompasses the features and processes that alter the conditions of living of the population at large, as well as the institutions that underlie the changes.

It ought to be mentioned here that in his masterly tract entitled 'The Theory of Economic Development' published in 1912 Joseph Schumpeter too had also comprehensively addressed the same issue, but his concerns were solely confined to the development processes of mature capitalist economies like those of Germany and England. For Schumpeter the *differentia specifica* of the capitalist system consisted of the marked expansion of the system of banking and financial intermediation which was not present under feudalism or the earlier economic systems. Among the many original formulations that Schumpeter had in this major work was the centrality of the 'entrepreneur' who was regarded to be the agent who organises finance and combines factors of production in an innovative manner to produce a product that will be valued in the market place. It is the entrepreneur who imparts the necessary dynamism to the capitalist system.

One should therefore remember that no matter what the contemporary formulations may be, the subject of development economics ultimately has a clear link with its original classical concerns. It is remarkable that more than two and a half centuries after the onset of the Industrial Revolution in England and parts of Western Europe some of the basic issues of poverty, destitution and social and economic inequality that were live issues then continue to be very much valid in large tracts of Asia, Africa and Latin America today. In China and India today there is massive relocation of labour from agriculture into urban metropolitan centres. Working conditions are poor and wages are barely at subsistence level, a feature that Friedrich Engels had noted in Manchester in the 1840s, and which was later to be comprehensively theorised by Marx.

II THE PROBLEM

Countries are often poor because they are trapped in a vicious cycle of poverty. Low incomes in a populace would typically lead to low levels of savings and investment. This would in turn imply low levels of income generation. These were the characteristic features of large swathes of countries in Asia, Africa and Latin America, many of which still continued to be under colonial yoke till the late 1940s. It is this setting which led Joan Robinson, Rosenstein-Rodan and Ragnar Nurkse,

Approaches to Development Economics

Prof. Pulin B. Nayak

I INTRODUCTION

Development economics emerged as a major subject of study in the post Second World War period. A large number of countries in Asia, Africa and Latin America were at that time emerging from long centuries of colonial rule. Most of these were low income countries with poor economic infrastructure and low levels of education and health care. Most of these were also afflicted by high incidence of poverty and destitution. It is in this context that some pioneering contributions were made during the late 1940s and through the decade of the 1950s by Joan Robinson, Ragnar Nurkse, Albert Hirschman, Paul Rosenstein-Rodan and Sir William Arthur Lewis, among many others, that set the ball rolling to create an area that became known as development economics.

It is nevertheless possible to argue that the subject of development economics was very much the agenda of the founding fathers of the subject of political economy, the foremost among them being Adam Smith and David Ricardo. In his 'Enquiry into the Nature and Causes of the Wealth of Nations' published in 1776 Smith comprehensively defined the scope of the subject that was concerned with improving the material conditions of living of the general masses in a country that was entering into the first phase of the Industrial Revolution. Peasants were getting relocated from agriculture into industrial townships and were typically living in uncongenial circumstances. Working conditions were poor and wages were barely at subsistence level.

The current agenda and the scope of the subject of development economics therefore bears affinity to the original concerns of the classical authors. Development economics is of course concerned with

---

Pulin B. Nayak is Professor of Economics at the Delhi School of Economics. He is the President of the Orissa Economics Association for the year 2009-10. This is the text of the first Prof. Baidyanath Misra Lecture delivered on 14th February, 2009, at Utkal University, Vani Vihar, Bhubaneswar.

among others, to make some of the early contributions to the new discipline of development economics. Most of these early writers suggested that a major break in the policy regime was a pre requisite to rescue the system from the low level equilibrium trap.

Paul Rosenstein-Rodan in 1943 was among the first to argue for a 'big push' by stepping up investment in a range of industries to give a fillip to the growth process. Ragnar Nurkse suggested in 1953 that low incomes were due to the low level of capital formation. He made a well reasoned case for balanced growth of all sectors. It was also suggested by Joan Robinson, Mihail Manoilescu and others in the late 1940s that there was disguised employment in most low income countries. If true, this meant that labour may be removed from the farm sector to build, say, rural infrastructure, without any drop in farm output.

In his very influential contribution entitled 'Economic development with unlimited supplies of labour' published in The Manchester School in 1954, William Arthur Lewis used the classical mode of economic analysis to make a case for removing labour from subsistence agriculture to be employed in industrial activity. Lewis stressed the importance of removing all bottlenecks in the process of growth. It was also emphasised that the terms of trade between agriculture and industry must be kept in balance so that neither sector is constrained. Lewis was substantially in favour of a balanced growth of all principal activities and sectors.

There was an opposing view advanced notably by Albert Hirschman in 1958 who made a case for unbalanced growth on the ground that this will enable countries to specialise and economise on scarce resources. This would in particular enable countries to exploit the special advantages arising out of their special endowment or situation arising due to their natural resources, climate or geographic location. This would also make a lot of sense for small countries in a regime of free, open and fair trade. Serious problems may well arise if trade does not abide by the requirement of fairness, which often is the unfortunate political reality. It has been one of the stark facts of geo political trade that developing countries relying principally on primary products for their exports typically suffer from unequal exchange and have invariably suffered a secular decline in the their terms of trade. However, unbalanced growth, as such, might not be an appropriate strategy for a large economy like that of India.

It would be simplistic to presume that either one or the other of the above approaches would be the correct potion for any specific developing country. In fact there is good reason to believe that the two approaches should be regarded not as strict substitutes, but as complementary to each other.

III STATE VERSUS THE MARKET

A very important question pertains to the relative roles of the state and the market in the process of development. The role of the state has to be regarded as crucial for the provision of public goods and social overheads, such as roads and rail networks, the irrigation system, policing and the judicial system, among others. It is well known that the market mechanism will typically fail to adequately channelise resources for the provision of public goods. This happens owing to the reason that public goods inherently involve externalities, which implies that rational economic agents committed to maximising behaviour would find themselves in sub optimal situations. In order to ensure efficiency it would be necessary for the state to intervene, possibly by making use of taxes and subsidies, though other forms of interventions may also be thought of.

The above may be regarded as the allocative rationale for state intervention. But, as has clearly been postulated by Richard Musgrave, the state also has a vital role to play in the realms of distribution and stabilisation. It is well known that the market mechanism may give rise to and then sustain extremely skewed distributions of income and wealth. One of the key functions of a modern welfare state must be to work towards a more equitable distribution of outcomes.

On the issue of stabilisation one of the key foundational features of the Smith-Ricardo-Say system was the idea that the market mechanism is inherently self correcting. That this need not necessarily be the case was recognised early at least by Malthus and Marx but somehow mainstream neoclassical economists trained in the Marshallian tradition presumed that the market mechanism is intrinsically stable. This view received a rude shock during the Great Depression of the early 1930s. It needed the genius of a John Maynard Keynes to establish beyond incontrovertible doubt that the market mechanism may easily sustain an equilibrium with less than full employment level of output. To move the system onto the full employment level of output one would need the intervention of the state by way of public expenditure.

The case for state action would therefore appear to be almost axiomatic. It would particularly be so in the context of a developing low per capita income country like India, where the levels of basic health and education are poor and which call out for public action. Yet there appears to be a fairly prominent counter view that just as there is the possibility of market failure, the expectation that government intervention will automatically or necessarily ensure efficiency is equally misplaced. In other words there is some reason to fear the possibility of what may be called 'government failure'. This may well arise due to a number of factors that are inherently related to the nature of the existing economic and social power structure which makes the government machinery a tool for the already rich and influential. But quite distinct from this, there is also the argument that the incentive system and the task of monitoring in a governmental system have inherent institutional inefficiencies built into it.

We are at present at a conjuncture where the advanced capitalist world is undergoing possibly the severest slowdown after the great depression that followed the Wall Street crash of 1929. The current financial and economic crisis snowballed after the sub-prime crisis in the US economy which followed the great housing bubble of the 1990s and the early years of the present decade. Combined with this was the mistaken presumption amongst investment bankers that they could leverage questionable asset portfolios of 'junk' municipal bonds into further rounds of investment. The system became so unsustainable that established investment houses such as Lehman Brothers had to be liquidated, and several major financial institutions went through deep trouble. Major icons of US capitalism such as General Motors had to appeal to US government for bail out packages. After nearly a quarter century of free market fundamentalism that had gained currency after the Thatcher Reagan years of the early 1980s, it seemed that Keynesianism was again back with a vengeance.

IV SOME MAJOR CONTENDING VIEWS

The mainstream view of the development process has tended to favour maximisation of income generation. Heavy emphasis is therefore usually placed upon ensuring the maximum possible growth rate of GDP. This is very much consistent with the utilitarian norm of achieving the greatest good for the greatest number. However it is well known that

this norm does not ordinarily pay attention to the requirement of distributive justice. While there is some empirical support to the thesis that high growth goes hand in hand with poverty reduction there are any number of instances where the link is tenuous at best. There are numerous instances of the development process giving rise to a dualistic trend where the rich get richer and the poor yet poorer. In other words the presumption that the high growth would automatically have a 'trickle down' effect to the bottom rungs often simply does not follow.

