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## Environment and Rural Issues

## Vellayani Lake: Conservation Efforts

*Sreejith Sreedharan*



Vellayani Lake, also called Vellayani Kayal is one of the three rain-fed freshwater lakes in Kerala. This very vast picturesque lake surrounded by lush greenery is located about 9 kms away from the Thiruvananthapuram city. Vellayani lake is a rich repository of flora and fauna, and the biodiversity supports the livelihood of people around the lake. About hundred species of wetland birds frequent the lake, including migratory ones.

The local legend regarding the origin of the lake is that a saint used to meditate under a banyan tree at this place. One day, a beggar came up to him and asked for some water to drink. When saint found that his pot was nearly empty, he poured the last few drops in the pot into his palm and with a prayer, threw the drops as far as he could. And the land till the point where the drops touched the earth turned into a big lake. Two temples dedicated to Vishunu and Devi are situated on the banks of this lake. It is believed that till 1953, the lake was solely used for the cultivation of lotus flowers for the famous Sri Padmanabhaswamy Temple. But later the water from the lake was extensively used for drinking and irrigational purposes.

The Vellayani fresh water lake is the major source of drinking water for the people of Kalliyoor, Venganoor, and Vizhinjam grama panchayats. However interventions in the form of paddy cultivation has deteriorated the quality of water and drastically reduced the water spread area. The area of the lake which was 750 ha in 1926, was reduced to 397.5 ha by 2005. As a result the villages bordering the lake have been experiencing acute water shortage. During 1950s a rice cultivation project after dewatering

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# INSIDE

According to the latest submissions by India to the United Nations the annual mean temperature in India is expected to rise by 3.5 to 4.3 degrees Celsius by 2098, impacting the production of Wheat. Increase in temperature can lead to a loss of 27.5 million tones of wheat annually, by the end of century.

India's wheat production for year 2011-12 was 88.31 million tones. So losing 27.5 million tones annually would be more than one fourth of current production. According to some studies there will be 14 per cent deficit in global wheat production, 11 per cent in rice and 9 per cent in maize by 2020.

Such is the impact of climate change on production of crops that the phenomenon has not only to be studied but efforts made to reverse the changes anticipated.

In this issue we discuss how various aspects of the environment impact agriculture and ultimately the lives of the people living in the rural areas. Climate Change can lead to serious issues relating to food security and poverty for the vast masses living on the earth.

Production of crops like cotton, potato and short season crops such as vegetables, fruits are also likely decrease with rising temperature and altered pattern of precipitation.

On the impact of climate change on human health, the communication to the United Nations says malaria outbreak is likely to increase in northern states and some region of southern India especially Karnataka.

It says that climate change and climate variability on the water resources are likely to affect irrigated agriculture, installed power capacity, environment flows in dry seasons and higher flows during the wet season, thereby causing severe droughts and floods problems in urban and rural areas.

Forests in India are already subjected to multiple stresses like over-extraction, anthropogenic pressures and climate change will be an additional stress.

Climate change will have a negative effect on all living beings and increase the risk of extinction of several species as extreme weather conditions like hurricanes, draughts and torrential downpours become more frequent.

# ENVIRONMENTAL DEGRADATION, CLIMATE CHANGE AND EFFECT ON AGRICULTURE

Dr. Harender Raj Gautam and Dr. H.L. Sharma

*According to the Inter-Governmental Panel on Climate Change (IPCC), the three main causes of the increase in greenhouse gases observed over the past 250 years have been fossil fuels, land use, and agriculture. The increase in greenhouse gases from the late nineteenth century to the present time has resulted in global warming of 1 to 3°C to the planet. The warming for the next 20 years is projected to be about 0.2°C per decade.*

**E**nvironment is the most important agenda of the international community due to its far reaching consequences on the survival of human beings and other forms of biodiversity on the earth. Climate change is the most important indicator of environment degradation. Climate change is occurring due to increase in the level of greenhouse gases (GHG).

In greenhouse gases, carbon dioxide, methane, nitrous oxide and fluorinated gases are

the main contributors. GHG emissions have had a significant impact on the climate, particularly in recent times, with the global-average surface temperature rising. Studies have revealed that the warming of the planet is closely linked with the build-up in the atmospheric concentrations of carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and some other greenhouse gases (GHG).

China is the major contributor of greenhouse gases with 19.5 per cent followed by USA (19.2



%), India (5.3 %), Russia (5.1 %), Japan (3.6 %) and Germany (2.6 %). Climate change affects many natural and human systems. According to the *Inter-Governmental Panel on Climate Change* (IPCC), the three main causes of the increase in greenhouse gases observed over the past 250 years have been fossil fuels, land use, and agriculture. The increase in greenhouse gases from the late nineteenth century to the present time has resulted in global warming of 1 to 3°C to the planet. The warming for the next 20 years is projected to be about 0.2°C per decade.

Studies indicate that *global warming* increases the risk for species extinction, especially in bio diverse ecosystems, because extreme weather conditions like hurricanes, draughts and torrential downpours become more frequent. Flora and fauna become extinct at a rate 100-1000 times higher than normal. Climate change is one of the main causes of species depletion. According to a recent study of *Stockholm Environment Institute*, *greenhouse gases* can inflict costs of nearly \$2 trillion annually in damage to the oceans by 2100. The estimate is based on the assumption that climate-altering carbon emissions continue their upward spiral without a pause. This study indicates that warmer seas will lead to greater acidification and oxygen loss, hitting fisheries and coral reefs. Rising sea levels and storms will boost the risk of flood damage, especially around the coastlines of Africa and Asia.

### Warmest Decade

According to the UN weather agency (*World Meteorological Organisation*), *Climate change* has accelerated in the past decade (2001 to 2010) and it was the warmest decade on record since records began in 1850. This period was marked by extreme levels of rain or snowfall, leading to significant flooding on all continents, while droughts affected parts of *East Africa* and North America. The global land and sea surface temperatures estimated at 0.46 degrees Celsius above the long term average of 14.0°C. The UN weather agency noted that the world is warming because of human activities and

this is resulting in far-reaching and potentially irreversible impacts on our Earth, atmosphere and oceans. According to a Government statement in the Parliament, there is 1.29 millimetre rise in sea level along the Indian coastline.

### Impact on Agriculture

Climate change will adversely affect agriculture globally. This will have serious impact on food security all over the world. All the studies indicate adverse effect on our food grain production. Changes in production patterns will occur due to higher temperatures and changing precipitation patterns. Agricultural productivity will also be affected due to increased carbon dioxide in the atmosphere. Leading international agencies like Inter-Governmental Panel on Climate Change (2007) and Universal Ecological Fund (2011) have indicated affect of climate change on agriculture, globally. According to these reports, there will be 14 per cent deficit in global wheat production, 11 per cent in rice and 9 per cent in maize by 2020. Research findings coming from different parts of the world indicate that climate change will affect many crops. According to the findings of the Australian scientists, climate change is causing the early ripening of grapes. These findings are based on the harvesting data of last 64 years. Scientists attribute the fruit's ripening to climate warming and a decline in soil water content, based on a comparison of decades of vineyard records.

There are no conclusive studies in India on the prospective impact of climate change on the agriculture sector including livestock and fisheries. Much of the country's understanding comes from global data provided by the Inter governmental Panel on Climate Change, the World Meteorological Organization and other world bodies. However, there are some examples which indicate the adverse effects of climate on crop production. According to a report of the Central Government in the Parliament, the productivity of staple grain wheat could decline by upto 18 per cent by 2020 due to adverse impact of climate change. The

yield of another major food crop rice might also fall by up to 6 per cent by 2020. These findings are based on the research conducted under Indian Council of Agricultural Research (ICAR)'s *Network Project on Climate Change* (NPCC). The report further indicates that the productivity of kharif maize and sorghum could also be affected by climate change. In 2002, drought affected food production by 10 per cent; the cold wave in January 2003 hit cultivation of mustard, mango, guava, papaya, brinjal, tomato and potato. High rainfall in 1998 and 2005 affected kharif and late kharif onion crops, resulting in price hike. There is urgent need for research to assess the impact of changing climate on agriculture. But, the research should not be driven solely by the international agenda. The research should clearly focus on the specific regions and crops. There is pressing need for honest location-specific research in partnership with small and marginal farmers to assess over a period of time the impact of climate change. Instead of being driven by international funding, such research should be driven by the needs of farmers.

### **Adaptation Plan**

Scientists are working world over to develop adaptive plants for flood, drought and salty conditions of soil and the work has begun to pay off. Recent tests on farms in Bangladesh show that a new line of rice containing the flood-resistant gene can live underwater for two weeks. The period of 7 to 10 days is very crucial in case of floods that destroy the crop of paddy in thousands of hectares every year. The problem of flooding is predicted to worsen as climate change brings more intense rainfall there. These findings are crucial because 70 per cent of the world's poor live in Asia particularly in south Asia where rice is the staple.

**According to a report of the Central Government in the Parliament, the productivity of staple grain wheat could decline by upto 18 per cent by 2020 due to adverse impact of climate change. The yield of another major food crop rice might also fall by up to 6 percent by 2020.**

Corn is another staple that is going to be affected due to more dry spells or droughts anticipated with the climate change. Recent tests in South Africa indicate that drought resistant maize plants, created by breeding, produced 30 to 50 per cent more corn than traditional varieties under arid conditions.

To mitigate the impact of climate change, the Government of India has launched the National Action Plan on Climate Change in 2008. The Central Government has announced its intent to reduce the emissions intensity by 20 to 25 per cent between 2005 and 2020, thus making a major contribution to mitigating climate change. This commitment is based on GHG Emissions profile which is based on five independent studies. The government has also formed an Expert Group on Low Carbon Strategy for Inclusive Growth under the Planning Commission to develop a roadmap for low-carbon development. The government has also launched the Indian Network for Climate Change Assessment (INCCA), in October 2009, as a network-based programme with broad objectives of measuring, modeling and monitoring the changes due to climate change. It brings together over 120 institutions and over 220 scientists from across the country. The fight against climate change will take a strategic jump in the 12th Five-Year Plan (2012-2017) with the government intending to plough in almost 2 lakh crore Rupees through various missions.

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## Environment and Economic Development: A correlation

Barna Maulick

*Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs. The Environmental Kuznet Curve hypothesis establishes an inverted U-shaped relationship between economic growth and environment degradation. It assumes that environmental degradation increases when per capita income reaches a certain point, or the turning point. We can say that there is inverse relationship between income and emissions, higher the income, lower the emissions and vice-versa.*

**E**nvironment and economy are interdependent and need each other. Development that ignores its repercussions on the environment will destroy the environment that sustains life forms. What is needed is sustainable development which will allow all future generations to have a potential average quality of life that is at least as high as that which is being enjoyed by the current generation.

The term 'sustainable development' was popularized in *Our Common Future*, a report published by the World Commission on Environment and Development (WECD) in 1987. According to WECD p.43 "development which meets the needs of the present without compromising the ability of future generations to meet their own needs." Acceptance of the report by the United Nations General Assembly gave the term political salience and in 1992, leaders set



out the principles of sustainable development at the United Nations Conference on Environment and development in Rio de Janeiro, Brazil.

Sustainable development means convergence between the three pillars i.e. economic development, social equity and environmental protection. Sustainable development is a fluid concept and various definitions have emerged over the past two decades. Despite an on-going debate on the actual meaning, a few common principles tend to be emphasized. The first is a commitment to equity and fairness As such priority should be given to improving the conditions of the world's poorest and decisions should account for the rights of future generations. The second is a long-term view that emphasizes the precautionary principle, i.e., "where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation". Third, sustainable development embodies integration, and understanding and acting on the complex interconnections that exist between the environment, economy, and society. This is not a balancing act or a playing of one issue off against the other, but recognizing the interdependent nature of these three pillars.

Many papers have been written on the relationship between economic growth and environmental preservation since R.C. d'Arge published his Essay on economic growth and environmental quality in 1971. The main questions arising before the environmentalists are: Is long-run economic growth compatible with environmental preservation? Is sustainable growth viable? What would be the effect of greater concern for the environment over economic growth? How do environmental externalities influence growth rate, and thus, what is the effect of environmental policy on economic growth?

These questions have been analyzed in many of these papers in the framework of stationary models and exogenous growth models. In this

type of models, either there is no long-run growth or if there is long-run growth it is exogenously determined, so that environmental quality may have a negative effect on capital accumulation or no effect on the growth rate. In addition, in this literature the emphasis has been put on analysis of the efficient growth path without paying much attention to growth based on market equilibrium. Since the appearance of the new theory of growth at the end of the eighties and the start of the nineties, a series of papers has been published in which these questions are addressed in the framework of endogenous growth models.

Many studies have explored the development - environment relationship. The Environment Kuznet Curve (EKC) is one hypothesis that has elicited much attention (Arrow et al.1995). The EKC concept was put forward in early 90s by Grossman and Krueger (1991) as well as in World Development Report (Shafik and Bandyopadhyaya 1992). This hypothesis establishes an inverted U-shaped relationship between economic growth and environment degradation. It assumes that environmental degradation increases when per capita income reaches a certain point, or the turning point.

### **Relationship between Environmental Kuznet Curve and Economic Development:**

In the early stages of economic growth, the awareness of environmental problems is low or negligible and environment friendly technologies are not available. Environmental degradation increases with growing income up to a threshold level beyond which environmental quality improves with higher per capita income (Dinda 2004).

Kuznet (1955) predicted that the changing relationship between per capita income and income inequality is an inverted U-shaped curve. As per capita income increases, income inequality also increases at first and then starts declining after a turning point (TP). So the distribution of income becomes more unequal in early stage of income

growth and then the distribution moves towards greater equality as economic growth continues (Kuznet 1955). After 1990, the Kuznets curve got a new existence i.e. the level of environmental degradation and per capita income follows the same inverted U-shaped relationship as does income inequality and per capita income. The inverted U-shaped relationship between economic growth and measured pollution indicators (environmental quality) is known as EKC. Kuznet's name was attached to the inverted U-shaped curve which established a relationship between pollution and economic development because it resembled the original inverted U-shaped relationship kuznet curve which ascertains the relationship between income inequality and economic development. However, Panayotou (1993) first coined it as the Environmental Kuznet Curve. The relationship can be shown by an inverted U-shaped EKC. The EKC establishes a long term relationship between environmental impact and economic growth. As economic development speeds up with the intensification of agriculture and other resource extraction, at the take-off stage, the rate of resource depletion begins to exceed the rate of resource regeneration and waste generation increases in quantity and toxicity.