The Indian reality is one where nearly sixty years of planned economic growth have still not eliminated abject poverty. Nearly a third of the population lives in absolute poverty in India. There are some estimates which put the extent of the poverty at substantially higher levels. In the recent report of the NCEUS chaired by Dr. Arjun Sengupta it is computed that if we think of Rs. 20 per person per day is to be regarded as a bare minimal norm, then nearly 77% of the Indian population is below the poverty line. The groups which comprise this huge mass substantially belong to the SCs, STs, OBCs, minority communities, women, the physically challenged, the old and the infirm. Development policy therefore needs to explicitly address the concerns of these sections.

After the influential writings of John Rawls (A Theory of Justice, Harvard University Press, 1971) we have an alternative welfare norm which, in contrast to the utilitarian one, focuses on the well being of the worst off individual. This is consonant with Gandhiji's idea of the '*daridranarayan*' where his concern was focussed on the well being of the poorest member. Concentrating on the well being of the poor might often mean that the full growth potential may have to be sacrificed, presenting a dilemma of the equity-efficiency trade off. Yet it may nevertheless important to pursue targeted schemes for the poor for the sake of achieving some minimally acceptable norms of distributive justice.

Classical trade theory, following in the tradition of Smith and Ricardo, posits that trade and exchange benefits all parties. Marx used the same 'labour theory of value' of Ricardo to arrive at different conclusions. He achieved this by drawing a distinction between values and prices. Prices relate to the market, but it is an analysis of values that would enable us to understand the process of exploitation. There are some alternative theories of development based on the idea of

unequal exchange which try to examine the link between the advanced metropolitan countries that may be regarded as the 'centre' and the less developed colonial countries that may be thought of as the 'periphery'. Some of the major contributors in this mode are Andre Gunder Frank and Samir Amin.

Underdevelopment here is to be understood as a consequence of the nature of capitalist development which takes the form of imperialism. The economic centres use their military, economic and political power to continue to dominate and exploit the peripheries. The centre or the core typically locates several stages of the production chain in developing countries to take advantage of lower wages. This enables them to enhance their profitability and maintain high incomes within their own countries.

There has been a strong tradition of development thinking within India as well, contained in the substantial writings of Dadabhai Naoroji, Mahadeo Govind Ranade, R.C. Dutt, and B.R. Ambedkar, among others, in the pre Independence period. To this must be added Gandhiji's powerful and original formulations especially focussed on (i) decentralised village economies, (ii) limitation of wants and (iii) concern for the 'daridranarayan', the poorest of the poor. These were substantially contained in his small book entitled '*Hind Swaraj*' which Gandhiji had penned while on a sea voyage from England to South Africa, and which was published in 1909. In (ii) above, Gandhiji fundamentally questioned the mainstream formulation of the expansion of the good space which has been the central project of political economy from the original writings of Smith and Ricardo and continuing through the writings of Marshall and Keynes to the corpus of the modern day neo-classical masters, Paul Samuelson and Kenneth Arrow.

V CONCLUSION

In post Independent India early development theory and planning were indistinguishable and they were dominated by the thoughts of Pandit Jawaharlal Nehru, and during the mid 1950s, of Prasanta Mahalanobis, the well known statistician and planner. Prior to Independence, in 1938, the National Planning Committee was formed with Nehru as the Chair. It had a large and distinguished membership. Nehru was intellectually attracted to both Fabian socialism and the Soviet planning experience which had recorded some spectacular early

successes. The Fabians postulated that the state should have a strong presence in education, health and housing for the poor and the needy. The Soviets under Stalin went in for a system of centralised investment planning, which had been theorised in the works of Feldman. Nehru and Mahalanobis were to later reformulate this on the eve of the Second Five Year Plan in 1956 by giving special emphasis to the capital goods sector.

The Bombay school of economists comprising Vakil, Brahmananda and Dantwala, among others, were opposed to the above approach but Nehru in the early years of India's independence was unchallenged in the policy formulation arena. Some of the positive features of the Indian economy today, which include, inter alia, a diversified industrial base, a large pool of highly skilled professionals such as engineers, doctors etc., owe their origins to the policy formulations of those days. Among the major contributors to development thinking in India during the 1960s and thereafter include, notably, Sukhamoy Chakravarty, for his contributions to investment planning and Amartya Sen, for his espousal of investing heavily in education, health and women's empowerment, among others. Traditional development economics did not explicitly emphasise these aspects. But after more than six decades of self avowed practice of economic planning this is today regarded to be the need of the hour.

At the end of the day, any meaningful measure of development must address the question of enhancement of the well being of the population at large. Development must be fair and equitable and it must encompass the enhancement of capabilities of individuals so that they may realise their full potential. In order to realise the above the issue of effective governance is a matter of no small importance. This presupposes appropriate political and legal institutions as well as a heightened level of social awareness in the population. Regardless of what precise approach to development is adopted, a commitment to political democracy and a free press ought to be regarded as a basic prerequisite in all civilised societies. True democracy will prevail only when the lowest rungs of the population are empowered enough to pursue and realise their full potential.

□□□

LIST OF MEMBERS

INSTITUTIONAL MEMBERS

1. Council of Analytical Tribal Studies,
   Pujariput Road, Koraput - 764 020
2. Directorate of Economics & Statistics,
   Govt. of Orissa, Heads of Deptt. Buildings,
   Bhubaneswar - 751 001.
3. Gopabandhu Academy of Administration,
   Chandrasekharpur, Bhubaneswar - 751 013

LIFE MEMBERS

A

1. Dr, Adwait Kumar Mohanty
   N3/21, IRC Village,
   Nayapalli,
   Bhubaneswar - 751015.
2. Dr. Akhay Ku. Mohanty
   At : Matiapada,
   P.O.: Puri, Dist.: Puri.
3. Smt. Anajali Das
   Plot No.: 77-S
   Behind Jagannath Ashram,
   P.O.: Brahmeswar,
   Dist.: Bhubaneswar - 751018.
4. Aparajita Biswal
   Deptt. of A & A Economics
   Utkal University,
   Vani Vihar, Bhubaneswar.
5. Dr. Ajeya Kumar Mohapatra
   C/o K.K. Parija, Arunodaya Nagar,
   Badambadi, Cuttack-12
6. Major A.K. Roy
   Dy. Director
   H.E. (Retd.), Orissa.
7. Dr. (Smt.) Amita Choudhury
   Deptt. of Economics,
   Berhampur University
   Bhanja Vihar, Berhampur-7,
   Dist : Ganjam.
8. Sri Anirudha Behera
   Deptt. of Economics
   F.M. Junior College,
   Balasore.
9. Sri Askhaya Kumar Panda
   457, Laxmi Bai Nagar,
   New Delhi - 110023.
10. Smt. Anuradha Mohapatra
    Deptt. of Economics,
    P.N. College,
    Khurda
11. Dr. Akrura Chand
    Deptt. of Economics,
    Sambalpur University,
    Burla,
    Dist : Sambalpur.
12. Miss Annapoorna Satapathy
    At : Ganeshpur,
    P.O.: Chandol,
    Dist.: Kendrapara.
13. Dr. Abhay Kumar Nayak
    Asst. Registrar, I.I.T.,
    Kanpur,
    Uttar Pradesh,
    Pin - 208016.
14. Sri Aditya Kumar Patra
    Deptt. of Economics,
    Kalinga Mahavidyalaya
    G.Udayagiri,
    Phulbani.
15. Dr. Arabinda Mishra
    Associate Professor,
    Deptt. of Natural Resources,
    TERI School of Advanced Studies,
    Darbari Seth Block,
    IHC Complex,
    New Delhi-110003.

16. Smt. Asha Dugal
Deptt. of Economics,
Banki College, Banki
Dist.: Cuttack.

17. Sri Amulyanidhi Pradhan
Deptt. of Economics,
Govt. Evening College,
Rourkela.

18. Mrs. Arati Nanda
Research Scholar, ARDCOS
115, Basundhara Apartments,
Rasulgarh, Bhubaneswar-10.

19. Sri Artatrana Tripathy
Lect. in Economics
Narasinghpur College,
Narsinghpur, Dist.: Cuttack.

B

20. Dr. B. Eswar Rao Patnaik
SBR Govt. Women's Junior College,
Berhampur,
Dist.: Ganjam.

21. Sri Bhabani Prasad Dash
Madhapur,
Gandhi Chhak, Jagatsingpur.

22. Smt. Banabasini Mohapatra
Deptt. of Economics,
S.K.D.A.V. College, Rourkela.

23. Dr. Binayak Rath
Vice Chancellor,
Utkal University,
Vani Vihar, Bhubaneswar.

24. Dr. Bidyadhar Nayak
Plot. No.- 932,
Mahanadi Vihar, Cuttack.

25. Sri Basanta Kumar Das
Co-ordinator,
Fakir Mohan University,
Vyasavihar, Balasore.

26. Sri Benudhar Mishra
Qrs. No.- IV B/37/2,
Unit-3, Bhubaneswar -1

27. Sri Bimal Kumar Dash
Deptt. of Economics,
Govt. Women's College,
Dhenkanal.

28. Smt. Babylata Shroff
Deptt. of Economics,
D.A.V. College, Titilagarh,
Dist.: Bolangir.

29. Smt. Binodini Dalei
Deptt. of Economics,
V. Deb College,
Jeypore, Koraput.

30. Sri Bhabani K. Patnaik
Deptt. of Economics,
R.C.M. Science College,
Khallikote, Dist.: Ganjam.

31. Sri Bibhudendu Mishra, I.R.S.
Director General,
Investigation, Income Tax,
Calcutta.

32. Sri Bijay Kumar Bose
SIDBI,
IPICOL House,
Bhubaneswar.

33. Dr. Bhimasen Prusty
Deptt. of Economics,
Charampa College,
Charampa, Dist.: Bhadrak

34. Dr. Bimal K. Mohanty
Deptt. of Economics,
G.M. College,
Sambalpur.

35. Dr. Basudeb Sahoo
Retd. Prof. of Economics,
A/M-39, Kapila Prasad,
Bhubaneswar-2.

36. Dr. Bhagaban Swain
Deptt. of Economics,
Revenshaw College,
Cuttack.

37. Dr. Bhagabat Patro
Deptt. of Economics,
Berhampur University,
Berhampur-7, Dist : Ganjam.

38. Sri B.K. Sahoo
Principal,
Chikiti College, Chikiti,
Dist : Ganjam.

39. Dr. B.K. Panda
Deptt. of Economics,
Berhampur University,
Bhanja Vihar, Berhampur-7,
Dist : Ganjam.

40. Dr. Baijayanti Rout
Deptt. of Economics,
B.J.B. College,
Bhubaneswar.

41. Dr. Bholeswar Sahu
Deptt. of Economics,
Attabira College, Attabira,
Dist.: Bargarh - 768027.

42. Sri Biranchi Narayan Mohapatra
Deptt. of Economics,
Sarala Mahavidyalay,
Rahama, Dist.: Jagatsinghpur.

43. Sri Binayak Das
Deptt. of Economics,
KSUB College,
Bhanjanagar,
Dist : Ganjam.

44. Sri B. Samantray
Deptt. of Economics,
R.C.M. College,
Khalikote,
Dist : Ganjam.

45. Smt. Basanti Das
Deptt. of Economics,
Rayagada Women's College,
PO./Dist.: Rayagada.

46. Sri B.K. Mohanty
Deptt. of Economics,
Malyagiri College,
Pallahara, Angul.

47. Dr. Bijayalaxmi Rout
Deptt. of Economics,
Ravenshaw College,
Cuttack.

48. Major Bramhanda Sahoo
Plot No.- 1215/1423
Khandagiri,
Bhubaneswar.

49. Dr. Benudhar Nayak
HSS Dept. NERIST,
Nirjuli,
Arunachal Pradesh.

50. Prof. Baidyanath Misra
17, Sahid Nagar,
Bhubaneswar.

51. Dr. Bedabati Mohanty
N-3/314, IRC Village,
Nayapalli,
Bhubaneswar - 751015.

52. Dr. Benudhar Bhuyan
Sai Jyoti, N - 1/7
Ekamra Kanan Road,
IRC Village,l Nayapalli
Bhubaneswar - 751015

53. Dr. Balaram Mishra
Deptt. of Economics,
F.M. College,
Balasore.

54. Sri Bhikari Behera
Deptt. of Economics,
Godavarisha Mohavidyalaya,
Banpur, Dist - Khurda.

55. Sri Basanta Kumar Mohanty
Deptt. of Economics,
Malyagiri College, Malyagiri,
Pallahara, Angul - 759118.

56. Sri Biswambhar Jena
Deptt. of Economics,
D.K. College, Jaleswar,
At/P.O.: Dhansimulia,
Balasore - 756084.

57. Dr. Bishnupriya Mishra
Deptt. of Economics
B.J.B. College,
Bhubaneswar.

58. Dr. Bandana Pathak
Deptt. of Economics,
J.K.B.K. Govt. College,
O.M.P. Square,
Cuttack - 3.

59. Sri Bharat Bhusan Mohanty
Deptt. of Economics,
S.A. College,
Balipatna, Khurda.

60. Dr. Bidyadhar Parida
Deptt. of Economics
Sukinda College,
Sukinda,
Dist : Jajpur.

61. Sri Binod Bihari Nayak
Deptt. of Economics,
Bamra T.F. College,
Bamra, Sambalpur.

62. Sri Bidyadhar Praharaj
Deptt. of Economics,
Vyasanagar College,
Jajpur Road,
Dist : Jajpur.

63. Dr. Bhabesh Sen
Deptt. of A & A Economics,
Utkal University,
Vani Vihar,
Bhubaneswar.

64. Sri Biswabas Patra
NCDS,
Chandrasekharpur
Bhubaneswar - 13

65. Sri Bidyadhar Mahanta
Matru Nilaya,
Keonjhar.

66. Sri Bhaskar Chandra Jena
At : Kaptipada,
P.O.: Kaptipada,
Dist.: Mayurbhanj.

67. Miss Bharati Das
Deptt. of Economics,
Brahmanjharilo Mahavidyalay,
P.O.: Raipur,
Dist : Cuttack.

68. Sri Bibekananda Mishra
Deptt. of Economics,
Bhagabati Mahavidyalay,
Konark, Puri.

69. Biswaswarup Mishra
Assistant Professor of Economics,
Xavier Institute of Management,
Bhubaneswar.

70. Sri Bijoy Kumar Dash
Deptt. of Economics,
P.P. Mahavidyalay,
Tigiria, Cuttack - 754030

71. Bijoy Kumar Dey
Deptt. of Economics,
LN College, Jamsuli,
Dist.: Balasore.

C

72. Sri Chittaranjan Das
Deptt. of Economics,
Padmapur College,
Padmapur, Bargarh.

73. Sri Chitrasen Pasayat
Asst. Administrative Officer,
Temple Administration Office,
Shree Jagannath Temple, Puri.

74. Sri Chittaranjan Das
NCDS, Chandrasekharpur,
Bhubaneswar-13.

75. Sri Chintamani Satapathy
Deptt. of Economics,
Karanjia College, Karanjia,
Mayurbhanj.

76. Sri Chandrakanta Das
Deptt. of Economics,
Bhadrak College,
Bhadrak.

77. Sri Chandramani Das
Plot No.- 454,
Mahanadi Vihar,
Cuttack.

78. Dr. Chandradwaj Panda
Deptt. of Economics
Gunupur College,
Gunupur, Dist.: Rayagada.

D

79. Sri Dayanidhi Pal
College Road,
Salipur, Cuttack.

80. Dr. Debendra Kumar Biswal
Deptt. of Economics,
Mangala Mahavidyalaya,
Kakatpur, Dist.: Puri.

81. Sri Dayanidhi Samantaray
Narayana Mishra Lane,
Behind Grand Cinema,
Cuttack.

82. Dr. D. Chaudhury
Deptt. of Economics,
Dalmia College,
Rajgangpur.

83. Smt. Ditpti Panda
Deptt. of Economics,
S.C.S. College, Puri.

84. Sri Dipak Ranjan Das
Deptt. of Economics,
Aeronautics College,
Sunabeda, Dist : Koraput.

85. Dr. Durgasankar Sarangi
Deptt. of Economics,
F.M. College,
Balasore.

86. Dr. Dilip Ray
Assistant Director,
District Statistical Office,
Puri.

87. Sri D. Mishra
Deptt. of Economics,
Godavarisha Mahavidyalaya,
Banpur, Khurda.

88. Dr. Damodar Mohapatra
Deptt. of Economics,
U.N.S. Mahavidyalay, Khairabad,
Mugapal, Kuakhia, Jajpur.

89 Sri Debendra Nath Bhoi
Deptt. of Economics,