At higher levels of development, structural change towards information-intensive industries and services coupled with increased environmental awareness, enforcement of environmental regulations, better technology and higher environmental expenditures results in leveling off and gradual decline of environmental degradation. As income increases, there is transition in the economy. Economy moves from natural process of

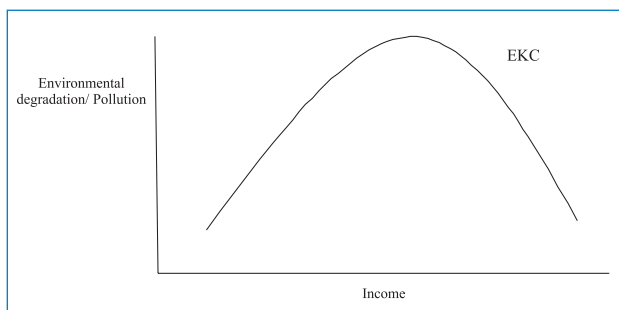


Figure1: Environmental Kuznet Curve (EKC)

economic development i.e. from a clean agrarian economy to a polluting industrial economy, and again to a clean service economy (Arrow et al. 1995).

Economic development can be traced back to the industrial revolution and to the industrial development in the modern world. The industrial revolution irreversibly changed the nature of labour, consumption, family structure, social structure and the thought processes of the individuals. The amazing thrust in the field of production, power, science and technology brought along with it even the bad effects of environmental degradation. Development may be defined as double-edged sword, which has far reaching effects on the environment. The ill effects of development are many but unlike the benefits, they are not visible and are camouflaged.

The following ill effects of development had been discussed in agenda 21 of the Rio Conference of 1992:

**Atmospheric Pollution:** includes (i) Smog caused by chemical reactions between pollutants derived from different sources, mainly automobile exhaust and industrial emissions, acid rain occurs when pollutant like sulphuric acid combines with droplets of water in the air, the water becomes acidified. (ii) Acid rain kills trees and harms animals, fishes and other wild life, green house effect or global warming is a common fact of atmospheric pollution. (iii) Global warming is increasing due to increase in carbon dioxide content in the air. This carbon dioxide builds up a blanket and traps the heat from going out which causes unusual heat in the earth's surface. (iv) Ozone depletion is the major trouble of the development rather industrial development. Our earth is surrounded by layers of atmosphere, ozone gas which protects harmful ultra violet rays from coming in the earth's surface is found in the stratosphere. The release of chlorofluorocarbons (CFCs) from aerosol cans, refrigerators, air conditioners etc. are continuously harming ozone layer causing holes and allowing the radiation to reach the earth.

Air pollution effects health in many ways, may be short or long term short term effects include irritation of eyes, nose , throat such as bronchitis, pneumonia.

**Marine Pollution:** oceans are the largest ecosystem on earth. Seventy five percent of sea pollution is based on land activity. Some major types of contamination are: (i) Oil spills which primarily effects marine mammals and reptiles like turtles that need surface to breathe and breed. Adult fishes living near shore waters and juveniles in shallow water nursery and birds who live near shorelines are vulnerable to adverse effects of oil pollution. (ii) Sewage adds to suspended particles in the water column. This sewage is hard to detect in open coast but in semi-enclosed areas, their effects are devastating. (iii) Garbage has huge effect on ocean life. Litters on land find their way to the oceans being carried by the wind; as a result tons of plastic bags, cigarette buds, bottles etc. are always floating in the sea. Sea turtles often mistake plastic bags with jelly fish which blocks their digestive system and finally leads to death. (iv) Radioactive wastes- the world's oceans have been dumping ground for radioactive wastes since 1944. Dumping of high radioactive wastes in the ocean is no longer permitted but low level wastes are still dumped in deep sea. May be in near future its devastating effect will be seen by our coming generations. (v) Thermal pollution only affects the communities adjacent to the discharge. Electrical generating plants along the coastlines use marine waters for cooling purposes which leads to heated water being expelled in the marine environment, tropical areas are affected by thermal discharge. For e.g. mangrove trees in a heated bay will not reproduce. (vi) Eutrophication means release of extra nutrients into coastal waters. Fertilizers used on land are washed into the ocean through rivers; streams etc. which may lead to the birth of phytoplankton blooms as red tides, yellow or green foams, a higher frequency of the occurrence of algae blooms also indicate unhealthy eco system. Toxicity of the recent blooms are increasing which has direct effect on the organisms that feed upon them.

**Deforestation:** means permanent destruction of indigenous forests and woodlands. Forests are home for many important species, they also play a major role in ecosystem. Forests produce huge amount of oxygen, tend to help replenish nutrients in land and prevent desertification. Forests are also a main source of timber. If people exhaust their supply of forests, they will no longer be able to continue using them as the source of building materials, heating fuels and paper (Bragaw,1999).

**Desertification:** "Land degradation means reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, pasture, range, forests and woodlands resulting from land uses or from a process or combination of processes. These processes include soil erosion caused by wind or water, deterioration of the physical, chemical and biological or economic properties of soil, and long term loss of natural vegetation." Soil degradation, is defined as human –induced phenomenon, which lower the current or future capacity of the soil to support human life. In drylands, soils are especially vulnerable to degradation due to the slowness of their recovery from a disturbance. ("Desertification", 2001)

**Hazardous Wastes:** The generation of hazardous wastes is one of the major consequences of development. As defined by the High Powered Committee Report, hazardous wastes refer to "any substance, whether solid, liquid or gaseous form, which has no foreseeable use and which by reasons of any physical, chemical, reactive, toxic, flammable, explosive, corrosive, radioactive or infectious characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or environment, and should be considered as such when generated, handled, stored transported, treated and disposed of." Hazardous wastes are generally a by-product of the industrial operations which involve the use of heavy metals such as arsenic, cadmium, lead, mercury and processes which utilize different categories of oil and

petrochemicals. The main difficulty is, recycling of hazardous waste is itself very hazardous and is more toxic in concentration than the material recycled.

**Climate Change-**“If temperatures rise by almost 6° C over the next 100 years, then the rising sea levels, shifting weather patterns and an increase in the frequency of extreme weather events could cause massive traumas both for human populations and for nature” says Intergovernmental Panel on Climate Change (IPCC). A blanket of water vapour and other greenhouse gases (carbon dioxide, methane, nitrous oxide) traps some of the sun’s radiation from going back causing warming of the atmosphere. The main cause of this global warming is carbon dioxide which is produced by burning of fossil fuels and another is methane which traps heat 30 times more than carbon dioxide. Methane emissions come from cultivation of rice, pipeline leaks, the flatulence of cattle and forest fires. It is predicted that if global warming keeps on following the same pattern then a day will come when the glaciers and ice-caps will melt and cause the sea level to rise and tropical diseases like malaria will spread in the tropical climates.

**Decline in the Biodiversity:** biodiversity is often thought of as the variety of organisms on the earth. It also includes factors like ecological diversity (the variety of ecosystems and ecological communities) and genetic diversity (the range of genetic differences found within and between species). All the three aspects are crucial for the success and development of life on the earth. Since environmental conditions are constantly changing, only diversity can ensure that some individuals and species will be able to adapt to the changes (Biodiversity, 2001). All these have profound value for human beings. The value of biodiversity lies not only on direct use of the nature’s product but also on the vast range of products prepared from these ranging from food, medicines, fibres and materials. Biodiversity also guarantees a permanent source of new genetic materials for future breeding programmes. Life

on the earth is currently undergoing a sixth mass extinction event. Its extent is only vaguely known, species are only recorded as extinct after their last individual has also died.

But from this we cannot draw a conclusion that development has only led to the degradation of the environment. Every coin has another side. It has been proved by many researches that development in technology has led to the saving of the environment in many ways. “The invention of new technology is not necessarily a threat to the environment; rather it is usually the best hope of environmental improvement” (Ridley 2002).

The World Development Report, 1992 linked the economic development with the environment. The main message of the report was the need to integrate environmental considerations into development policy making. The report argued that continued and accelerated economic and human development is sustainable and can be consistent with improving environmental conditions.

A more fruitful analysis of the relationship between economic development and environmental impact depends upon several factors as:

**Specific Effects:** There are large differences in state level per capita emissions due to the enforcement of pollution laws and the use of outdated industrial technology. Low income states are still sources of emissions because of land conversion through burning and replanting of tree crops while high income states are emitting increasing emissions because of industrial and municipal wastes.

**Production Structure:** Developed countries have fairly stable production structures, whereas rapidly industrializing and developing countries have unstable production structure. A change in the composition of consumption has resulted in a downturn in pollutants (Rothman, 1998).

**Institutional Change:** Along with the economic development, societies advance with their social, legal and fiscal infrastructures that

are essential to enforce environmental regulation (Bhattarai and hamming, 2001). Institutional changes triggered by citizens' demand for cleaner environments are more likely to occur in democratic countries (Shafik and Bandyopadhyay, 1992).

**Technological Progress:** Technological progress leads to greater efficiency in the use of energy and materials. Thus, a given amount of goods can be produced with successively reduced burdens of natural resources and environment. One aspect of the progress can be better and more efficient reuse and recycling of materials, which (coupled with greater efficiency in use) can yield large resource savings.

**Research and Development:** As income grows, people can adopt better and efficient technology that provide cleaner environment. This preferential behaviour of people should be reflected through their income elasticity. The income elasticity of public research and development funding for environmental protection is positive (Komen et al., 1997). This indicates the key role of such public investments for environmental improvements in reducing environmental degradation. As income levels rise, decreasing relationships are found for some pollution indicators in developed countries. The effect of economic growth on pollution/emissions differs substantially among high-income countries. This also depends on the adoption of new technology.

**Innovation and Adoption:** New technologies, unambiguously, improve productivity but create potential dangers to the society such as new hazardous wastes, risk and other human problems. These externalities are unknown in the early phase of diffusion of technology; in later stages regulation becomes warranted to address it. Once the technology is regulated, this may stimulate the gradual phase out of existing technology. So, a cyclical pattern arises in technologies, which first diffuse, then become regulated and finally are phased out by next generation of technologies (Smulder and Bretschger, 2000).

**Technological and Organisational Change:** Improved technology not only significantly increases productivity in the manufacture of old products but also the development of new products. There is a growing trend among industries to reconsider their production processes and thereby take environmental consequences of production into account. This concerns not only traditional technological aspects but also the organization of production as well as the design of products. Technological changes associated with the production process that may also result in changes in the input mix of materials and fuels (Lindmark, 2002). The economy-wide reforms often contribute simultaneously to the economic, social and environmental gains (Anderson and Cavandish, 2001; Pasche, 2002). Developing countries could learn from the experiences of industrialized nations, and restructure growth and development (Munasinghe, 1999) — thereby avoiding going through the same stages of growth that involve relatively high (and even irreversible) levels of environmental harm.

**Conclusion:** We find that although there is inverse relationship between development and environment the developing (low and middle income) countries of today have a unique opportunity to learn from the past history and thereby avoid some mistakes from earlier growth experiences. With increased awareness of environmental hazards and the development of new technologies in recent years that are cleaner than ever before, we might hope to see the developing countries turn their attention to preservation of the environment at earlier stages of development than has previously been the case.

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# PROMOTING RURAL SANITATION FOR A BETTER ENVIRONMENT IN RURAL INDIA

Anupam Hazra

*The deteriorating rural environment is not only creating problem for rural population but also emerging as a threat to urban India, since rural India is the key provider of agricultural and other indigenous products being consumed being by the big cities.*

In current context of sustainable development, concern is mounting over an ever growing list of environmental issues across rural India. By tradition, Indian society and culture values personal hygiene but gives little importance to clean and healthy community environment. Human excreta is regarded as the most hated object and anything connected to latrine is considered so defiling that one is supposed to take a bath immediately after coming out of the toilet and before going into kitchen due to psychological and religious taboos. Sanitation is, therefore, regarded as a matter of individual initiative and not a collective obligation of the community and under this socio-cultural background, environmental sanitation has sadly been given the lowest priority.

For a healthy living we all require a healthy environment and sanitation is regarded to be one of the core components of the same. As far as the concept of sanitation is concerned, it is no more confined only within the various methods and technologies of safe disposal of human excreta, the Central Rural Sanitation Programme of India has updated and upgraded the perception of sanitation by incorporating the components like liquid and solid waste disposal, food hygiene, personal hygiene, domestic as well as environmental hygiene in the context of health improvement, school and home sanitation, and safe water and garbage disposal. In short, sanitation is being considered as a comprehensive initiative for a healthy environment within a community with the



top priority of separating excreta with its host of biological pathogens, from contact with human beings as well as plant and animal life.

Now coming to the environmental concern of a rural nation like India where about 70% of its people live in the villages - these days the question of improving the sanitation in villages is gaining much attention of both the people and the government as inadequate sanitation always puts an adverse effect on the environment; without a clean, safe toilet close to home people are forced to live in an unhealthy and unpleasant environment. One gram of faeces can contain ten million viruses, one million bacteria, one thousand cyst parasites and about a hundred worm eggs - so the danger of disease is massive and when any waste is exposed and clean water and hygiene education are limited, all people in the community are vulnerable to illness caused by faeces. On the other hand if we look into statistics then it shows that every year around 1.8 million children mostly from rural areas, die of diseases such as cholera, typhoid and dysentery caused by unclean water and poor sanitation; in this regard rural women and girls are the most disadvantaged section as in absence of a well-built toilet at home, they often have to wait till dark for going to the field for open defecation which make them vulnerable to illness as well as sometimes to sexual-assault. Moreover sickness due to insanitary condition takes children away from school and adults away from earning an income. Medical expenses make massive demands on the limited incomes of the rural poor.