N.C. College, Jajpur.

90 Sri Dolagobinda Sethi
Deptt. of Economics,
N.C. Junior College, Jajpur.

91. Sri Digamber Chand
Deptt. of Economics,
Bamra T.F. College,
Bamra, Sambalpur.

92. Sri Dhananjay Patnaik
Deptt. of Economics,
Seva Mahavidylaya,
Bidanasi, Cuttack-8.

93. Sri Damodar Jena
Tatadhan Academy
Boys' Town Campus,
Tulloth Post, Madurai-16,
Tamilnadu.

94. Sri Dharmabrata Mohapatra
Deptt. of Economics,
Christ College,
Cuttack - 8.

G

95. Smt. Gopa Das
Deptt. of Economics,
Municipal College,
Rourkela-2.

96. Sri Gobind Chandra Das
Deptt. of Economics,
Govt. Womens' College,
Keonjhar.

97. Dr. Golak Bihari Nath
Deptt. of Economics,
L.N.College,
Jharsuguda.

98. Sri Gangadhar Behera
Deptt. of Economics,
Seemanta College,
Jharpokharia,
Dist : Mayurbhanj.

99. Sri Gopinath Kar
Deptt. of Economics,
Mangala Mahavidyalaya,
Kakatpur, Puri.

100. Sri Gouranga Panda
Deptt. of Economics,
Nilamani Mahavidyalay,
Rupsa, Balasore.

101. Dr. Gayadhar Giri
Deptt. of Economics,
Nilgiri College, Nilgiri,
Dist.: Balasore.

102. Prof. Ghanshyma Das
Retd. Director, H.E., Orissa,
699, Sahid Nagar,
Bhubaneswar.

103. Dr. Gyan Chandra Kar
Siddheswar Sahi,
Tulsipur,
Cuttack - 8

104. Dr. Gayatri Panda
Deptt. of Economics,
Dr. J.N. College,
Rasalpur, Dist.: Balasore.

105. Professor Gajendra Nath Das
Golgunda,
Jagriti Vihar,
Sambalpur - 768020

106. Sri Gobind Chandra Padhi
Reader in Economics,
Upper Block Colony,
Hinjilicut, Ganjam.

107. Sri Golak Bihari Prusty
Deptt. of Economics,
Kamakhyanagar College,
Kamakhyanagar,
Dist : Dhenkanal.

108. Dr. (Smt.) Gitanjali Panda
Deptt. of Social Science,
F.M. University, Vyasa Vihar,
Balesore.

109. Sri Ghanashyam Jena
Deptt. of Economics,
Kharasrota Mahavidyalay,
Singpur, Dist - Jajpur.

110. Sri Gopabandhu Mohapatra
Deptt. of Economics,
Khaira College, Khaira,
Dist.: Balasore.

H

111. Dr. Hemant Kumar Pradhan
Institute of Financial Management
30, Kothari Road,
Nungambakkam,
Chennai - 600034.

112. Dr. Harapriya Patnaik
Lecturer
C/O.: Sri L.N. Patnaik,
Govinda Vihar, Lochapada,
Berhampur, Ganjam.

113. Sri Harekrushna Nayak
Deptt. of Economics,
Bhadrak College,
Bhadrak.

I

114. Sri I. Gopal Rao
Deptt. of Economics,
Gunpur College, Gunupur,
Dist : Koraput.

115. Smt. Indira Udgata
Deptt. of Economics,
Govt. Women's College,
Puri.

116. Smt. Indulekha Das Bhatta Mishra
Deptt. of Economics,
Govt. College,
Rourkela.

117. Miss Ifat Nawaz
Deptt. of Economics,
S.A. College, Balipatna,
Dist : Khurda.

J

118. Smt. Jharana Roy
C/o.: Sri Dinesh Saha, Advocate,
Bangali Sahi, Cuttack.

119. Dr. Jayanta Kumar Parida
Deptt. of Economics,
Banki College, Banki,
Dist : Cuttack.

120. Smt. Jyotsna Udagta
Deptt. of Economics,
P.N. College,
Khurda.

121. Dr. J.S. Mahaprasastha
Deptt. of Economics,
Christ College,
Cuttack.

122. Dr. Jagannath Lenka
Deptt. of Economics,
North Orissa University,
P.O.: Takatpur, Baripada,
Dist.: Mayurbhanj

123. Dr. Jagabandhu Samal
COATS
Pujariput Ro
Koraput.

124. Smt. Janaki Pradhan
Deptt. of Economics,
M.S. College, Baramba,
Dist.: Cuttack.

125. Jnana Ranjan Mohanty
Brahmanbhog, Harianta
Choudwar, Cuttack.

126. Sri Jayabandan Jena
Deptt. of Economics,
Meghasan College,
Nudadiha, Mayurbhanj.

127. Dr. Jyotirmayee Kar
Deptt. of Economics,
ICFAI University, A-123,
Mancheswar Industrial Estate,
Mancheswar, Bhubaneswar.

128. Dr. Jyoti Prakash Patnaik
Professor of Economics,
Sambalpur University,
Jyoti Vihar, Burla, Sambalpur.

129. Dr. Jitaram Dey
Deptt. of Economics,
U.N. College, Nalagaja,
Dist.: Mayurbhanj.

130. Sri Janmejay Senapati
Lecturer in Economics,
Seemanta Engineering College,
Jharpokharia, Mayurbhanj.

K

131. Sri Kartik Ch. Rath
Deptt. of Economics,
Netaji Subash Bose Memorial City College,
Rajagabicha, Cuttack.

132. Smt. Kanak Manjari Mishra
C/O.: N.K. Mishra,
N-1/256, Nayapalli,
IRC Village, Bhubaneswar-751015.

133. Dr. Kumarbar Das
Deptt. of A & A Economics,
Utkal University, Vani Vihar,
Bhubaneswar-4.

134. Sri Kamalakanta Acharya
Academy of Business Administration
At/P.O./Dist.: Balasore.

135 Sri Kushadhar Panda
Deptt. of Economics,
Madhupur College, KALAN,
Dist.: Jajpur.

136. Sri Kailash Chandra Mishra
Deptt. of Economics,
M.P.C. Junior College,
Baripada, Mayurbhanj.

137. Dr. Kartik Chandra Dash
Deptt. of Economics,
B.J.B. College,
Bhubaneswar.

138. Dr. K.N. Mohapatra
Shree Towers, BJB Nagar,
Bhubaneswar - 751014

139. Sri Srinivasan, I.A.S.
Retd. Commissioner of Agriculture,
Govt. of Orissa,
Bhubaneswar.

140. Dr. K. Nana Buchi
Baikuntha Nagar,
Berhampur,
Dist : Ganjam-760001.

141. Dr. Kishore Chandra Samal
N.K.C. Centre for Development Studies,
Chandrasekharpur,
Bhubaneswar-13.

142. Sri K.C. Maharana
Deptt. of Economics,
Khalikote College,
Berhampur, Dist.: Ganjam.

143. Sri Kartik Prasad Jena
Deptt. of Economics,
Bhadrak College, Bhadrak.

144. Smt. Kanaka Manjari Mohanty
Deptt. of Economics,
S.B.Women's College, Cuttack-1.

145. Sri K.C. Nayak
Suryasikha,
At/P.O.: Shymsunderpur
Via : Raj Nilgiri,
Dist.: Balasore.

146 Mrs. Kasturi Panda
Deptt. of Economics
Govt. Women's College, Puri.

147. Sri Kali Charan Nayak
MIG-10, BDA Colony,
Laxmi Sagar, Bhubaneswar.

148. Dr. Kabita Kumari Sahu
Deptt. of Economics,
North Orissa University,
Takhatpur, Baripada,
Mayurbhanj.

149. Dr. Khetra Mohan Mohapatra
Asst. Professor of Economics,
HSS Department, HBTI,
Nawabganj,
Kanpur - 208002.

150. Dr. Kartik Kumar Das
Deptt. of Economics,
Nimapara College, Nimapara,
Dist.: Puri.

151. Miss Krushnapriya Behera
Deptt. of Economics,
Emarti Devi Women's College,
Naya Sarak, Cuttack-2.

152. Sri Kishore Chandra Pattnaik
Deptt. of Economics,
Berhampur City College,
P.O.: Berhampur,
Dist.: Ganjam.

153. Sri Kishorehari Badatya
Deptt. of Economics,
Govt. College,
Phulbani.

154. Dr. Kasturi Sahoo
Deptt. of Economics,
K.B.D.A.V. College,
Nirakarpur, Dist.: Khurda.

155. Sk Kalimullah
Deptt. of Economics,
Sudarsan Mahavidyalaya,
42 Mouza, Dist.: Cuttack.

156. Sri Kamal Kumar Tripathy
Deputy Director,
Ministry of Food Processing Industries,
Panchasheela Bhawan,
August Krantimarg,
New Delhi - 110049.

157. Sri Kalyan Sankar Ray
Asian School of Business Management
Sikhya Vihar, Bhola
Barang, Khurda Road,
Chanda, Bhubaneswar.