## Rural Environment

The deteriorating rural environment is not only creating problem for rural population but also emerging as a threat to urban India, since rural India is the key provider of agricultural and other indigenous products being consumed being by the big cities. Rural lifestyles have close links with nature and its resources. Thus the environmental problems that manifest in rural areas of the country are largely due to over-use or misuse of resources mostly because of sheer poverty, ignorance and lack of alternatives. The denudation of vegetative cover due to expansion of agricultural activities, indiscriminate collection for firewood and the overgrazing by cattle and other livestock and consequent soil erosion are good examples of the impoverishment of environ-

mental resources. Rural communities are generally resource conscious and the amount of waste generated in villages is, therefore, much less than in urban centres. Also the nature and composition of waste is different in villages from that of cities. Most of the waste generated in villages is from individual households, whereas in urban areas, commercial establishments and institutions are also an important source of waste. At the same time, the organic proportion of waste in village households is much higher than that in the cities. This is mainly because of different life styles, consumption patterns, food habits, etc. Traditionally, the village communities never considered anything as waste and had well-managed waste management systems which allowed for maximum recycling and reuse of waste. However, with increase in population, the quantities of waste have increased several fold, whereas the resources available for its management such as land availability for composting of organic waste - have diminished over time. These wastes are, therefore, now dumped in the open and are managed unscientifically, leading to problems of environmental sanitation in rural India.

Realizing the adverse impact of sanitation on environment as well as for recognizing and encouraging the efforts of Panchayati Raj Institution under Total Sanitation Campaign, *Nirmal Gram Puraskar* (NGP) was initiated by the Government on October 2, 2003. A '*Nirmal Gram*' signifies an 'open defecation free' village with all houses, schools and *anganwadis* having sanitary toilets besides awareness amongst communities about the importance of maintaining personal and community hygiene, good sanitation and clean environment. But when we look into the very recent statistics, we notice that out of 2.5 lakh gram panchayats of this country, only 25,000 have received '*Nirmal Gram*' status - which signifies that only 10 percent of Indian villages have full sanitation coverage.

## Sanitation Coverage

Taking into account the different research-findings and survey-results on Total sanitation Campaign, it can be suggested that increasing sanitation coverage in rural areas would require more clarity of the issue and understanding of the rural sensibilities. Building toilets is just one half of the battle; the other half is to make

### Ensuring a Healthy Rural Environment through Proper Sanitation: The Way Forward

- Encouraging more and more fundamental research in the sphere of rural sanitation with a special focus on different issue of environmental sanitation of rural India
- Encouraging the development of indigenous, affordable, eco-friendly and culturally acceptable sanitation technologies in rural India
- Greater emphasis on personal hygiene and environmental sanitation as essential prerequisites for achieving total sanitation status in rural villages
- Generating awareness and creating demand at community level for safe access to water and sanitation through community participation
- Rural women are mostly affected by the absence of sanitary latrines at home. Access to adequate and sanitary latrines is a matter of security, privacy and human dignity, particularly for rural women. So while carrying out total sanitation campaign in rural India - targeting gender issues in communication strategy will be quite effective in focussing on the needs of the women and yields considerable success
- Higher degree of transparency in program-implementation leading to the proactive provision of relevant and complete information to all stakeholders to bring about their more effective participation
- Creating stakeholders' network comprising eminent personalities, civic bodies, political elected representatives, industry, educational institutions, civil society, media and community leaders to ensure smooth functioning and sustainability of rural sanitation programs
- Environmental regeneration and improvement of environmental resource-base as a source of labour-intensive growth, while augmenting productive capacities, increasing resource-use efficiency and correcting regional and rural-urban imbalances
- Integration of poverty reduction and environmental regeneration through participatory watershed management
- Promoting behavioural change towards adoption of environment-friendly practices among the rural mass
- Creating provision for livelihood security to resource-poor households through sustainable access to basic needs such as food, fodder, fuel and water
- Initiating location-specific interventions in promoting rural sanitation, keeping in view the diverse natural resource and socio-economic conditions of the nation

people use them. Merely building latrines in a community will not ensure environmental sanitation or the reduction of water-borne diseases as NSSO survey indicates only around 18 % of rural population are using latrines. It must be combined with hygiene education which is designed to encourage changes in people's personal behavioural pattern and outlook as well as to block the faecal-oral transmission route and reduce the spread of diseases. This is the high time for the social scientists to look at society's collective blindness towards the practice of open defecation and the reluctance to change. Despite the high rate of urbanization - the rural population is still characterized by ignorance and poverty, and the attitudes of these people are mainly

influenced by age-old cultural beliefs and values. So to protect rural environment on sustainable manner through proper environmental sanitation, rural people need to change their attitudes and beliefs toward the whole issue. Lastly it may be concluded that though concern is mounting over an ever growing list of environmental issues across the nation but compared to urban India, we can still find a much better, safer and cleaner environment across the villages of this country, where one can at least breathe contentedly in fresh air.

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# WHEAT PRODUCTION IN INDIA UNDER CHANGING SCENARIO OF GLOBAL WARMING

T. P. Singh

*In India, lower productivity is due to shorter crop duration and period of grain-filling and higher temperatures during crop growth, particularly during grain-filling. The wheat crop in the northern plains exposed to higher ambient temperatures at the time of grain filling, which significantly reduces the productivity .*

Common wheat (*Triticum aestivum* L.) belongs to *Poaceae* family. It is the most important staple food crop in the world and second important crop in India after rice. Its straw is used as food for cattle. India is the second largest producer of wheat in the world after China and contributes more than 12% to the global wheat basket. Wheat is the second most important crop after rice in India and occupies approximately 29.25 m ha area. India is also the second largest wheat consumer after China.

In India, wheat is mainly grown during the winter season, planted during October-November and harvested in March-April. The Northwestern Plains Zone (NWPZ) comprising Punjab, Haryana, Delhi, parts of Rajasthan, and western Uttar Pradesh (UP) and the Northeastern Plains Zone (NEPZ) including eastern UP, Bihar, Jharkhand, Orissa, West Bengal and Assam are have to wheat.

An in-depth analysis arrived at the following causes for declining wheat productivity in the



country: (i) decrease in the use of fertilizers (N, P and K) in the NWPZ and NEPZ; (ii) micronutrient imbalance in soils; (iii) fatigue in genetic gain in varietal development and terminal heat stress in the NWPZ; and (iv) low minimum support price fixed by the Government for the procurement. Though India is the second largest producer of wheat in the world, the average productivity is 2907 kg/ha against 4738 kg/ha in China and 7926 kg/ha in UK (2009).

Productivity in India is only 27.3% than in UK. The wheat crop in UK and NW European countries grows at much lower temperatures all through the crop duration with no water stress, and the grain-filling takes place over an extended period of 60 days at temperatures below 20°C. In India, the lower productivity is due to shorter crop duration and period of grain-filling and higher temperatures during crop growth, particularly during grain-filling. The wheat crop in the northern plains exposed to higher ambient temperatures at the time of grain filling, which significantly reduces the productivity .

Experimental results indicate that each degree rise in ambient temperature reduces the yield by 3-4%. Crop duration varies from 150 days in the north and goes down to 100 days in Maharashtra and further south, with corresponding decline in yield. Late planting of wheat in India is common due to the intensive cropping system, often delays the sowing of the crop up to the middle of January, particularly in North West India where it is generally sown after harvest of paddy, sugarcane, pigeonpea , cotton and potato.

## Species

The wheat species grown on commercial basis in India are of spring type but cultivated during winter season. Among the wheat species, *Triticum durum* (Bread wheat) and *Triticum*

*dicoccum* (Emmer or Khapli) are grown in India. In wheat species, *T. aestivum* continues to be the most important species accounting about 95% of total wheat production of the country and is grown in almost all the wheat growing states. *T. durum* is next in importance with approximately 4% of total wheat area and confined mostly to central and southern parts of India. The cultivation of *T. dicoccum* is confined to the southern region mainly Karnataka and southern Maharashtra that contributes less than 1% of total national wheat production.

## Heat Stress

Heat stress is one of the major abiotic stress that reduce wheat quality and productivity. Terminal heat stress is a serious problem in about 40% of the irrigated wheat growing area of the world. Hence identification of sources of heat tolerance in wheat gene pool in the changing scenario of global warming. The productivity under rain-fed and late sown wheat are about 50% yield obtained in irrigated timely sown crops. Endeavors to identifying factors imparting tolerance against heat stress will go a long way in increasing the crop productivity and thus in erasing the curse of hunger from the planet earth. Wheat is a sink limited crop and high temperature during grain filling causes the production of shriveled grains due to forced maturity.

Late sown crop gets exposed to mean maximum temperature of about 35°C during grain growth causes yield reduction of 270 kg ha per degree rise in temperature. **Temperature adversely alters the growth and development of wheat during the early phase of panicle emergence, grain set and grain development. High temperature reduces the yield drastically due to in detrimental effect on metabolism and duration of phenological phases.**

**Experimental results indicate that each degree rise in ambient temperature reduces the yield by 3-4%.**

In India the lower productivity of wheat is due to shorter crop duration and period of grain filling, and higher temperatures during crop growth particularly during grain filling. Besides, heat stress wheat crop faces water stress during the period of grain filling. Higher temperature affects all phases of crop growth, accelerates floral initiation, reduces the period of spike development, resulting in shorter spike with lower number of spikelets and adversely affecting pollen development. The duration of grain growth in post-anthesis period is considered the most significant determinant of yield in wheat, both day and night temperatures have a pronounced effect on duration of grain filling. Most of the carbohydrates in wheat grain are derived from the photosynthates produced in flag leaf after anthesis. Thus the processes that determine yield are net canopy photosynthesis, translocation of assimilates and sink capacity in the developing grains. High temperatures are known to have deleterious effects on photosynthesis, respiration and reproduction.

**Higher temperatures affect all phases of crop growth, accelerate floral initiation, reduce the period of spike development, resulting in shorter spike with lower number of spikelets, and adversely affecting pollen development.**

### Physiological changes

Higher temperatures affect all phases of crop growth, accelerate floral initiation, reduce the period of spike development, resulting in shorter spike with lower number of spikelets, and adversely affecting pollen development. The duration of grain growth in the post-anthesis period is considered the most significant determinant of yield in wheat. Higher temperatures further associated with limitation of water cause rapid shrinkage of grain volume. At molecular level, these effects are brought about by altered gene expression and manifested at the biochemical and metabolic level, membrane stability, and production of heat shock proteins (HSPs).

A 5°C increase results in selective expression of HSPs, with continued synthesis of normal cellular proteins. The late sown wheat is more affected by high temperature stress leading to reduced yield and quality. Morphologically, similar wheat varieties have showed different degrees of tolerance to post-anthesis high temperature stress. Hence breeding for heat stress tolerance can open new insights significant in Indian agriculture. There are several physiological traits that are associated with heat tolerance. Photoassimilation, chlorophyll retention, chlorophyll a:b ratio, canopy temperature depression, stomatal conductance, membrane stability are some of the examples. Photosynthesis, respiration, conversion of sugar into starch in developing grain has been found to be affected by high temperature. It has been reported that high temperature causes membrane damage resulting in electrolyte leakage and this leakage has been shown to be related to temperature and drought tolerance of the wheat genotypes. Wheat varieties with similar morphological

traits have been shown to have differential tolerance to post-anthesis high temperature stress. Temperature is the key factor that influences the phenological development and grain yield of wheat crop. Physiological traits such as canopy temperature depression that are reported to be strongly associated with the yield traits much also be used for enhancing the wheat yield in the warmer areas. Significant variability was observed among the genotypes for canopy temperature depression measured at full canopy development and these values correlated with yield under hot environments.

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## AGRICULTURE & CLIMATE CHANGE

Dhurjati Mukherjee

*According to the Indian Council of Agricultural Research (ICAR), there is empirical evidence to show that change in weather patterns affected at least two cropping cycles in recent years. The impact of changing climate on Indian agriculture is inevitable but the ICAR is reported to have the capacity to initiate mitigation and adaptation measures.*

The predictions of the Indian Meteorological Department about rainfall are eagerly awaited in the country. Normal or near normal rainfall like this year (2010) no doubt brings cheer to millions of farmers all over the country. As is well known, over 70 per annual precipitation falls between the months of June and September and a good monsoon heralds a bountiful harvest and financial security to millions in the country. But climate variability -- the effect of global warming -- has been the source of both misery and prosperity for much of rural India.

Experts have concluded that the national emission targets are not sufficient to limit global warming to 2<sup>o</sup> Celsius during this century. It is also a fact that a 1<sup>o</sup> Celsius rise in mean temperature

will lead to a reduction in wheat production in India by 6-7 million tonnes per annum, which will have a very great effect on the poorer sections of the population.

There can be no denying that India is among the many developing countries whose agriculture has been impacted by climate change but whether the country has the capacity to adapt to such change is a matter of discussion and debate. According to the Indian Council of Agricultural Research (ICAR), there is empirical evidence to show that change in weather patterns affected at least two cropping cycles in recent years. The impact of changing climate on Indian agriculture is inevitable but the ICAR is reported to have the capacity to initiate mitigation and adaptation measures.



## Monsoon

The June-September monsoon is critical for the country as two-thirds of Indians depend on agriculture. Last year, the farm economy was hammered by a severe drought which affected production. Patch rains last year cut rice production by over 14 per cent and sugar by 13 per cent. It set food prices soaring which had risen to an 11-year high of around 19 per cent during the first half of December.

It is generally believed that extreme temperatures and heat spells could alter patterns of monsoon rains. There have been reports by scientists that India will experience a decline in summer rainfall by the year 2050 or even earlier. This has been corroborated by G. Nelson of the Washington-based International Food Research Institute (IFRI) as he felt that the situation may worsen by 2050 with “higher temperatures, less precipitation, depending on where in South Asia you are”.

Reports reveal that climate change is likely to increase the number of people at risk of hunger compared with reference scenarios with no climate change (Schmidhuber & Tubiello, FAO 2007). Due to climate change, reductions in cereal production of up to 22 per cent are likely in South Asia (Tubiello & Fischer 2007). Prices of cereals more than doubled in 2008 and further increased in 2009 compared to 2000 as consumption has been consistently higher than production and that has reduced stocks steadily.

## Crop Production

Estimating the effect of a changing climate on crop production in India is rather difficult due to the variety of cropping systems and levels of technology used. Although a large number of simplifying assumptions must necessarily be made, these models allow the complex interaction between the

main environmental variables influencing crop yields to be understood.

According to the World Development Report 2010, India's post-1980 deceleration in the increase of rice productivity is attributable not only to deteriorating irrigation infrastructure and also partly to stagnant rice prices but also to climate phenomena from local pollution and global warming. Extrapolating from year-to-year variations in climate and agricultural outcomes, yields of major crops in the country are projected to decline by 4.5 to 9 per cent within the next three decades, even allowing for short-term adaptations. The implications of such climate change for poverty – and GDP – could be enormous given projected population growth and that one percentage point of agricultural GDP growth in developing countries, including India increases the consumption of the population by 4 to 6 percentage points.

After 2050, temperature in India is expected rise by 3-4<sup>o</sup> C over current levels and rainfall would become heavier, more intense and erratic and less

regular, posing a threat to agriculture, according to the Indian Institute of Tropical Meteorology, Pune. It has been estimated that 2<sup>o</sup> C increase in mean air temperature could decrease rice yield by about 0.75 tonne per hectare in high yield areas and by about 0.06 tonne per hectare in the low yield coastal

regions in India (Sinha & Swaminathan 1991). Also 0.5<sup>o</sup> C increase in winter temperature would reduce the wheat crop duration by 7 days and reduce yield by 0.45 tonne per hectare. Moreover an increase in winter temperature would thereby translate into a 10 per cent reduction in wheat production in the high-yield states of North India.

Kumar & Parikh in a study way back in 1998 showed that even with adaptation by Indian farmers of their cropping pattern and inputs, in response to climate change, the losses would mean significant. The loss in farm level net revenue is estimated to range between 9 and 25 per cent for a temperature

**After 2050, temperature in India is expected rise by 3-4<sup>o</sup> C over current levels and rainfall would become heavier, more intense and erratic and less regular, posing a threat to agriculture**

rise of 2° C to 3.5° C. Later in 2001 they projected that with 2° C increase in temperature and 7 per cent increase in precipitation, the net revenue of India will decline by 8.4 per cent. This would be due to warmer temperature coupled with the low level of management in small and marginal farms which constitute 60 per cent of the total.

A study by the World Bank (2006, 2009) found that in the arid regions of Andhra Pradesh, the climate projections indicate substantially higher temperature (2.3° C- 3.4 ° C on an average) and a modest but more erratic increase in rainfall of about 4 to 8 per cent at the basin level. With high prevailing baseline temperatures these changes would have a deteriorating effect with declining yields for the major crops – rice, groundnut and jowar. In the harsher climate change scenarios, farm incomes could decline substantially by over 20 per cent, suggesting that agriculture as currently practised may not be capable of sustaining large populations on small rain-fed areas.

Similarly in the study districts of Puri and Jagatsingpur in Orissa, the assessment found that rice yields could decline by 5 to 12 per cent and profits by 6 to 8 per cent under climate change. It also found that with the dominance of rice and high levels of pre-adaptation of floods, there is little that can be done to build flood resistance through adjustments in cropping patterns and farming practices. While the prospects of floods would increase under climate change, obviously agricultural production is bound to suffer.

However, in the drought prone belt of Maharashtra, specially Nashik and Ahmednagar districts, climate projections suggest a significant though more variable increase in rainfall – around 20 to 30 per cent at the basin level accompanied by higher temperature of about 2.4° C- 3.8 ° C on an average. As a result, the yield of several dryland crops, including the millet varieties of jowar and bajra varieties exhibit small improvements and provide a measure of relief to rain-fed farmers with a boost of around 8 to 15 per cent in incomes. But under climate change scenarios, sugar cane yields are expected to decline by nearly 30 per cent due to increased heat stress caused by warmer climate.

## Assam Tea and Himachal apples

Already the effects of climate change are seen to be slowly becoming apparent. Assamese tea and Himachal apples are just three on a lengthening list of crops that are affected by climate change patterns. Maharashtra's grapes, Goa's mangoes and cashew nuts and Kerala's paddy crops and Haryana's wheat are seen to be affected too. One may mention here that Dr. H. Pathak of the Indian Agricultural Research Institute's Climate Change Programme pointed out that change in rainfall patterns and the 'terminal heat' – observed in the months of February and March, not to speak of the summer months – could affect the country severely in the coming years. The United Nations' Food & Agriculture Organization have already noticed this trend in India and other countries as well.

It is well known fact that 60 per cent of the total cropped area is still rainfed in India, the uncertainties of the monsoon could have an impact on agriculture. It is necessary to understand in detail how the possible climate change will affect the intensity, spatial and temporal variability of the rainfall, surface and groundwater availability for irrigation, evaporation rates and temperature in different agro-climatic regions, soil transformations, crop-pest interactions, etc. and taking necessary steps.

Water management remains an overarching priority both for current and future agricultural development. Thus there is an overwhelming case for aggressively pursuing water conservation in semi-arid and arid regions. Greater attention must be given to hybrid approaches and emphasize the efficiency of groundwater use and increase the effectiveness of watershed activities to conserve soil moisture and harvest water.

## Extreme Temperature

Experts have unanimously agreed that there is likely to be substantial increase in extreme maximum and minimum temperatures all over the country due to increase in greenhouse gas concentrations. This is very important finding from the point of view of agriculture as the mid-day temperature increase increases the saturation deficit of the plants. It

accelerates photosynthesis and ripening of fruits. "When high temperature occurs in impacts of climate changes would be small on *kharif* crops but overall *kharif* agriculture will become more vulnerable due to increased incidence of weather extremes such as onset of monsoon, duration and frequency of droughts and floods and pest incidence and virulence". Moreover *rabi* is relatively "more risky" due to possibilities of large increase in temperature and higher uncertainties in rainfall.

Available scientific studies have found that climate change will have an overall impact on agriculture though the situation may not be out of control till 2050. Food production may not be threatened by that year at least in our country if proper strategies and corrective measures are taken. It is thus quite appropriate that though the ICAR does not find an immediate threat, in the coming decades increasing production may definitely pose a problem, more so because of the increase in population levels.

A climate-resilient agriculture is urgently needed at this juncture to achieve the objectives of maximizing farm productivity and production

during a normal monsoon period and minimizing the adverse impact of unfavourable weather, as witnessed in 2009. The components of the new strategy would be to:

- (i) to improve soil health and help farmers to benefit from the nutrient-based subsidy regime introduced from April, 2010;
- (ii) maximize the benefits of all available water sources – rain, ground, river and sea water – and ensure its optimum use;
- (iii) undertake research on monsoon management and water use of crops while also ensuring that dryland agriculture is practised in water-deficient areas;
- (iv) spread technologies regarding appropriate use of seeds in the 128 agro-climatic regions of the country; and
- (v) ensure that the benefits of research undertaken at ICAR and the agricultural universities are translated into the field for better results.

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## ENVIRONMENTAL PROTECTION: IMPORTANT TIPS FOR THE DEVELOPMENT OF AGROFORESTRY

R.S. Sengar and Reshu Chaudhary

*Agroforestry, which is a form of multiple land use system, Different workers at various places have reported the beneficial effect of agroforestry. Most of the findings were in favour of this system with increased productivity and improved soil conditions*

**T**rees and forests were always considered as an integral part of the Indian culture. Planting of trees was regarded as a noble act during the ancient times. Now, due to increasing population and huge gap between demand and supply, forests have been ruthlessly exploited to meet the increasing demand of fuel, fodder and timber. Hence, in the light of ever increasing demand, concept of multiple use of land with multipurpose tree species has become immensely

important. In this context. Agroforestry is an integrated approach of using the interactive benefits from combining trees and shrubs with crops and/or livestock. It combines agricultural and forestry technologies to create more diverse, productive, profitable, healthy and sustainable land-use systems.

Agroforestry is basically a land management system but in recent years its importance has been strongly felt for two main reasons. Firstly,



there is a heavy pressure on agricultural land due to urbanization and secondly, due to resource crunch agriculture is becoming un-profitable. Agroforestry is a blend of agriculture and forestry. Agriculture means crops and forestry means trees. Normally, it is a domain of agriculture where in crops the area is 80% or more and in trees it is 20% or less. Through trees occupy very little area in the Agroforestry system but play the dominant role. The success of agroforestry vis-à-vis farmers accepting the technology will only be possible if the agricultural production is not affected to a greater extent in the association with the tree component. In our country, greater emphasis is being given to agroforestry but still it has not reached to the farmer as it should be, whereas in China it has developed like an industry and

the most popular agroforestry is the ‘paulownia based agroforestry system’. Similarly, to some extent ‘popular based agroforestry’ in Punjab, Haryana and western Uttar Pradesh has build up the confidence among the farming community.

### Important Agroforestry Systems

1. Agri-silviculture (crops + trees) including alley cropping
2. Agri-horticulture (crops + fruit trees)
3. Silvi-pasture (pastures + trees)  
Horti-pasture (pastures + fruit trees)

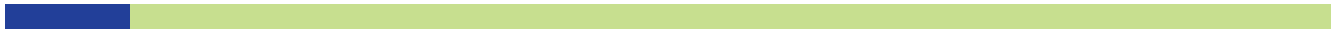
Prominent agroforestry systems in different agro-climate regions on India are mentioned in Table 1.

**Table 1. Prominent agroforestry systems for various agro-climatic zones**

Agro-climatic zones	Agroforestry systems					
	Agri-silviculture	Agrihorti-silviculture	Agri-horticulture	Horti-pastoral	Silvi-pastoral	Specialized
Western Himalayan region	4	4	5	4	4	
Eastern Himalayan region	3	3	5	4	3	5 jhum
Lower Gangetic plains	5		3	2	2	Energy
Middle Gangetic plains	4		2			Homestead
Upper Gangetic plains	5		5			Agri-horti-silviculture
Trans-Gangetic plains	5		5			Agri-horti-silviculture
Eastern plateau and hills	5		4	3	4	Block plantation
Central plateau and hills	4		5	4	4	Block plantation
Western plateau and hills	4		5	2	4	
Southern plateau and hills	5		3	2	4	
East-coast plains ghat	4	5	4	2	2	Home garden/ Shelter belt
West-coast plains ghat	4	5	4	2	2	Home garden
Gujarat plains and hills	4	2	4	3	5	Block plantation
Western dry region	5	3	4		5	Shelter belt
Islands region	4	5	4	1	2	Home garden

Nos1-5 indicate th priority practised model; 1, least; 5, highest  
Source; Vision 2000. ICAR, New Delhi.

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Minist

“We must hold fast to constitutional methods of achieving our social and economic objectives”

**Babasaheb Dr. B.R. Ambedkar**  
in the Constituent Assembly on 25<sup>th</sup> November 1949

14<sup>th</sup> April  
Birth Anniversary



Ministry of Information and Broadcasting

Government of India

Ministry of Social Justice and Empowerment

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The sustainability of agroforestry systems in different environments depends on several factors. The important ones are environment of the area, site characters, plant species and cultivars, cropping patterns and management system practiced by the farmers. In agroforestry systems there are both ecological and economic interaction amongst the different components.

## Impacts

Agroforestry systems can be advantageous over conventional agricultural and forest production methods through increased productivity, economic benefits, social outcomes and the ecological goods and services provided. Biodiversity in agroforestry systems is typically higher than in conventional agricultural systems. Agroforestry incorporates at least several plant species into a given land area and creates a more complex habitat that can support a wider variety of birds, insects, and other animals. Agroforestry also has the potential to help reduce climate change since trees take up and store carbon at a faster rate than crops.

Agroforestry tree species of research interest in the tropics, particularly in relation to improving maize yields in sub-Saharan Africa, include the nitrogen fixing species *Sesbania sesban*, *Tephrosia vogelii*, *Gliricidia sepium* and *Faidherbia albida*. For example, a ten year experiment in Malawi showed that by using fertilizer trees such as *Tephrosia vogelii* and *Gliricidia sepium*, maize yields averaged 3.7 tonnes per hectare, compared to 1 tonne per hectare in plots without fertilizer trees or mineral fertilizer. Research with *Faidherbia albida* in Zambia over several years showed that mature trees can sustain maize yields of 4.1 tonnes per hectare compared to 1.3 tonnes per hectare beyond the canopy of the tree. Unlike other trees, *Faidherbia* sheds its nitrogen-rich leaves during the rainy crop growing season so it does not compete with the crop for light, nutrients and water. The leaves then regrow during the dry season and provide land cover and shade for crops.

Potential impacts of agroforestry can include:

- Reducing poverty through increased production of agroforestry products for home consumption and sale
- Contributing to food security by restoring farm soil fertility for food crops and production of fruits, nuts and edible oils
- Reducing deforestation and pressure on woodlands by providing fuelwood grown on farms
- Increasing diversity of on-farm tree crops and tree cover to buffer farmers against the effects of global climate change
- Improving nutrition to lessen the impacts of hunger and chronic illness associated with HIV/AIDS
- Augmenting accessibility to medicinal trees, the main source of medication for 80% of Africa's population

The tangible and intangible benefits of agroforestry as suggested in the leaflet are mentioned below:

- To meet the demand of fuel, fodder and timber for the increasing population.
- To reduce the biotic pressure on existing forests.
- To obtain maximum output in terms of yield from the same piece of land.
- To develop wasteland/ degraded lands by planting suitable tree species with agricultural crops.
- To reduce the environmental pollution by planting tree species.
- To reduce soil erosion.
- To increase the soil fertility by planting nitrogen fixing tree species.
- To create availability of raw material for wood based industries.
- To create opportunity of employment to local people and to increase the return in terms of money by increased crop production.