158. Dr. Krupasindhu Pradhan
Plot No.- 1045/6,
Gadasahi, Nayapalli,
Bhubaneswar - 751012.

L

159. Dr. L.N. Dash
Deptt. of Economics,
North Orissa University, Takhatpur,
Baripada, Dist.: Mayurbhanj.

160. Sri L.N.Panigrahi
Deptt. of Economics,
Aska Science College,
Aska, Dist.: Ganjam.

161. Ms. Lipika Das
Deptt. of Economics,
Balikuda College, Balikuda,
Dist.: Jagatsinghpur.

162. Sri Lalit Mohan Sahoo
Deptt. of Economics,
Maharshi College of Natural Law,
Saheed Nagar, Bhubaneswar,

163. Ms. Lila Subudhi
Deptt. of Economics,
Niranjan Govt. Women's College,
Aska, Ganjam.

164. Ms. Lipika Das
Deptt. of Economics,
K.B.D.A.V. College,
Nirakarpur, Dist.: Khurda.

165. Sri Lalit Kumar Dash
Remuli College,
Remuli, Dist.: Keonjhar.

166. Sri Lalit Kumar Mahanta
Deptt. of Economics,
P.S. College,
Jhumpura, Keonjhar.

167. Dr. L.K. Choudhury
Reader in Economics,
Govt. College, Angul.

168. Mrs. Lipsa Mishra
Deptt. of Economics,
R.D. Women's College,
Bhubaneswar-7.

169. Dr. Lopamudra Mishra
C/O.: Professor Gajendranath Das
Golgunda, Jagriti Vihar,
Sambalpur - 768020.

M

170. Dr. Manoranjan Das
Deptt. of Economics,
G.M. College, Sambalpur.

171. Sri Manoj Kumar Hui
Deptt. of Economics,
D.S. College, Bahalada,
Mayurbhanj.

172. Sri Manmohan Das
At : Gopalbag,
(Near Satyasai Vihar),
Baripada.

173. Dr. Mamata Swain
C-202, Nirupama Apartments,
Near Kalinga Stadium,
P.O.- Nayapalli, Bhubaneswar.

174. Smt. Minati Mishra
Deptt. of Economics
Govt. College, Bhawanipatna,
Dist.: Kalahandi.

175. Smt. Manorama Mohapatra
The Samaj,
Gopabandhu Bhavan,
Buxi Bazar, Cuttack-1.

176. Sri Mihir Kumar Mohapatra
Goa Institute of Management,
Ribandar, Goa,
Pin - 403006.

177. Sri Muktikanta Satapathy
Deptt. of Economics,
Khaira College, Khaira,
Balasore.

178. Minati Mallick
Deptt. of Economics,
North Orissa University,
Takhatpur, Baripada,
Mayurbhanj.

179. Dr. Manmath Ku. Mohanty
S-3 Madhuban, Sishu Vihar,
Infocity Road, P.O.: KIIT,
Bhubaneswar - 751024.

180. Dr. Mohit Kumar Sarangi
Near Convent School,
Prafulla Nagar,
Baripada.

181. Sri Manmohan Biswal
Kanpur Anchalik Mahavidyalay,
At/P.O.: Kanpur,
Dist.: Cuttack.

182. Dr. (Smt.) Mitali Chinara
Deptt. of Economics,
R.D. Women's College,
Bhubaneswar.

183. Shri Muralidhar Sahoo
Deptt. of Economics,
F.M. College,
Balasore.

184. Smt. Meghamala Behera
C/O.: Surendra Nath Behera,
Ward No.- 21, Bhanjpur,
Baripada, Mayurbhanj.

185. Sri Mahendra Prasad Agasty
Lecutrer in Economics,
Silicon Institute of Technology,
Silicon Hills, Patia,
Bhubaneswar.

186. Dr. Manoj Kumar Panda, Professor
Indira Gandhi Institute of
Development Research,
Gen. Vaidya Marg,
Goregaon (E),
Mumbai, Pin - 400065.

187. Sri Mrutyunjay Adhikari
Deptt. of Economics,
S.R. College, Baliapal,
P.O.: Baliapal,
Dist.: Balasore.

188. Sri Mahiranjan Dash
Retired Principal
H1/48, BDA Colony,
Kapilaprasad,
Bhubaneswar.

189. Sri Manoj Kumar Dora
Deptt. of Economics
North Orissa University,
Takhatpur, Baripada,
Mayurbhanj.

190. Smt. M.K. Devi
Deptt. of Economics,
P.N. College,
Khurda.

191. Dr. Manaranjan Behera
NCDS, Chandrasekharpur,
Bhubaneswar-751 013.

192. Smt. Manaswini Sahoo
Deptt. of Economics
Govt. Women's College,
Dhenkanal.

193. Sri Mrutyunjay Dash
Senior Lecturer in Economics,
Asian School of Business Management,
Sikhya Vihar, Bhola,
Barang-Khurda Road, Chanda,
Bhubaneswar.

N

194. Dr. Nagen Chandra Mohanty
Lower Police Colony
Tulsipur, Cuttack-8.

195. Dr. Narendra Kumar Behera
Deptt. of Economics,
Larambha College, Larambha,
Dist.: Bargarh.

196. Sri Natabar Rout
Deptt. of Economics,
S.V.M. College,
Jagatsinghpur.

197. Sri Nabaghan Nanda
Lecturer in Economics,
Women's College, Japakud,
Jagatsinghpur.

198. Mrs. Nilendree Panda
Deptt. of Economics,
G.M.College, Sambalpur.

199. Sri Niranjan Rana
Deptt. of Economics,
Rajdhani College,
Bhubaneswar.

200. Dr. Niranjan Pathy
Lecturer in Economics,
Meghasan College, Nudadiha
Dist.: Mayurbhanj

201. Dr. Niranjan Acharya
Lecture in Economics
Rajadhani College, Bhubaneswar.

202. Smt. N.Pravat Kusum
Deptt. of Economics,
R.C.M.College,
Khallikote,
Dist.: Ganjam.

203. Dr. N.C. Sahoo
5th Line, Gandhi Nagar,
Berhampur, Dist.: Ganjam,
Pin - 760001.

204. Sri Nalinikanta Mohapatra
Deptt. of Economics,
S.V.M. College,
Jagatsinghpur.

205. Namita Pattanaik
Lect. in Economics,
Maharshi College of Natural Law,
Sahid Nagar, Bhubaneswar.

206. Sri Narasingh Charan Acharya
Principal
Choudwar College,
Choudwar,
Dist.: Cuttack.

207. Prof. Nilakanth Rath
Retd. Prof. of Economics,
Gokhale Institute of Politics
and Economics, Pune.

208. Sri N.C. Ray
Deptt. of Economics,
KBDAV College,
Nirakarpur, Dist.; Khurda.

209. Sri Narottam Nanda
Near Parade Padia,
Baripada,
Dist.: Mayurbhanj.

210. Dr. N.B. Pradhan
C/O.: Vima Rao,
Rangeilunda,
Berhampur, Ganjam.

P

211. Dr. P.C. Mohapatra
Director C.O.A.T.S.
Pujariput Road,
P.O./Dist.: Koraput.

212. Sri Pramod Kumar Sahoo
Lecturer in Economics,
P.S. College, Saintala,
Dist.: Bolangir.

213. Sri Prakash Dash
Baghra Road, Ward No - 16,
Near Pratibha Nursing Home,
Baripada - 1, Dist.: Mayurbhanj

214. Sri Pratap Keshari Nayak
Deptt. of Economics,
Dhenkanal College,
Dhenkanal.

215. Dr. Prahallad Panda
Prof. of Economics,
Berhampur University,
Bhanja Vihar, Berhampur-7.

216. Dr. Padmaja Mishra
Deptt. of Economics,
Utkal University,
Vani Vihar, Bhubaneswar-4

217. Smt. Pratima Sarangi
Deptt. of Economics,
Sailabala Women's College,
Cuttack.

218. Smt. P.K. Singh
Deptt. of Economics,
V. Dev College, Jeypore,
Dist.: Koraput.

219. Prof. Pravat Kumar Patnaik, CESP,
SSS,
Jawaharlal Nehru University,
New Delhi-110067.

220. Sri Pradosh Kumar Jena
Deptt. of Economics,
N.C. Junior College,
P.O./Dist.: Jajpur.

221. Sri P.K. Mohapatra
Deptt. of Economics,
Khemundi College,
Digapahandi,
Dist.: Ganjam.

222. Sri Prasanna Kumar Das
Lecturer in Economics,
Krupajal Engineering College,
Purba Sasan, Kausalyagang,
Bhubaneswar.

223. Sri Prabhat Kumar Mohapatra
Deputy Director,
Gopabandhu Academy of Administration,
XIM Square, Bhubaneswar.

224. Sri Purna Chandra Minj
Deptt. of Economics,
Rajdhani College, CRP Squre,
Bhubaneswar.

225. Sri Purna Chandra Patra
Deptt. of Economics,
Khallikote Junior College,
Berhampur, Ganjam.

226. Sri Prasanta Chandra Panda
Lecturer in Economics
IBAT School of Management,
KIIT Deemed University,
Bhubaneswar - 751024.

227. Dr. P.C. Dhal
Deptt. of Economics,
Kharasrota Mahavidyalaya,
Singpur, Dist.: Jajpur.

228. Sri Prafulla Kumar Mansingh
Deptt. of Economics,
S.C.S. College, Puri.

229. Dr. Pragati Mohanty
L/82 Phase-I,
Basanti Colony,
Rourkela,
Dist.: Sundargarh.

230. Miss Pragyan Pal
Deptt. of Economics,
Ravenshaw Junior College,
Cuttack.

231. Sri Pravakar Sahoo
Deptt. of Economics,
Balikuda College,
Balikuda,
Dist.: Jagatsinghpur.

232. Sri Pratap Chandra Mohanty
Deptt. of Economics,
Bramhanajharilo Mahavidyalaya,
Bramhanajharilo,
P.O.: Rajpur,
Dist.: Cuttack.

233. Dr. Purusottam Sahu
Deptt. of Economics,
Gopalpur College,
Gopalpur on Sea,
Dist : Ganjam.

234. Dr. Parsuram Samal
Senior Scientist,
Division of Social Sciences,
CRRI, Cuttack - 753006.

235. Sri Pradip Kumar Patnaik
Deptt. of Economics,
K.D. Science College,
Pochilima,
Dist.: Ganjam.

236. Sri Prasanna Kumar Das
Deptt. of Economics,
Karanjia College, Karanjia,
Dist : Mayurbhanj.

237. Smt. Priyambada Bhainsha
Deptt. of Economics,
V.S.S. College,
Jujumara, Sambalpur.

238. Smt. Pratima Mohapatra
Deptt. of Economics,
Nimapara College,
Nimapara, Dist.: Puri.

239. Sri P.K. Bisoi
Deptt. of Economics,
T.T.Mahavidyalaya,
Ghatagaon, Dist.: Keonjhar.

240. Smt. Prajna Samantaray
Deptt, of Economics,
Christ College,
Cuttack-8.

241. Sri Patitapabana Sahoo
Deptt. of Economics,
Panchayat College,
Bargarh.

242. Ms. Puspa Das
Deptt. of Economics,
Kamala Nehru Mahavidyalaya,
Unit-IV, Bhubaneswar.

243. Sri Prabodh Kumar Samal
Deptt. of Economics,
G.C. College, Ramachnadrapur,
Dist.: Jajpur.

244. Sri Prasant kumar Chhotray
Deptt. of Economics,
Ekamra College,
Bhubaneswar.

245. Mrs. Prativa Kumari Dei
Deptt. of Economics,
S.K.C.G. College,
Paralakhemundi,
Dist.: Gajapati.

246. Dr. Prasanna Kumar Mohapatra
Anchalika Mahavidyalaya,
Swampatna,
Dist.: Keonjhar.

247. Dr. Pitambar Dash
Swarnamayee Nagar,
Berhampur,
Dist.: Ganjam.

248. Pulin B. Nayak
11-Mandakini Enclave
Alaknanda, New Delhi- 11019.

249. Puspanjali Patnaik
Savitri Women's College,
Bhanjanagar, Dist.: Ganjam.

250. Dr. Prabir Kumar Pattnaik
Dept. of Economics,
Srimaa Mahila Mahavidyalay,
Baripada, Mayurbhanj.

R

251. Sri Rabindra Kumar Mishra
335A, Acharya Vihar,
P.O.: R.R.L.,
Bhubaneswar.

252. Sri Rajkishore Mishra
Vice-Principal,
BJB College,
Bhubaneswar.

253. Sri Rabi Narayan Kar
Asst. Director (El & S),
House No.-605, Block-E,
MS Apartments and Hostel,
Kasturba Gandhi Marg,
New Delhi-110001.

254. Dr. R.P. Choudhuri
Professor of Commerce,
G.M.College, Sambalpur.

255. Sri Rasbihari Samal
Principal,
Women's College, Angul.

256. Dr. R.N. Mohapatra
D-74, Koel Nagar,
Rourkela-14.

257. Sri Rabi Narayan Patnaik
M-66, Baramunda,
Housing Board Colony,
Bhubaneswar-751003.

258. Sri Ramesh Chandra Sarangi
Deptt. of Economics,
N.C. College, Jajpur.

259. Sri Ramakanta Sahoo
Principal,
Biraja Women's College,
P.O./Dist.: Jajpur.

260. Smt. Rabeya Parveen
Deptt. of Economics,
S.C.S. Junior College,
Puri.

261. Sri Ratnakar Jena
Sundar Pokhari,
Tuloti, Korai,
Dist.: Jajpur.

262. Smt. Ranjita Kumari Mohanty
Deptt. of Economics,
Govt. Women's College,
Keonjhar.

263. Dr. Rabindra Kumar Nayak
Deptt. of Economics,
Rama Devi Women's Junior College,
Bhubaneswar.

264. Dr. R.K. Panda
Deptt. of Economics,
Utkal University, Vani Vihar,
Bhubaneswar.

265. Sri R.P. Behera
Deptt. of Economics,
Rajendra College, Bolangir,
Dist.: Bolangir.

266. Dr. Ramchandra Mishra
Deptt. of Economics,
Govt. Women's College,
P.O./Dist.: Puri.

267. Dr. Ramesh Chandra Mishra
Deptt. of Economics,
KKS Women's College,
Balasore.

268. Dr. Rajan Kumar Sahoo
Deptt. of Economics,
B.S. College, Nayahat,
Dist.: Jajpur.

269. Sri Rabindra Nath Ray
Deptt. of Economics,
Mangala Mahavidyalaya,
Kakatpur,
Dist.: Puri.

270. Dr. Radha Mohan Mallick
783 E, Jayadev Tower Complex,
Jayadev Vihar,
P.O.: R.R.L.,
Bhubaneswar-751013.

271. Prof. R. Padhy Sharma
Director,
Institute of Economic Studies,
Manasi Mansion,
Jayprakash Nagar,
Berhampur-10, Ganjam.

272. Dr. Rabi N. Patra
Deptt. of Economics,
Ravenshaw University,
Cuttack.

273. Sri Ratikanta Kumbhar
Lecturer in Economics
Deptt. of Social Science,
F.M. University, Balasore.

274. Dr. R.K. Sahoo
Principal,
Nimapara College,
Nimapara, Dist.: Puri.

275. Sri Ramesh Chandra Panda
Deptt. of Economics,
Swarnachud College,
Mitrapur,
Dist.: Balasore.

276. Sri Ratnakar Mohapatra
Deptt. of Economics,
Khaira College, Khaira,
Dist.: Balasore.

277. Sri Rabindra Kumar Mishra
Deptt. of Economics,
Nilamadhab College,
Kantilo, Dist.: Nayagarh.

278. Sri Raghunath Dalei
Co-operative Colony No.-2,
Berhampur, Ganjam.
Pin - 760004.

279. Sri Ramakanta Prusty
B.P.College of Business Administration,
Gh-6, Sector-23,
Gandhinagar,
Ahmedabad.

280. Sri Ranjit Kumar Das
House No.- 269, Sector-51A
Chandigarh, Pin-160047.

281. Dr. Rasananda Panda
D-1, Lake View Apartments,
Vastrapur,
Ahmedabad-380015.

282. Miss Ritanjali Das
Regional Institute of Education,
Bhubaneswar.

S

283. Smt. Sashikala Patnaik,
N-2/121, Nayapalli,
Bhubaneswar.

284. Sri Saroj Kumar Panda
Deptt. of Economics,
Rajdhani College,
Bhubaneswar.

285. Smt. Susama Dash
Deptt. of Economics,
Rayagada Womens' College,
At/P.O./Dist.: Rayagada.

286. Dr. Sarba Narayan Mishra
Asst. Professor of Economics,
D/20, Kalpana Flats,
Bhubaneswar - 751014.

287. Dr. Saroj K. Rajguru
Deptt. of Economics,
Govt. Science College,
Chhatrapur,
Dist.: Ganjam.

288. Sri S.N.Panigrahi
Deptt. of Economics,
Khalikote College,
Berhampur,
Dist.: Ganjam.

289. Smt. Sutapa Gopangana
Assistant Director,
Directorate of Fisheries,
Jobra, Cuttack.

290. Dr. Surendra Nath Behera
Deptt. of Economics,
Khallikote College,
Berhampur, Dist.: Ganjam.

291. Dr. Subhransu Sekhar Mohapatra
Deptt. of Economics,
Khaira College, Khaira,
Dist.: Balasore.

292. Sri Sunil Kumar Rath
Deptt. of Economics,
Paramanand College, Bolgada,
Dist.: Khurda - 752066

293. Dr. Salik Ram
Scientist, C.R.R.I.,
Bidyadharpur, Cuttack.

294. Mrs. Shova Das
Plot No.- 71,
Krishnayana, Satyanagar,
Bhubaneswar - 751007.

295. Sri S.Mishra
Deptt. of Economics,
K.B.D.A.V. College,
Nirakarpur, Khurda.

296. Sri Surendra Swain
Deptt. of Economics,
KKS Women's College,
Balasore.

297. Dr. Srijit Mishra
IGIDR, Gen. Vaidya Marg,
Goregaon (E),
Mumbai-400065.

298. Sri Sarbananda Sahu
Asst. Professor, OB and HRM
Asian School of Business Management,
Sikhya Vihar, Bhola,
Barang-Khurda Road, Chanda,
Bhubaneswar.