## Role of Agroforestry Systems

Basically in all agroforestry systems there are two common roles:

**Productive roles:** In a given agroforestry system there are two or more productions like food, fodder, fuel, fibre, fertilizer and fruit, etc. Commonly agroforestry system is known for 'five Fs'.

**Service roles:** Agroforestry systems were mainly borne for its service roles. The major ones being soil and moisture conservation, fertility improvement, water and wind erosion control, extending shade and shelter, etc.

## Multi-purpose tree Species

The multi-purpose tree species (MPTs) are those that can produce two or more than two products at a time. For the success of an agroforestry system following points need most consideration:

**Selection of trees:** Right choice of tree with all precautions is necessary as it is a perennial component and initial mistake done will be difficult to be rectified at a later stage. The tree should be eco-friendly (at no stage cause any damage to the environment). It should not compare for the natural resources with the associated dominated component. Other criteria are that it should have a deep-rooted system, plant canopy should not be dense, should grow straight, have less branching and should be fast in growth. The major trees fall in this category are anjan, acacia's, casuriana, siris, neem, etc.

**Management of trees:** Once a species is identified, it is essential to manage the tree. It is essential to decide their number and their mode of arrangement (row direction, spacing etc.). The next step is to know how to plant the tree either by seed, sapling or by cuttings. As the tree is the perennial component, initial steps taken will ultimately decide the success of the system. For raising trees we must decide the size of the pit,

application of good soil and FYM mixture along e=with fertilizers and pesticides. Once the trees are established the next step is to manipulate the tree canopy from time to time (as and when the need is felt) to such an extent that the tree growth is not affected as well as the inner-sown crop gets all the benefits like light, etc. Even if it is felt at a later stage that the tree density can be reduced (this will also generate extra resources).

Thus, to manage trees in agroforestry systems, farmers should have an idea about:

- i) The choice of species and provenance, to get desired produce,
- ii) Proper manipulation of canopy and stands in order to facilitate maximum penetration of sun-rays,
- iii) Nutrient cycling,
- iv) Suitable harvesting methods which permit trees to regenerate through sprouting, and
- v) Protection before and after harvesting.

**Nitrogen-fixing tree species:** Among the MPTs it is always desirable to restrict our choice to nitrogen-fixing tree species (NFTs). Where soils are low in their fertility levels raising any exhaustive tree species will cause extensive damages, e.g. planting tree species like *Eucalyptus*. There are numerous choice for the selection of an ideal NFT for the success of the agroforestry system. The important ones are anjan, acacia, shisham, siris, casuriana, leucaena, khejri etc. Further, inclusion of a NFT in the system is an advantageous proposition in view of the fact that whatever nitrogen fixed by NFTs besides building the soil fertility can also be utilized by the associated crop, and 'N economy' can be done. The NFTs foliage is also a rich source of protein.

## Agroforestry systems as carbon sinks

Land-management actions that enhance the uptake of CO<sub>2</sub> or reduce its emissions have the potential to remove a significant amount

of CO<sub>2</sub> from the atmosphere if the trees are harvested, accompanied by regeneration of the area, and sequestered carbon is locked through non-destructive (non-CO<sub>2</sub> emitting) use of such wood. Carbon management through afforestation and reforestation in degraded natural forests is an useful option, but agroforestry is attractive because: (i) it sequesters carbon in vegetation and possibly in soils depending on the preconversion soil C; (ii) the more intensive use of land for agricultural production reduces the need for slash-and burn or shifting cultivation, which contributes to deforestation; (iii) the wood products produced under agroforestry serve as a substitute for similar products unsustainably harvested from the natural forest and (iv) to the extent that agroforestry increases the income of farmers, it reduces the incentive for further extraction from the natural forest for income augmentation. Evidence is now emerging that agroforestry systems are promising management practices to increase aboveground and soil C stocks to mitigate greenhouse gas emissions.

**Carbon management through afforestation and reforestation in degraded natural forests is an useful option,**

the path to sustainable development could be a decentralized planning and implementation of strategies that promote local biomass production in agroforestry systems. Such decentralized systems in India can provide critical inputs for livelihood improvement and sustainable development. Along with mitigating the climate change, agroforestry systems can at least partially meet the energy needs of one billion people in India through bioenergy options, by a prudent use of agricultural residues and biomass generated in agroforestry systems. Biomass energy based supply options can create rural wealth and employment necessary for livelihood improvement and sequester large amount of carbon in a decentralized manner. Such a strategy would also ensure ecological, economic and social well-being. Thus, an energy and food self-sufficient taluka (a small administrative unit) can be a new model of rural development in India. Although agroforestry options for carbon sequestration are attractive, they present critical challenges for carbon and cost accounting due to dispersed nature of farmlands and dependence of people on the multiple benefits from agroforestry. Additionally, important concerns regarding monitoring, verification, leakage and the establishment of

### Future strategy

Although numerous issues are involved with livelihood improvement, agroforestry systems are one option with multifunctional value. In India and other developing countries,



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**Table 2. Regional examples of soil-fertility enhancement in multifunctional agroforestry systems in India**

Region	Challenge	Changes observed due to agroforestry
Himalayas (Kuruksheetra)	Improvement of sodic soils	Increase in microbial biomass, tree biomass and soil carbon; enhanced nitrogen availability
Himalayas	Restoration of abandoned agricultural sites	Biomass accumulation (3.9 t ha <sup>-1</sup> in agroforests compared to 1.1 t ha <sup>-1</sup> in degraded forests); improvement in soil physico-chemical characteristics; carbon sequestration
Western Himalayas	Reducing soil and water loss in agroecosystems in steep slopes	Contour tree-rows (hedgerows), reduced run-off and soil loss by 40 and 48% respectively (in comparison to 347 mm run-off, 39 Mg ha <sup>-1</sup> soil loss per year under 1000 mm rainfall conditions)
Sikkim Himalaya	Enhancing litter production and soil nutrient dynamics	Nitrogen-fixing trees increase N and P cycling through increased production of litter and influence greater release of N and P; nitrogen-fixing species help in maintenance of soil organic matter, with higher N mineralization rates in agroforestry systems
Indo-Gangetic Plains (UP)	Biomass production and nutrient dynamics in nutrient-deficient and toxic soils	Biomass production (49 t ha <sup>-1</sup> /decade)
Himalayas (Meghalaya)	Enhancing tree survival and crop yield	Crop yield did not decrease in proximity to <i>Albizia</i> trees
Western India (Karnal)	Improvement of soil fertility of moderately alkaline soils	Microbial biomass C which was low in rice–berseem crop (96.14 gg <sup>-1</sup> soil) increased in soils under tree plantation (109.12 gg <sup>-1</sup> soil); soil carbon increased by 11–52% due to integration of trees and crops
Western India (Rajasthan)	Compatibility of trees and crops	Density of 417 trees per ha was found ideal for cropping with pulses
Central India (Raipur)	Biomass production in N and P-stressed soils	<i>Azadirachta indica</i> trees were found to produce biomass in depleted soils
Central India	Soil improvement	Decline in proportion of soil sand particles; increase in soil organic C, N, P and mineral N
Southern India (Hyderabad)	Optimality of fertilizer use	
Southern India (Kerala)	Growing commercial crops and trees	Ginger in interspaces of <i>Ailanthus triphysa</i> (2500 trees ha <sup>-1</sup> ) helps in getting better rhizome development of the former compared to solo cropping

credible baselines also need to be addressed. Another challenge is the incentives that promote tree growing by rural people. Not everyone is willing to adopt agroforestry. We shall need effective communication strategy to extend innovations among people to adopt and maintain agroforestry to supply fuelwood and other products. The likelihood of adoption depends

on the availability of lands, progressive attitude of farmers, supportive village institutions, their wealth status and their perceived risk concerning agricultural production.

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# 'ENVIRONMENTAL CHALLENGES & ISSUES OF INDIAN AGRICULTURE'

Shivkumar L. Biradar

*There would be adverse impacts on yield and productivity of wheat and rice. 15-17 % decrease in the yields of wheat and rice for a 2°C rise in temperature. Wheat, which is generally grown in the winter, is predicted to be affected more than rice.*

Agriculture provides significant support for economic growth and social transformation of the country. As one of the world's largest agrarian economies, agriculture plays a crucial role in ensuring food security while also accounting for a significant share of India's Gross Domestic Product (GDP). It engages almost two-thirds of the workforce in gainful employment. Several industries such as sugar, textiles, jute, food and milk processing etc. depend on agricultural production for their requirement of raw materials. On account of its close linkages with other economic sectors, agricultural growth has a multiplier effect on the entire economy. In order to sustain agricultural growth for meeting food requirements of growing population, policies

and strategies need re-orientation with appropriate response mechanisms to meet not only food grain and buffer stock requirements, but also, to ensure livelihood security in times of calamitous incidents both natural and human driven.

## Deceleration in Agricultural Growth:

The share of agriculture in Gross State Domestic Product (GSDP) has declined significantly during the last two decades. The agriculture sector in India accounted for 17.57 percent of the GDP (at constant 2004-05 prices) in 2010-11 compared to 18.9 percent in 2004-05. Likewise agriculture sector witnessed a growth of 2.1 percent during the Tenth Plan. The sector registered a growth of 5.8 percent in 2005-



06, 4.0 percent in 2006-07 and 4.5 percent in 2007-08. However, there was a slowdown in agriculture growth in 2008-09 to 1.6 percent. Plan-wise growth rate of GDP and Agri. GDP is given in table 01.

<b>Table No. 01</b> <b>Plan-wise Growth Rate of GDP &amp; Agri. GDP</b> (at 1993-94 prices)			
<b>Sr. No.</b>	<b>Period</b>	<b>Compound Growth Rate (% per annum)</b>	
		<b>GDP</b>	<b>Agri. GDP</b>
1	Fifth Plan (1974-79)	4.8	3.4
2	Sixth Plan (1980-85)	5.6	5.6
3	Seventh Plan (1985-90)	5.9	3.0
4	Two Annual Plans (1990-92)	3.4	1.2
5	Eighth Plan (1992-97)	7.0	4.7
6	Ninth Plan (1997-2002)	5.5	2.0
7	Tenth Plan (2002-2007)	7.6	2.1

## **Environmental Challenges for Indian Agriculture: Issues and Implications**

The challenges for Indian agriculture are, to increase production, while minimizing environmental impact. This includes conserving and protecting the quality of the resources that determine the performance of agriculture like land, water and air. Reductions in yield, although determined by many factors, may be partially a consequence of land and water exploitation. Below are the observations based on limited information available on land degradation and the relationship between quality and productivity of soil.

### **a) Degradation of Land:**

It is observed that land degradation is more or less a universal phenomenon spread across all the states. By the early 1980s approximately 53 percent of India's geographical area had been considered degraded. Water logging affected about 6 percent of the cultivated area, while alkali and acidic soils both affected about 3 percent. The major process of land degradation is soil erosion contributing to over 71 percent of the land degradation. One third of this

land was degraded by human activities, while nearly one half was degraded by a combination of human and natural causes. Recent research found a negative and significant negative relationship between land degradation and food grain productivity in both the 1980s and 1990s.

### **(b) Depletion of Ground water:**

Water is another major constraint for Indian agriculture. During the green revolution period water consumption in agriculture has risen sharply as the net irrigated area increased from 31.1 to 54.68 million hectares between 1970-71 and 2000-01, while the area under irrigation increased from 7.09 million to 20.46 million hectares during the same period. Groundwater, one of the India's major sources for irrigation, is being rapidly depleted. The problem of groundwater depletion has been reported from rainfed states like Andhra Pradesh, Karnataka, Rajasthan, Madhya Pradesh, Chattisgarh and Gujarat.

### **(c) Imbalanced Use of Chemical Fertilizer:**

The use of chemical fertilizers is concentrated in the two major crops namely; rice and wheat, together they constitute nearly two third of the total chemical fertilizers use in the country. Similarly, the use is concentrated in states like Punjab, Haryana, Andhra Pradesh and Tamil Nadu, where the rate of NPK use has already gone beyond 100 kgs. per hectare. Fertilizer application rose more than five-fold between 1970 and 2002. Imbalanced proportioning of chemical nutrients is a major problem associated with fertilizer application in India. It has been observed that heavy use of NPK has negative impact on environment.

### **(d) Quality of Pesticides Used:**

Pesticide consumption increased from 24.32 million tonnes in 1970-71 to 46.2 million tonnes in 1999-00. It may be noted that about half of the pesticides registered with the Indian Pesticides Registration Committee are banned. Of course, this does not mean that all the banned products have the same effect on Indian soils. However, India accounts for one third of the cases filed with WTO on pesticide poisoning. Evidence suggests the need for proper planning in order to promote and regulate pesticides use in the country. This finding has been supported

by the fact that the farmers have only limited awareness of the hazardous effects of pesticides and at the same time have little information on the environment-friendly alternatives.

### **(e) Impact of Climate Change on Indian Agriculture:**

Climate change refers to the statistical variations in the properties of the climate system such as changes in global temperatures due to natural or human drivers over a long period of time. Climate change could drastically alter the distribution and quality of natural resources thereby adversely affecting the livelihood security of the people. Some of the major impacts are discussed below.

#### **Impact on Crops:**

There would be adverse impacts on yield and productivity of wheat and rice. 15-17 % decrease in the yields of wheat and rice for a 2°C rise in temperature. Wheat, which is generally grown in the winter, is predicted to be affected more than rice. In wheat, grain number and weight is reduced due to prolonged high temperatures and drought conditions. Climate change is also likely to have significant effect on the quality of plantation and cash crops such as cotton, fruits, vegetables, tea, coffee, aromatic & medicinal plants, etc.

#### **Impact on Soil and Water Resources:**

Availability and quality of both surface and ground water would have effect on quality and quantity of grain. Reduction in ground water recharge will affect irrigation potentials. Possibilities of salination of land due to sea water ingress and salt accumulation result in to degradation of soil quality and moisture content.

#### **Impact on Insects and Diseases:**

Insects have very high degree of adaptability to climate change. Change in climate is likely to bring about a change in the population dynamics, growth and distribution of insects and pests thereby, upsetting crop-pest balance. These changes could lead to enormous crop losses in altered environment. Climate change would decrease plant defense mechanism and creates more favourable environment for pests and insects.

#### **Impact on Livestock and Fisheries:**

Impacts of climate change on livestock will be felt in the form of elevated body temperatures, increased respiration rates, decrease in feed intake, etc. Indirect impacts would be observed in the form of reduction in grazing land and water availability, decline in available cattle feed, emergence of new diseases, etc. Thermal or heat stress would impact animal production and profitability in dairying due to lower feed intake, milk production and reproduction.

#### **Impact on Livelihoods, Food Security and Economy:**

The impact of climate change on agriculture has large detrimental effects on availability of food, livelihoods and the overall economy. Lack of sufficient income to purchase food is a major factor contributing to food insecurity; hunger itself contributes to poverty by lowering labor productivity, reducing resistance to disease and depressing educational achievements.

#### **Key risks to Indian agriculture from climate change:**

The agriculture and allied sector in India is exposed to potential risks arising from climate variability and climate change which are expected to exacerbate the stress on Indian agriculture. Major risks are such as, decline in yields, increased farm expenditure, reduced farm incomes and increased threat of food insecurity and malnutrition. Significant negative impacts are being projected in the medium-term (2010-2039) such as reduction of agriculture yields up to 4.5 - 9%, fall in GDP growth up to 2% per annum and reduction of agriculture yield in long term.

Indian agriculture has major challenges to ensure food security for growing population, which is estimated 310 million tonnes of food grains in 2050, stagnation of net-sown area. As a result, agricultural productivity has been witnessing stagnation in recent years.

#### **Policy Measures to Sustainable Agriculture Development:**

Fostering rapid, sustainable and broad-based growth in agriculture is a key priority keeping in mind the overall socio-economic development path

of the country, especially in the light of existing vulnerabilities that relate to a shrinking land resource base, and issues emerging due to climate change. To overcome this problem we need strategic approaches which balance environmental health and economic profitability in agriculture to promote social and economic equity.

Sustainable Agriculture is a special kind of agriculture along with farming technique which makes maximum utilization of the environment without causing any form of harm to it. The outputs from this Sustainable Agriculture are devoid of any types of inorganic chemicals such as pesticides and insecticides. This farming technique uses the organic way of farming through the conservation of natural resources and maintenance of ecosystem functions. All these factors produce the products in a more environment friendly manner and are thus healthier for the consumers to consume. Following are the initiatives taken by the government.

### **Improved Crop Seeds, Livestock and Fish Culture**

Biotechnology is an important tool for the development of genetic resources with greater adaptive capacity to cope with changing environments. It has huge potential for combating vulnerabilities in crops, livestock and fisheries. The rich indigenous genetic resources in the crops, livestock and fisheries sectors should be conserved, catalogued and advantageously used while also conserving the agricultural heritage of the country. Relevant technologies should be used for rapid bulking of improved varieties of crops, livestock and fishes. Public private partnerships should be promoted in development, management and dissemination of the improved varieties.

### **Water Efficiency:**

Two-thirds of the cultivated land in India is rainfed and suffers from water scarcity. Effective management of available water, increasing water use efficiency and establishment of additional sustainable sources of water emerge as the primary issues that need to be addressed. Strategies and technologies under this dimension must be coupled with demand and supply side management

solutions to enhance water use efficiency for irrigation. The role of local institutions in managing water allocation and utilization will also be crucial for promoting efficiency. Policy instruments will have to be leveraged to encourage adoption of technologies for enhancing water use efficiency and to promote public-private partnerships.

### ***Pest Management:***

Pesticide consumption in India has increased over time and its injudicious use has created problems like development of resistant strains in insects and plant pathogens, resurgence of pest species, direct exposure to the applicator. Pesticide residues in feed and water affect livestock health due to direct and indirect exposure in the course of pest control measures. Strategies suggested under this intervention have to primarily focus on establishment of decision and information support systems for pest and disease surveillance, demonstration of best practices and quick response mechanism that are at par with the norms to deal with other disasters or natural calamities.

### ***Improved Farm Practices:***

The most effective way to address climate change is to adopt a sustainable development pathway by shifting to environmentally sustainable technologies and adaptation of energy efficient equipments, renewable energy, and conservation of natural resources. Improved agronomic practices have the potential to help reduce farm level losses through improved soil treatment, increased water use efficiency, judicious use of chemicals.

### ***Nutrient Management:***

Plant nutrient management to increase soil nutrients and thus enhance crop productivity, it is a major technological challenge for ensuring food security and sustaining rural development. Soil health can be improved through several site and soil-specific management options. Application of integrated nutrient management techniques has been found to increase nutrient use efficiency by integrating and balancing the nutrient dose in relation to nutrient status and crop requirement.

### ***Agricultural Insurance:***

Agricultural insurance is an important mechanism by which risks to agricultural output and income can be addressed. Crop insurance incentivizes farmers to adopt innovative options by spreading the risks over space and time. Deficiencies in the existing framework of assessment of crop damage and prompt settlement of claims need to be addressed so that a disaster mode of operational efficiency is institutionalized. Research and development activities for developing new insurance products in the light of new risks emerging from climate change also need to be taken up. An effective design and efficient implementation mechanism is required to ensure timely benefits especially to the small and marginalized farmers.

### ***Credit Support:***

Adequate, untied and timely credit support to farmers is essential for sustaining farm productivity, especially when it comes to small and marginal farmers. Easy and timely financial support provided to farmers can help in adoption of improved management practices including resource conservation technologies, diversification, and post harvest value addition processes etc. which would contribute to reducing risks and enhancing farm incomes. Facilitating providing financial support through input dealers, NGOs, Self Help Groups (SHGs) etc. would help in providing access to credit to the needy, small and marginalized farmers, which facilitate them to manage the additional risks arising from climate change in a sustainable manner.

### ***Markets:***

Inadequate marketing infrastructure, presence of large number of intermediaries, lack of market information and inadequate storage facilities results in huge post harvest losses in the food supply chain. Some of the major initiatives need to be taken up under this head such as; creating market aligned production systems; strengthening post harvest management, storage, marketing and distribution system; strengthening timely access to farmers to quality inputs; strong farmer institution-industry interface and encouraging food processing industries and greater exports.

### ***Access to Information:***

Effective communication approaches are

very important for farmers to adapt with market fluctuation or climate change. Fresh strategies for management of information may be required to sustain production levels. At the level of the farm, focus needs to be on enhancing awareness of farmers as well as the developmental agencies with the latest scientific research, market information, and policy initiatives so that they are empowered to take informed decisions for maximizing farm productivity.

### ***Livelihood Diversification:***

Livelihood diversification plays a major role in providing options of supplementing income from core agricultural activities through on-farm or off-farm activities by providing additional support to agricultural income under conditions of climatic and non-climatic stresses. The strategies under this dimension would aim to promote diversification of agriculture into other high value crops and horticulture; research, development and extension of crop-livestock farming systems; agro-forestry, crop-fish farming, etc.

### ***Conclusion:***

The Journey of Indian agriculture and its associated environmental problems has brought about recognition that future agricultural growth and productivity will have to occur simultaneously with environmental sustainability. The environmental challenges, especially in terms of land degradation and groundwater depletion, water logging and excessive use of chemical inputs are posing problems for the future of Indian agriculture. To address the problems, policies have laid emphasis on promoting sustainable agriculture including organic farming. The National Mission for Sustainable Agriculture seeks to transform agriculture into an ecologically sustainable production system while at the same time, exploiting its fullest potential and thereby ensuring food security, equitable access to food resources, enhancing livelihood opportunities and contributing to economic stability at the national level.

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## COMMUNITY EFFORTS TO SAVE FORESTS

Naushad Alam Dumka, Jharkhand

**G**arurpidi Village, barely 35 km from the capital city of Ranchi in Jharkhand State, is too small to count. That it does not appear on an internet search is proof enough in today's technology driven world. This 'backward' village, located in Namkum Block of Ranchi District, is as nondescript as any of India's 6.4 lakh villages. What sets it apart is it's people's silently successful effort to keep alive the tradition of protecting its forests. The Munda tribe, known for their excellent hunting skills, lives here, surrounded by lush green forests; forests that are the basis of their life, livelihood and inspiration. Their ethos is simple: The forest is our mother. We live by her affection, without which life cannot sustain.

The hamlet of Garurpidi houses nearly two hundred tribes of the Munda community. There is a clear absence of the basic essentials like electricity, roads and health services in the village yet this

diffident community has nothing to complain about. Accepting the exclusion from the development as their destiny, this community continues to believe in their inherited wisdom.

Walking in the footsteps of their ancestors, the Munda tribe simply took over the onus of protecting and conserving their forests. From shepherd to Pahan (the religious head), every single individual in the community, irrespective of community status, bears the responsibility of protecting the natural assets. An interesting and surprising contribution comes from the womenfolk who, otherwise, do not enjoy much freedom in the community.

The thumb rule to protect and conserve the forest is the "security by the community". Three teams with ten boys each have been constituted as a part of the effort. Specific tasks have been assigned to them, for instance, every team will guard the



forest for four hours each during different times of the day. The role of shepherds is crucial: while grazing the livestock, they safeguard the forest.

There are few but strict rules and regulations laid down by the villagers themselves which are dutifully followed by members of the community. The leading one is that no one will axe down a young and fruitful tree. For fuel, only dry leaves and wood will be used. There is a strict prohibition on the exchange of jungle wood for monetary compensation. How much wood is required in each house is also decided in community gatherings and then distributed accordingly. The forest is never subjected to the high-handedness of any particular individual.

According to Etwā Munda, a freelance journalist, "Villagers have had this inclination towards the security of the forest, the only source of their sustenance, since time immemorial. Like the other forests in the state, the natural wealth of Garurpidi was also at threat from the mafia which couldn't penetrate the defence layer of the villagers who stood united against the selfish marauders. This is the only reason for the hitherto surviving and flourishing valuable trees in the region." For sustenance, villagers trim the forests once a year. This helps the trees grow faster and healthier. This they do without any help from the forest department which, like roads and electricity, is effectively missing from the picture.

Curiously, the forest officers have held back from joining hands with the community in what is essentially their professional mandate. The presence of Naxals in the region is many a times seen as a reason for their passivity. No programme has been initiated by the officials so far for the conservation of the forests. The other issue raised by the community many a times before the forest

officials is the allowance of the land to the people residing in or near the forest under the Forest Rights Act. According to Purnendra Munda, an active member of the community, "The forest officials are avoiding offering the land to the beneficiaries. They are continuously misdirecting us in the official procedures under the Forest Rights Act by misleading us, telling us that officials will complete this task only when they will come to the village." Seeing the current relationship of the officials with the Naxal infested village, we are guessing our wait for them will be quite long."

Despite all the hopelessness around them the villagers are incessantly working for the betterment of the forest. The reason for their deep understanding and relationship with the woods is their ancient involvement with nature. In ancient times, the Munda tribes were the traditional wood cutters who later shifted to agriculture for their livelihood. Today, in the absence of irrigation sources, their sole source of water supply remains the natural rains. That is the reason they deeply understand the significance of the forests for their very survival.

Budhram Munda, a local, maintains that the destruction of the forest will lead to the destruction of the community.

Today, when issues like global warming and deforestation are looming larger over the rest of the world, the Munda tribes are holding up the flag of Community Forest Management in their backward region. Their affection and dedication is showing the world a fresh way of looking at our natural resources. Sustainable growth can be ensured only after getting rid of man's characteristic greed and giving back to nature what she offers us – her fondest affection.

*(Charkha Features)*

**There are few but strict rules and regulations laid down by the villagers themselves which are dutifully followed by members of the community. The leading one is that no one will axe down a young and fruitful tree.**

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# MGNREGS: A TOOL FOR SUSTAINABLE ENVIRONMENT

Dr. S.M. Jawed Akhtar

*An ecological act is one of the best features of the MGNREGA as it designates a balance between human action and natural resources creating a sustainable economic security through green jobs. The MGNREGS must be strengthened and revamped to provide not just wages for work done but work that will make ecological regeneration possible.*

The global economic and ecological crises can be seen as an opportunity to fundamentally question our paths of 'development', and move towards ideologies, policies, and practices of ecological sustainability and social equity. India in its current globalizing form, presents a vivid picture of unsustainability. Just as there is increasing concern that the current path of globalization is yielding too few decent jobs, so is there concern that we cannot continue with growth at the expense of environmental quality. We are therefore in a period of transition searching for the policies and the leadership that can take us into a sustainable

development path where social and environmental dimensions of globalization are an integral part of economic policy-making. Transitions in employment structures and in workplaces are central to this process. Environmental degradation is one of the most serious threats facing economic and broader sustainable development. All these environmental and ecological perspectives are taken into account in Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS). This paper attempts to examine and assess the environmental implications of the activities implemented under the MGNREGS.



## MGNREGA: An Ecological Act

MGNREGA provides for the enhancement of livelihood security of the households in rural areas of the country by providing at least one hundred days of guaranteed wage employment in every financial year to every household whose adult members volunteer to do unskilled manual work with the auxiliary objective being: Generating productive assets and protecting the environment. This Act designed to provide an ecological perspective to the implementation of the programmes under the MGNREGA in order to achieve long-term livelihood sustainability. The ecological perspective is needed to work for the improvement of the natural resource base and for sustaining the ecological systems on which large number of people depend for their livelihoods.

The ecological aspect is one of the best features of the MGNREGA as it designates a balance between human action and natural resources creating a sustainable economic security through green jobs. The MGNREGS must be strengthened and revamped to provide not just wages for work done but work that will make ecological regeneration possible. MGNREGA has also been able to contribute to ecological restoration through its design. **According to findings of a pilot study conducted by the Indian Institute of Science, Bangalore in Chitradurga district of Karnataka, there is an increase in groundwater level, increase in water percolation, and an improvement in soil fertility leading to improved land productivity. In addition to these findings, there has also been a reduction in water vulnerability and livelihood vulnerability in these areas. The study also indicates that MGNREGS has some in-built limitations such as only a focus on employment, activities not implemented according to a plan, spatially or time-wise, and disconnected and scattered implementation of activities to name a few.** But many of the MGNREGS activities still have the potential to provide environmental services, conserve and enhance natural resources (soil, water, and grass and forest resources). There is a need to identify such activities that improve soil, water, grass and forest resources, even without micro-plans or watershed plans. Investment in MGNREGA activities, given the scale and importance, should lead to

sustained flow of benefits such as employment, income, water supply, food and grass production. Research suggests that MGNREGS works need to be seen as contributing to sustainable development. The successful implementation of the MGNREGA indicates that the climate is conducive for a far-reaching, rights-based legislation to eliminate hunger and deprivation, sustainable environment and maintains of eco system.