299. Dr. Sakti Padhi
Near Ad Hospital and Jalaram Sweets
Kitab Mahal Road, Cuttack - 3.

300. Sri Subrat Kumar Rana
Deptt. of Economics,
K.K.S. Junior College,
Balasore.

301. Dr. Shanti Das
Backside of Sangam Talkies,
Mahatab Road,
Cuttack.

302. Sri Sarat Kumar Nayak
Deptt. of Economics,
Ravenshaw College,
Cuttack.

303. Smt. Sita Sahoo
Badambadi,
Cuttack.

304. Dr. Sailabala Debi
C/o.: Sri N.R. Mishra (CA),
Hospital Square, Puri-2.

305. Sri S.C.Mohapatra
Deptt. of Economics,
S.K.C.G. College,
Paralakhemundi.

306. Sri Srinath Sahoo
Vill : Kendal,
P.O.: Madhusudanpur Sasan,
Dist.: Jagatsinghpur-754103.

307. Sri Siben Kumar Bose
Old College Lane,
Cuttack-2.

308. Smt. Surangini Mishra
Deptt. of Economics,
B.J.B. Morning College,
Bhubaneswar.

309. Smt. Sipra Sarkar
C/o.: Dr. Benudhar Nayak,
HSS Deptt. NERIST,
Nirijuli,
Arunchal Pradesh.

310. Dr. Sanjit Mohapatra
Deptt. of Economics,
S.C.S. Junior College, Puri.

311. Sri Sarbeswar Mohanty
Asst. Professor of Economics,
KIIT University,
Bhubaneswar - 751024

312. Dr. S.N. Tripathy,
Professor
Gokhale Institute of Politics and Economics,
PUNE, Maharashtra.

313. Sri Suresh Chandra Rout
Deptt. of Economics,
Anandpur College, Anandpur,
Dist.: Keonjhar.

314. Dr. Sailaja Nandini Jena
Deptt. of Economics,
Ravenshaw College, Cuttack.

315. Dr. Sudhakar Patra
Deptt. of Economics,
F.M. University,
Balasore.

316. Dr. Sukanta Kumar Sahoo
S.I.S.I., Vikash Sadan,
P.O.: College Square,
Dist.: Cuttack753003.

316. Smt. Sadhana Satapathy
Deptt. of Economics,
Dhenkanal Women's College,
Dhenkanal.

317. Sri Simanchal Mishra
Deptt. of Economics,
Kesinga Mahavidyalaya,
Kesinga, Dist : Kalahandi.

318. Dr. Susanta Kumar Das
Dept. of Economics
JKBK Govt. College,
OMP Sequare, Cuttack.

319. Dr. Susanta K. Mallick
Deptt. of Economics,
University of Warwick,
Conventry, CV-47 AL, U.K.

320. Dr. Sanjukta Dash
Deptt. of Economics,
Sambalpur University,
Jyoti Vihar, Dist.: Sambalpur.

321. Dr. Satyabrata Mishra
Sripadganj, Ward No-13,
Station Bazar, Baripada,
Dist.: Mayurbhanj.

322. Smt. Sakuntala Behera
Lecturer in Economics,
Baripada College,
Baripada, Dist.: Mayurbhanj.

323. Dr. S.K. Das
Deptt. of Economics,
M.P.C. Junior College,
Baripada, Mayurbhanj.

324. Sri Sachindra Nath Mohanty,
Niliabag,
P.O./Dist.: Balasore.

325. Sri Siba Charan Behera
Deptt. of Economics,
Anchalika Mahavidyalaya,
Swampatna, Dist : Keonjhar.

326. Sri Satrughna Nath Das
Deptt. of Economics,
Govt. Women's College,
Dist.: Puri.

327. Dr. Saroj Kumar Kanungo
Principal
IMIT, Jobra, Cuttack.

328. Dr. Satyakam Mishra
Annapurna Apartments,
Shelter Chhak, cuttak.

329. Mrs. Sarita Supakar
Flat No.- 302,
Krishnakunj Apartment,
Road No.- 8, Unit-IX,
Bhubaneswar-7

330. Dr. S.C. Koomar
781, Madhusudan Nagar,
Unit-IV, Bhubaneswar.

331. Smt. Sujata Mohanty
Deptt. of Economics,
R.D. Women's College,
Bhubaneswar.

332. Dr. Sridhar Behera
Deptt. of Economics,
Ravenshaw College, Cuttack.

333. Dr. Sangram Kumar Mohapatra
Deptt. of Economics,
Simulia College, Markona,
Dist.: Balasore.

334. Smt. Sanjukta Patnaik
Deptt. of Economics,
S.M.College, Rengali,
Dist.: Sambalpur.

335. Sri Sanjay Kumar Mishra
Lecturer in Economics,
M.K. Gandhi College,
At/P.O.: Sadangi,
Dist.: Keonjhar.

336. Dr. Satyananda Sahoo
Deptt. of Economic Analysis & Policy,
Reserve Bank of India,
Mumbai.

337. Smt. Saudamini Rout
Deptt. of Economics,
Bhadrak College,
Bhadrak.

338. Dr. S.M. Ali
Deptt. of Economics,
Kendrapara College,
Kendrapara.

339. Dr. Surendra Nath Das
Deptt. of Economics,
M.P. Mahavidyalaya,
Erakana, P.O.: Podamarai,
Dist.: Cuttack.

340. Prof. Surendra Nath Mishra
Shyamakali Lane, 3rd Line,
In Front of Loka Seva
Pharmacy Factory, Puri.

341. Ms. Sunanda Patnaik
Deptt. of Economics,
Niranjan Govt. Women's College,
Aska, Ganjam.

342. Dr. Subhranshubala Mohanty
C/o.: Dr. P.K. Mohanty,
Qrs.No. (F-5),
Utkal University Campus,
Vani Vihar,
Bhubaneswar-751004.

343. Sri Sukanta Chandra Swain
Deptt. of Economics,
Godavarish Mahavidyalaya,
Banapur,
Dist : Khurda.

344. Ms. Sailabala Patnaik
Deptt. of Economics,
Govt. Women's College,
Berhampur,
Dist.: Ganjam.

345. Dr. Srikanta Chandra Patra
Deptt. of Economics,
U.N. College, Nalgaja,
Dist.: Mayurbhanj.

346. Sri Sanjib Kumar Majhi
Lecturer in Economics,
Deptt. of Social Science,
F.M. University,
Balasore.

347. Sri Soumendra Dash
The ICFAI Business School,
Vastrapur, Near GNFC info Towers
Sarkhej G' Nagar High way,
Bodak Dev,
Ahmedabad-380054.