## Activities

The activities under the MGNREGS are largely linked to water, soil and land, which are the key natural resources determining agricultural and livestock production. They can have a positive or negative influence on these natural resources, affecting their ability to provide environmental services. Environmental services include recharging groundwater, increasing rain water percolation, conserving water, increasing the area irrigated, reducing soil erosion, increasing soil fertility, conserving biodiversity, reclaiming degraded crop and grazing lands, enhancing the supply of leaf manure, fuel wood and non-wood forest produce, and carbon sequestration. The goal of MGNREGA activities includes conserving natural resources and enhancing environmental services to sustain food and livestock production, increasing the supply of fresh water for drinking, and increasing grass and forest product production. The benefits accruing from the activities implemented under the MGNREGA can be described as “services provided”. The Millennium Ecosystem Assessment (MEA, 2005) considers humans an integral component of the natural ecosystem unlike classical approaches, which differentiate humans as non-natural. The approach also addresses the sustainability of resources and livelihoods by considering human wellbeing a parallel theme to the functioning of the natural ecosystem.

Swaminathan. M.N (2009) described MGNREGA as the world’s largest ecological security and food security Act, which can successfully strengthen the ecological foundations for sustainable agriculture. By definition, food security involves every individual gaining physical, economic, social and environmental access to a balanced diet that includes the necessary macro- and micro-nutrients, safe drinking water, sanitation, environmental hygiene, primary healthcare and education so as to lead a healthy and

productive life. Food should originate from efficient and environmentally benign production technologies that conserve and enhance the natural resource base of crops, farm animals, forestry, inland and marine fisheries. With the initiation of MGNREGA, the minimum purchasing power for food security is being created in families living below the poverty line. Given the rising demand for foodgrains in future and irrigated areas having reached their plateau of productivity, development of rain-fed areas holds the key to future food security. But India's rain-fed areas have been in the throes of an agrarian and unemployment crisis. That is the reason why the Act gives importance to agriculture and irrigation. Additionally, to meet this huge employment demand, it advocates productive use of the forestry sector for livelihood generation. The Act attempts to unlock the potential of the rural poor to contribute to the reconstruction of their environment. To achieve this, it has laid emphasis on creation of productive assets in villages. Out of nine preferred areas of works under the MGNREGA, seven focuses on water and soil conservation. The attention of the scheme is on the following works in their order of priority:

- Water conservation and water harvesting
- Drought proofing (including afforestation and tree plantation)
- Irrigation canals (including micro and minor irrigation works)
- Provision of irrigation facility to land owned by households belonging to scheduled castes and scheduled tribes or to land of beneficiaries of land reforms or that of the beneficiaries under the Indira Awas Yojana of the Government of India.
- Renovation of traditional water bodies (including desilting of tanks)
- Land development
- Flood control and protection works (including drainage in water-logged areas)
- Rural connectivity to provide all-weather access

**Swaminathan. M.N (2009) described that MGNREGA as the world's largest ecological security and food security Act, which can successfully strengthen the ecological foundations for sustainable agriculture**

- Any other work, which may be notified by the Central government in consultation with the state government.

The priorities of the work to be undertaken include watershed management and water conservation, drought-proofing, flood protection, land development, minor irrigation and rural connectivity. Such work is important to strengthen the ecological foundations of sustainable agriculture. The MGNREGA is probably the world's largest ecological security programme. With the key provision that investments in an employment guarantee programme must be in productive, eco-friendly assets. This would ensure that the resultant growth dynamic is both sustainable (by regenerating the environment) and non-inflationary (by easing the agrarian constraint). Not only does demand need stimulation, growth has to be sustainable in both economic and ecological terms, especially in these times of climate change.

The purpose of the Act was to create rural assets, important among them being water and soil conservation

projects, especially minor irrigation works. The following table shows the various types of work undertaken through MGNREGS in the financial year 2011-12.

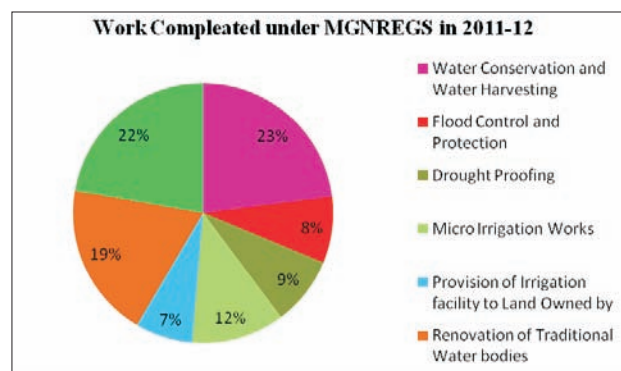
Focus on Work	2011-12
Water Conservation and Water Harvesting	204193
Flood Control and Protection	73063
Drought Proofing	75731
Micro Irrigation Works	102769
Provision of Irrigation facility to Land Owned by	63738
Renovation of Traditional Water bodies	170631
Land Development	197667

Source: www.nrega.nic.com

From the table 1 we can deduce that all the works mentioned ensure the sustainability of ecology. The maximum number of works completed focus on water conservation and water harvesting with number of 204193, followed by land development which is 197667 and Renovation of Traditional Water bodies 170631.

### Measures to Make MGNREGS more Ecological:

- MGNREGA should not only creation wage but also creation assets.
- Give importance to forestation under the MGNREGA by linking it to other forestry programmes.
- Conservation technologies — stress-tolerant, climate-resilient varieties of seeds, drip irrigation, zero-tillage, raised-bed planting, laser-levelling, Systems of Rice Intensification (SRI), can build adaptive capacities to cope with increasing water stress, providing “more crop per drop”.
- Strengthening land development practices such as land levelling, conservation bench terracing, contour and graded bunding, and pasture development prevent soil erosion and loss of organic matter. Reclamation of wastelands and degraded lands together with afforestation, horticulture plantation and agro-forestry have the potential to sequester carbon both above and below ground, thereby contributing to carbon mitigation.



Source: Table 1

- Creating green jobs through MGNREGS thus enabling ecological security.
- Augmenting water resources.
- Enabling planned convergence with programmes of water resources, afforestation, agricultural productivity.
- Adaptive towards the adverse effects of climate change.
- If the nature of work relates to natural resource management, they contribute to enhancing the productivity of soil, augment water tables, increase vegetal cover.

Labour intensive, green jobs are exemplar adaptation strategies for climate change. They combine economic advantages with environmental services.

### Conclusion:

The paper validates that assets created under MGNREGA have been useful and have contributed towards natural resource regeneration. Since MGNREGA is an ecological Act, it was suggested to set up a biological hedge that grows by the year and not degenerate like sea walls made of stone boulders. The Union Ministry of Rural Development has taken steps to achieve convergence of brain and brawn, by enlisting the support of Ministries and Departments. Such convergence of expertise for sustainable development will help to enhance farm productivity without causing ecological harm. There is also a need to raise the self-esteem of MGNREGA workers, making them feel proud of the fact that they are engaged in checking eco-destruction. Due recognition could be given to the MGNREGA groups that have done outstanding work in water harvesting, watershed development and soil healthcare with “Environment Saviour Awards”. This will help spread awareness of the critical role MGNREGA workers play.

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# PROSPECTS OF ORGANIC AQUACULTURE IN INDIA

Anulekshmi Chellapan, Bharat S. Sontakki and Laxman M. Ahire

*India is one of the richest in terms of shrimp and fish resources in the world and there is a huge demand for organic aqua products in European and American countries. All the big super markets, Coop (Switzerland) Aimare (Austria), and Bristall Bay (USA) are searching for organic product suppliers throughout the world.*

**D**iminishing fishery harvests, wild fish food-safety issues, environmental concerns, increased fish consumption and the increasing market share of organic foods have combined to focus attention on “organic aquaculture.” Consumer demand may well drive the organic production of finfish, shellfish and other aquatic species into the mainstream during the next decade.

## Problems of aquaculture today

1. The use of wild fish for farmed fish feed is a waste of protein resources because it takes about 3 ton of wild caught fish and other marine life to produce 1ton of carnivorous fish such as Salmon. This practice depletes fisheries of small wild oceanic fish.
2. Chemical and antibiotic usage, which is inherent to industrial aquaculture production and waste dispersal, pollute the surrounding marine environment.

Aquaculture in the country has faced setbacks in the last few years and organic aquaculture would be the right course for the industry at present. It is an attempt to mitigate the aforementioned problems with industrial aquaculture. This practice would entail raising aquatic food in a humane manner that is sustainable and doesn't pollute the environment. The United State Department of Agriculture (USDA) is working on drafting organic aquaculture standards. The specific standards the USDA chooses will determine whether or not organic aquaculture will become a viable alternative to environmentally degrading practices of industrial aquaculture. The Code of Conduct for Responsible Fisheries (CCRF), unanimously adopted in 1995, has been a key reference point for FAO members and beyond.

## Principles of organic aquaculture

- Absence of GMOs (genetically modified organisms) in stocks and feed prime material



- Limitation of stocking density
- Origin of vegetal feed and fertiliser from certified organic agriculture, no artificial feed ingredients
- No use of inorganic fertilisers
- No use of synthetic pesticides and herbicides
- Restriction on energy consumption (e.g. regarding aeration)
- Preference for natural medicines
- Intensive monitoring of environmental impact, protection of surrounding ecosystems and integration of natural plant communities in farm management
- Processing according to organic principles

### **Farmed Organic Fishery Products**

Black tiger shrimp:	India, Vietnam, Bangladesh
Vennami shrimp:	Ecuador, Peru
Freshwater shrimp:	USA, Bangladesh:
Tilapia:	China, Israel, Brazil, Honduras
<i>Pangasius</i> catfish:	Vietnam
Carps:	East and Southern Europe
Trout and sea bream:	Eastern, Western and Southern Europe: Europe
Cod:	Norway
Atlantic salmon:	U.K., Ireland, Chile
Mussels:	New Zealand

### **Organic Aquaculture in India**

India's farmers are still practicing organic methods, passed down for millennia. Organic fertilizer and natural pest control are the only tools available to most of these farmers, who have always lacked the financial resources to explore chemical solutions. But these farmers, whose produce is as organic as they come, cannot afford to pay the fees required to gain official certification. The Indian Central Government set up a **National Institute of Organic Farming** in October 2003 in **Madhya Pradesh**. The purpose of this institute is to formulate rules, regulations and certification of organic farm products in conformity with international standards. As the international community adopts standards for organic agriculture, the challenges faced by farmers in the USA versus farmers in India in order to adapt are very different indeed. The danger is that the well-intentioned global move towards organic standards will make small organic farmers in countries like India, who have been never done anything but organic farming, no longer able to sell their crops.

The world's first organic aquaculture harvest of the large fresh water prawn, scampi was made the backwaters of Kerala on November 1, 2007. This unique project is being implemented with the assistance of

the Marine Products Export Development Authority (MPEDA) in collaboration with the State Secretariat for Economic Affairs (SECO), Switzerland. Extensive use of chemicals and pesticides in conventional food production technology has been compelling health conscious people of developed countries to explore and support organic farming methods in agriculture and aquaculture. The Indian project for organic black tiger and scampi was initiated to pursue the huge market potential of selling aquaculture products in the European markets. **The Indian Organic Aquaculture Project was first initiated in January 2007** in the maritime States of **Andhra Pradesh** and **Kerala** with technical consultancy from M/s Blueyou. Certification is mandatory for selling organic products across the world and Naturland of Germany has been chosen as the certifying agency and Indocert in Kerala is the inspection body for the project.

India is one of the richest in terms of shrimp and fish resources in the world and there is a huge demand for organic aqua products in European and American countries. All the big super markets, Coop (Switzerland) Aimare (Austria), and Bristall Bay (USA) are searching for organic product suppliers throughout the world.

### **Research and Development**

Aquatic species, both animal and plant; ecological situations and locations; and various production systems, both marine and freshwater; are now under scrutiny in order to determine adaptability to organic production systems. Concern about the production and handling requirements that organic standards would impose and the overarching environmental impacts that organic systems attempt to address has pointed research and development efforts in some new directions. Current research activities with important implications for the organic aquaculture industry include: alternative feeds, especially protein sources from grain and oilseed plants; culture of low-trophic aquatic species; disease management and use of natural and alternative medicines; polyculture and multi-species systems; self-filtering systems; techniques for expanded recovery of fishery by-catch and waste for use in organic systems; implications of using closed containment systems; environmentally sound effluent management systems; and consumer studies related to food (preferences and purchasing habits).

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## **STATUS OF PARAJA WOMEN**

Snehalata Panda

**P**araja tribe is one of the primitive tribes dwelling in hills as well as in the periphery of towns in Koraput district of Odisha. It is divided into Sano Paraja and Bada Paraja. Both the categories have cultural and linguistic affinity, rudimentary political institutions like nayak (chief), chalan (messenger) and desari who has knowledge of herbal medicine and serves as the priest. The chiefs' position is hereditary that is the eldest male member of the family succeeds to the office. The focus of the paper is Paraja women of Tankuguda village in Randapalli panchayat of Jeypore block in Koraput district of Odisha.

### **Patriarchy and personal freedom:**

Paraja society is patriarchal. Women are economically independent and enjoy freedom in their personal lives particularly in selection of the husband and breaching marriage. But Social norms prescribe gender appropriate functions. Gender bias is rampant in division of labour, economy religion and superstitions. In fact, all types of labour is

important for their upkeep and sustenance of the family but men's labour is valued more than that of women. Men enjoy the monopoly of maintaining and utilising the ox drawn plough and they sow the seeds. Except this, women do all other agricultural work carrying the infants on their back. The plough has a significant place in an agrarian economy and so has the person using it. Usually physical labour of high intensity is done by men. Monotonous labour requiring more hours in a particular position and considered as light are done by women. This is in addition to their work at home like cleaning clothes and utensils in the pond or well, fetching water and firewood, looking after children and caring for the ailing family members. They do all types of "female appropriate labour" and share major responsibilities in the production process. Those with infants work in the field carrying the infant on their back. They are the principal contributors to the economy of the family and community. More women are visible in the market place vending and buying vegetables and forest products. Young women vendors with



infants have to care for the infant even in the market . Women are indebted to meet family expenses like food, clothes, medicine etc. They mortgage their meager belongings, which are not redeemed quite often. In many cases while the wife is anxious about the family and husband ,the husbands are indifferent to the requirements of the children and wife. Despite non dependence on the income of any member in the household women are subordinated in the male dominated culture.

Unmarried tribal women are free as individuals, in the family and also in their community. Girls are considered as an economic asset to the family as they contribute to the family economy till they are married . Marriage of girls fetches money for the parents from the groom . The amount is usually calculated on the basis of loss of income to the parents after their marriage .Girls are free to choose their marriage partner and break the marriage even after having children. In some cases the child is left with the father. If the woman remarries after separation the groom has to pay money to the former husband .This customary practice notwithstanding ,marriage and remarriage are numerous.

## Education

Formal education for girls is not accepted in the community. Of course, there is primary school where enrolment was shown as 77 students but in fact attendance is poor. Interactions with some parents revealed that the reasons for keeping away from school were mainly economic. Girls are required to work at home and in the field to earn wages. There is no need for school education as they will not work in offices .The teaching is uninteresting and timing is not suitable for them to attend.. The teachers said that girls education is not encouraged because of the conservative attitude of the parents , economic reasons ,difficulty to grasp lessons ,school timing, lack of awareness and lack of vision about future. Small girls tending cattle and looking after young children at home however, are interested to go to school because of the midday meal programme. Some of them attended at the time of distribution of food but did not attend class room teaching. An important reason for abstaining from classroom teaching is their inability to grasp the lessons which are not in their dialect .The lessons too are not useful for practical use. Their intellectual capabilities are

not developed because of malnutrition, family and community environment. The parents are in favour of educating boys rather than girls who according to them can work in offices ,stay in urban areas and lead a better life.

## Health

Lack of awareness is a major determinant of their poor health status which also results from family violence. Poor literacy adds to this problem. Most of them are married after attaining puberty and beget children at a tender age. Inexperienced motherhood is a bane for the child as well as the mother and the main reason for higher rate of maternal and child mortality. This also results from apathy of the husband in taking post natal care. Women do not get sufficient rest after delivery of the child. They have to work at home and outside after a confinement of forty days. Cultural norms of the Paraja society like attitude towards marriage, age at marriage, fertility and values attached to it, status in the family ,belief in the supernatural , lack of awareness about hygiene, sanitation, nutrition ,irrational prognosis of diseases and poverty also affect women' shealth. They do not follow the consanguineous marriage system. Cross cousin marriages ,marriage within the same village and same tribal group is preferred. It benefits both the spouses where familiarity develops into better understanding .But that does not guarantee absence of male dominance ,misunderstanding and physical violence. Marriage within close relatives affects the mental and physical health of the child. The area is malaria prone. Women as well as men suffer from the disease. Inadequate care results in dysfunction of vital body organs, deficiency of red blood cell.

Many women are handicapped visually, hearing impaired and suffer from gynecological disorder, goiter, pyrexia, respiratory problem, gastrointestinal diseases, rheumatism ,water and air borne diseases. Heavy physical labour and lack of nutrition result in anaemia which lowers their resistance to diseases. Frequency of pregnancy and maternal malnutrition affect the health of mother as well as the child. The child is breast fed till it takes solid food and even thereafter .Lactation is affected without nutritious food .Due to large scale felling of trees for construction of roads and other infrastructure, the distance between the village and forest has increased. As a result women have to walk longer

distances to collect forest products including herbal medicine. Lack of time, physical stamina, economic and domestic constraints restrain them to walk long distances. Quite often women prefer to be hungry rather than moving out to the forest for collecting forest products if other family members have been fed thereby increasing vulnerability to diseases.

Women follow crude methods of abortion which badly affects their health sometimes leading to death. Expectant mothers are not inoculated against tetanus. As they walk barefoot in muddy roads the chances of tetanus is high. Neither are they given vitamins, minerals and nutritious food. Deliveries are done at home. Complicated cases are referred to the nearby hospital located at a distance of ten kilometers. The patient is carried in an upturned cot by two or four men to the town. In many cases the woman loses chance to survive because of the time and distance. Maternal mortality is also due to unhygienic and primitive practices of parturition. There is no health centre in the village. Many women prefer to deliver the child at home for several reasons. Important reasons are unwillingness of the husband to attend the wife in the hospital and inability to meet medical expenses. Certain cases referred through ASHA under National Rural Health Mission are eligible to get financial assistance from the government if the child is delivered in the hospital. But in some cases the husbands could manipulate to get the money without ever passing it on to the wife or spending it for postnatal care.

Belief in superstitions is high in the Paraja society. "Duma" (spirit), pangan (occult) are believed to be reasons for diseases and death of humans as well as animals. The malevolent spirit is appeased through certain rituals performed by the desari. The cases are referred to the town hospital when the condition of the patient becomes critical. Gender bias is also perceptible as ailing boys are taken more care and admitted to hospital compared to girls.

## Family violence

Women's economic independence does not endow them with the power to have control on permanent material resources in a family even where the land and the house belong to the husband or are his ancestral property. Decisions like purchase of land, oxen, agricultural equipment, seed and loan from banks etc. are taken by men in consultation with other male members of the family or villagers. Their

position in the family and society is subordinate in a patriarchal system.

Independent earning capability of women has not elevated their position at home and the community. Husbands often beat them in a drunken stage, forcibly snatch their money or steal it resulting in altercation and breach of marriage. Chastity of the wife is under perennial scan if she works outside. The patriarchal familial and community culture, besides the myth that women are less knowledgeable except in domestic chores and raising children, marginalises their existence.

Even women have accepted male domination in family and outside. They accept physical torture by the husband as usual in spousal relationship and common to their culture along with habits like drinking and stealing. The process of family and community socialisation strengthens this feeling further. Accordingly, women accept the division of labour at home as well as in their work place and the difference of payment on the basis of sex as well. In a family, a woman's life cycle can be categorised as a daughter, wife, mother, concubine, barren, separated and widow etc. In each of these categories, the woman has a specific role to play. As a young girl, she assists her parents in domestic chores, looks after younger siblings, tends cattle, fetches firewood, water. After marriage she does all these work along with child bearing, nurturing and maintenance of the family.

Older women have miserable life as they are unable to contribute to the family economy or earn for their upkeep. Widows are not ostracised from social functions and religious rituals but have to earn their living. Polygamy is allowed for men which makes the first wife's position redundant. Such women usually leave the husband. If they do not remarry and stay in the same premises the husband with resources gives paddy or ragi once in a year. Barren women are discarded by the husband. Therefore, reproductive as well productive activities decide the position of married women. Patriarchal cultural norms have designed the status of women. Personal independence in some spheres of their lives and economic capability have not empowered women so much so to alter the conventions, practices and norms of gender prejudices.

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## BROCCOLI :

### A VEGETABLE THAT FIGHTS CANCER :

Dr. Ramesh Chandra Parida, Dr. Pranab Kumar Ghosh

As industrialization is continuously spitting carcinogens into our environment, cancer of various hues are spreading to take an ever-increasing toll on human life. An apparent relief has been discovered in lowly fruits and vegetables rich in anti-oxidants, polyphenols and other cancer preventive chemicals.

Among these, Italian broccoli, which is simply called as broccoli, a vegetable belonging to the Brassicacea family has proved to be a most potent one. Besides, the unique anti-cancer and other medicinal properties, it is also rich in various nutrients (Table – 1), that can ensure sound health and long life. Particularly, its vitamin C content is very high.

**Table – 1 : Nutritional constituents of Broccoli (per 100g of raw edible part)**

Energy = 30 kcal

Sl. No.	Constituents	Quantity
1	Carbohydrates	6.64 g
	Sugar	1.7 g
	Dietary fibre	2.6 g
2	Fat	0.37 g
3	Protein	2.82 g
4	Water	89.30 g
5	Vitamin A equiv.	31 µg
6	B-carotene	361 µg
7	Thiamin (Vit. B1)	0.071 mg
8	Riboflavin (Vit. B2)	0.117 mg
9	Niacin (Vit. B3)	0.639 mg
10	Pantothenic acid (B5)	0.573 mg
11	Vitamin B6	0.175 mg
12	Folate (Vit. B9)	63 µg
13	Vitamin C	89.2 mg
14	Calcium	47 mg
15	Iron	0.73 mg
16	Magnesium	21 mg
17	Phosphorus	66 mg
18	Potassium	316 mg
19	Zinc	0.41 mg

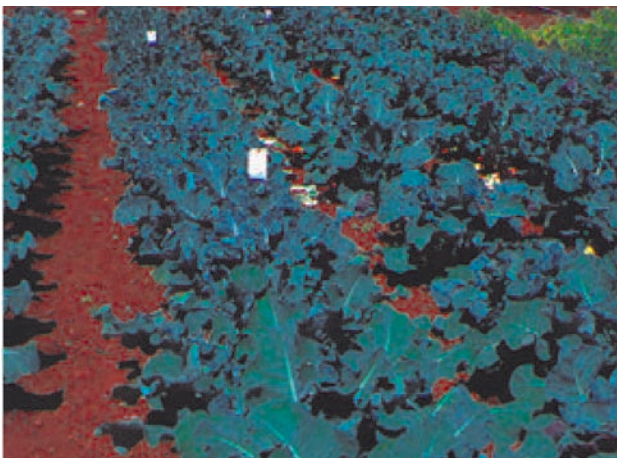
Source : USDA Nutrient database.



*Green Bud of Broccoli*

### Green Bud of Broccoli

This cool-weather crop is rich in vitamin-C, folic acid and soluble dietary fibres. It contains a number of nutrients with potent anti-cancer properties, including diindolyl methane and selenium. **Particularly, 3,- Diindolyl methane is an active modulator of the innate immune response system with anti-viral, anti-bacterial and anti-cancer activities.** Similarly, like other Brassica vegetables, broccoli is also rich in glucosinolates, which are metabolized to cancer preventive substances like isothio-cyanates. Glucoraphanin, a compound present in it can be processed into sulphoraphane, a known anti-cancer agent. Broccoli leaf is edible and it contains a lot of beta-carotene. Therefore, a high intake of broccoli has been found to reduce the risk of many types of cancer, especially prostate cancer. Recently, a research team from the US National Cancer Institute has found that eating



*Broccoli Field*

broccoli and cauliflower once in a week, decreases the aggressiveness of the disease by 45% to 52%. Similar effects have also been observed in case of colon cancer.

Methods of storage and cooking have varying impacts on anti-cancer effects of broccoli. Domestic storage of the vegetable at ambient temperature in a refrigerator shows only minor loss of glucosinolate levels over 7 days. However, when stored at a much lower temperature the loss may be up to 33% by fracture of vegetable material during thawing. On the other hand, a total loss of 77% glucosinolate has been observed after boiling it for 30 minutes, but steaming for 2 minutes, microwave cooking for 3 minutes and stir-fry cooking for 5 minutes do not have any significant effects on those, except when the vegetable is finely shredded. Therefore, in order to derive the maximum benefits from broccoli the later three methods of cooking should be adopted. However, if it is boiled, it should be done with less water, which should be consumed along with the vegetables and the boiling time should also be reduced.

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## Vellayani Lake: Conservation Efforts

the lake was taken up which resulted in intensive agriculture operations around lake area and reduction in the lake area.

### Studies and Recommendations

The environment committee of the Kerala Legislative Assembly which studied the environmental issues associated with the fresh water lakes submitted a report in 1993. The committee recommended that the State Government should identify and demarcate the encroached portion of the lake and steps should be taken to evacuate illegal encroachers, prevent pollution of lake water, increase the depth of the lake by dredging and prevent further siltation of the lake.

A study made by the College of Agriculture, Vellayani warned that dewatering the Vellayani lake for cultivation would endanger the reservoir and threaten several drinking water projects servicing the neighboring panchayats. In 2005 Kerala State Human Rights Commission (SHRC) study report recommended a revenue survey to demarcate the reservoir area and identify the encroachments. In 2006, the SHRC directed the state government to withdraw the order relating to paddy cultivation in the land around the Vellayani Lake. The Commission has also directed the state government to work with the Union Ministry of Environment and Forests to take steps to protect the lake as a source of drinking water.

### Conservation Initiatives

Public demand for the conservation of Vellayani lake began when water shortage intensified in villages around Vellayani during 1990s. There are now participatory movements taking place to conserve Vellayani fresh water lake and its ecosystem by several NGOs with the help of local public. Understanding the importance of this unique ecosystem the State government has taken steps for the ecological preservation and beautification of Vellayani Lake, by setting up the Vellayani Lake Conservation Society.

The Trivandrum district Panchayat has taken the initiative to include Vellayani Lake in the MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) scheme for the ecological preservation of the lake and its vicinity. As part of the project the panchayat is taking steps for strengthening bunds, cleaning up of wetlands etc. The Panchayat has decided to use Coir Corporation's Geo textile technology for strengthening bunds instead of cement and rock. Kalliyoor and Venganoor Gramapanchayats are responsible for implementing the project. The conservation project will be undertaken in phases for the only rain-fed freshwater lake in the Thiruvananthapuram district.

Vellayani lake presents a unique ecosystem and a multipronged strategy is required to preserve this lake's unique ecology while at the same time ensuring adequate drinking water for the villages dependent on lake water.

*(Source :PIB)*

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