348. Sri Santanu Kumar Nayak
Deptt. of Economics,
Regional College, Rambag,
Dist.: Jajpur.

349. Dr. Siblal Meher
N.K. Choudhury Centre for
Development Studies,
Chandrasekhapur,
Bhubaneswar-13.

350. Dr. Suvada Mohanty
Deptt. of Economics,
Ravenshaw College,
Cuttack.

351. Siba Prasad Samal
Deptt. of Economics,
Bishnu Samantray College,
Nuahat, Dist.: Jajpur.

352. Sri Srimanta Upadhyaya
Deptt. of Economics,
Nirakarpur College,
Nirakarpur, Dist.: Khurda.

353. Sri Sanyasi Sahoo
Deptt. of Economics,
J.K.B.K. Govt. College,
Cuttack.

354. Sri Srinibas Jena
Deptt. of Economics,
Gopaljew Mahavidyalaya,
Benamunda,
P.O.: Kaliahata,
Dist.: Keonjhar.

355. Sri Santosh Kumar Mohapatra
At : Divine Nagar,
Near Saar Sahi, Chauliaganj,
Dist : Cuttack.

356. Dr. Sandhyarani Das
Institute of Economic Studies,
Manasi Mansion,
Jayaprakash Nagar,
Berhampur-10, Dist.: Ganjam.

357. Dr. Sujata Pati
1477A (Pvt. Plot) IRC Village,
Nayapali, Bhubaneswar,
Pin-751015.

358. Sri Sanjay K. Lenka
Deptt. of Economics,
Aeronautics College,
Sunabeda, Dist : Koraput.

359. Prof. Satya P. Das
Professor of Economics,
Indian Satistical Institute,
Sansalwal Marg,
Qutab Enclave, New Delhi.

360. Dr. Sanjibani Patnaik
Dipt.of Economics,
S.G. Women's College
Sector-2, Rourkela-6.

361. Sri S.C. Bhuyan
Dept. of Economics,
SSJ Mahavidyalay,
Krushanachandrapur, Erasama,
Dist.: Jagatsinghpur.

362. Sri Santosh Kumar Giri
Dept. of Economics
Gopalpur College,Gopalpur,
Dist.: Balasore.

363. Mrs. Sikta Singh
Dept. of A & A Economics,
Utkal University, Vanivihar,
Bhubaneswar.

364. Sonalee Suchismita
Plot No-811, Kohinoor City,
Off. LBS marg. Kamani Junction,
Kurla, Mumbai.

365. Dr. Sheshadev Mohapatra
Lecturer in Economics,
DAV Public School,
Chandrasekharpur, Bhubaneswar.

T

366. Dr. Trilochan Mohanty
Shraddha, Plot No.- B/14,
Sector-10, CDA, Cuttack-14.

367. Sri Trilochan Kanungo
Sheikh Bazar, New Colony,
Cuttack - 753001.

368. Sri Tarun Kumar Ojha
Deptt. of Economics,
Seemanta Mahavidyalaya,
Jharpokharia, Dist : Mayurbhanj.

369. Trupti Mohanty
C/O.: Er. R.P. Das,
Deula Sahi, Tulasipur,
Dist.: Cuttack - 753008.

370. Dr. Tusharkanti Das
C/O.: Professor Gajendra Nath Das,
Golgunda, Jagriti Vihar,
Sambalpur - 768020.

U

371. Dr. Uttam Charan Nayak
Plot No. D-1067,
Sector-6, CDA,
Cuttack - 14.

372. Usha Satapathy
Deptt. of Economics,
Chitrada College,
Chitrada, Mayurbhanj.

373. Sri U.C. Panigrahi
Deptt. of Economics,
Gopalpur College,
Gopalpur on Sea,
Dist : Ganjam.

374. Sri Umesh Chandra Pati
Deptt. of Economics,
Nayagarh College,
Nayagarh, Orissa.

375. Smt. Usharani Pujari,
Kedargouri Apartments,
C2/005, Lewis Road,
Bhubaneswar-2.

376. Dr. Upendra Pathy,
Deptt. of Economics,
Kalinga Mahavidyalaya,
G. Udayagiri, Phulbani.

377. Sri U.C. Hota
Qrs. No.- 3,
Municipality Colony,
Near Women's College,
Jharsuguda - 1.

378. Sri Uma Charan Pati
Deptt. of Economics,
Govt. Women's College,
Bolangir.

379. Sri U. C. Pradhan
Lect.in Economics,
L.N. College, Jamsuli,
Dist.: Balasore.

❑❑❑

ANNUAL MEMBERS
2009-10

1. Sri Ajit Kishore Parija
   Dept. of Economics
   L.B. College, Angalo,
   Dist. : Jajpur
2. Dr. Ashwani Kumar
   Director, Water Technology
   Centre for Eastern Region,
   P.O.: Chandrasekharpur,
   Bhubaneswar-751023
3. Sri Bibekananda Dash
   Dept. of Economics
   P.N. College, Khurda.

3. Himansu Sekhar Dash
   Dept. of Economics
   Karanjia College, Karanjia
   Dist.: Mayurbhanj.

4 Miss Indumati Dash
   Dept. of Economics
   B.B. Mahavidyalay,
   Chandikhole, Dist.: Jajpur.

5. Miss Maitri Padhi
   Dept. of Sociology
   Kalinga Institute of Social
   Sciences,
   KIIT, Bhubaneswar-751024.

6. Sri Niranjan Behera
   Dept.of Economics
   Gop college, Gop,
   Dist.: Puri.

7. Sri N.P. Das
   Dept. of Economics
   B.B. Mahavidyalay,
   Chandikhole, Dist.: Jajpur.

8. Sri Pramod Kumar Mishra
   Dept. of Economics
   Jashipur College,
   Jashipur,
   Dist.: Mayurbhanj.

9. Miss Pranayini Mishra
   Dept. of Economics
   P.N. College,
   Bolgarh,
   Dist.: Khurda.

10. Sri Pradip Kumar Patnaik
    Youth Officers' Research
    Foundation,
    Bhubaneswar.

11. Sri Premananda Pradhan
    Dept. of Economics
    Aska Science College,
    Aska,
    Dist.: Ganjam.

12. Pravakar Nanda
    Principal Scientist,
    Water Technology Centre for
    Eastern Region,
    P.O.: Chandrasekharpur,
    Bhubaneswar-751023.

13. Mrs. P. Mohapatra
Dept. of Economics
Srimaa Mahila Mahavidyalay,
Baripada,
Dist.: Mayurbhanj.

14. Dr. Ramesh Chandra Pandit
Dept. of Economics
Aska Science College,
Aska,
Dist.: Ganjam.

15. Sri Raghuram Palei
Dept. of Economics
Jashipur College, Jashipur,
Dist.: Mayurbhanj.

16. Dr. Ravendeer Singh
Principal Scientist,
Water Technology Centre for
Eastern Region,
P.O.: Chandrasekharpur,
Bhubaneswar-751023.

17. Miss Reenati Mishra
Dept. of Economics
KIIT University,
KIIT, Bhubaneswar-751024.

18. Smt. Saudamini Maharana
Dept. of Economics
Dharmasala Mahavidyalay,
Jaraka,
Dist.: Jajpur.

19. Miss Snigdha Tripathy
Dept. of Economics
KIIT School of Management,
KIIT University,
Bhubaneswar-751024.

20. Miss Susama Panda
Dept. of Economics
P.N. College,
Khurda.

21. Dr. Sanjay Satpathy
Dept. of Commerce
R.D. Women's College,
Bhubaneswar.

22. Sri Santosh Kumar Bali
Research Scholar
Dept. of Economics
Berhampur University,
Bhanj Vihar,
Dist.: Ganjam.

❑❑❑

LIST OF PRESIDENTS

Year	Host	Venue	President
1968	Ravenshaw College	Cuttack	Prof. Sadasiv Misra
1969	Dhenkanal College	Dhenkanal	Prof. Devendra Ch.Misra
1970	Khallikote College	Berhampur	Prof. Bidyadhar Mishra
1971	Utkal University	Vani Vihar	Prof. Baidyanath Misra
1972	Bhadrak College	Bhadrak	Dr. Chakradhar Mishra
1973	Panchayat College	Bargarh	Prof. R.C.Patnaik
1974	O.U.A.T.	Bhubaneswar	Prof. S.P. Gupta
1975	Kendrapara College	Kendrapara	Prof. H.K.Mishra
1976	S.C.S. College	Puri	Prof. Devendra Ch. Misra
1977	Nimapada College	Konark	Dr. S. Tripathy
1978	Berhampur University	Bhaja Vihar	Prof. Nilakanth Rath
1979	Utkal University	Vani Vihar	Prof. K.Kanugo
1980	G.M. College	Sambalpur	Prof. Pravat Ku.Patnaik
1981	O.U.A.T.	Bhubaneswar	Prof. Dayanidhi Mohapatra
1982	Municipal College	Rourkela	Prof. Bibekanada Das
1983	Ravenshaw College	Cuttack	Prof. Ghanshyam Das
1984	Berhampur University	Bhanja Vihar	Prof. Basudev Sahoo
1985	Vikram Deb College	Jeypore	Prof. Santan Mohanty
1986	Banki College	Banki	Prof. B.C.Parida
1987	Kendrapara College	Kendrapara	Prof. Benudhar Binuyan
1988	S.C.S. College	Puri	Prof. Gyana Chandra Kar
1989	M.P.C.College	Baripada	Prof. N.P. Patro
1990	Not Held	–	–
1991	Utkal University	Vani Vihar	Prof. Khetra Mohan Patnaik
1992	Sambalpur University	Jyoti Vihar	Prof. Trilochan Satpathy

Year	Host	Venue	President
1993	Ravenshaw College	Cuttack	Prof. Surendra Nath Mishra
1994	B.B.Mahavidyalay	Chandikhol	Prof. Adwait Ku. Mohanty
1995	P.N.College	Khurda	Prof. Benudhar Mishra
1996	Paradip College	Paradip	Prof. Gajendra Nath Das
1997	Municipal College	Rourkela	Prof. Jyoti Prakash Patnaik
1998	Govt. Women's College	Keonjhar	Prof. Ajit Ku. Mitra
1999	Talcher College	Talcher	Prof. Binayak Rath
2000	Govt. Women's College	Sambalpur	Prof. Satya P.Das
2001	D.A.V.College	Koraput	Prof. Kumar B.Das
2002	Bhadrak College	Bhadrak	Prof. Bhabani P.Dash
2003	S.V.M. College	Jagatsinghpur	Prof. R.P.Sarma
2004	NCDS	Bhubaneswar	Prof. S.N.Mishra
2005	Christ College	Cuttack	Prof. N.B. Pradhan
2006	F.M. College	Balasore	Prof. R.M. Mallick
2007	U.N.S. College	Mugapal	Prof. Bedabati Mohanty
2008	Kendrapara College	Kendrapara	Prof. Kishore C. Samal
2009	Utkal University	Vani Vihar	Prof. R.K. Panda
2010	North Orissa University	Baripada	Prof. Pulin B. Nayak

□□□