Role of Mathematical Modeling in Preventing Natural Disaster

24

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Abstract:

Uttarakhand has always been prone to earthquakes, cloud bursts or flooding.Mathematics is an extraordinary exercise of the human mind in abstracting the results of observation to find similarities and differences between phenomena. These relations between phenomena make it possible to organize the natural world into discrete sets of objects that can be studied using similar mathematical objects and methods.Natural disasters cannot be prevented; scientists can use Mathematical Modeling to help limit the damage.Mathematical models are used to summarize relationships between the characteristics of natural disasters. They are ultimately used to answer questions that humans have about natural disasters, and predict the results of events that have not occurred, but may be possible or even likely. In this paper, Mathematical models of some problems related to Natural disaster are discussed.

Introduction:

Natural disasters that occur on terrestrial environment are those that are triggered due to:

(i) Internal disturbances/adjustments (e.g. tectonic activity) such as earthquakes, and volcano eruptions. The direct effects of such disasters of endogenic origin include Tsunamis, and landslides/snow avalanches; Atmospheric pollution.

(ii) Atmospheric disturbances (e.g. weather related) include storms, hurricanes, typhoons, sandstorms, tornadoes, and ground water depletions. The effects due to these disturbances include ozone depletion, drought/famine, global warming, and floods.

(iii) Neither endogenic nor exogenic origins, but are essentially due to anthropogenic activity (e.g. CO2 emissions, forest fires, disease and epidemic spread).

Natural disasters can be classified in five major categories.

- Meteorological: Storms, hurricanes, cyclones, tornadoes, typhoons, heat waves
- Hydrological: Floods, avalanches
- Climatological: Droughts, wildfires
- Geophysical: Earthquakes, tsunamis, landslides, volcanic eruptions
- Biological: Disease outbreaks in humans and animals, famine

According to the Centre for Research on the Epidemiology of Disasters (CRED) in 2011, 332 disasters from natural hazards were recorded in 101 countries, causing more than 30 770 deaths, and affecting over 244 million people (CRED, 2012). Disasters are severe events that are characterised by a sudden onset and affect a large fraction of the population in the area they appear. They can be natural such as earthquakes, tsunamis, floods, tornadoes, hurricanes and pandemics, or anthropogenic such as industrial accidents, traffic accidents, terrorist attacks.

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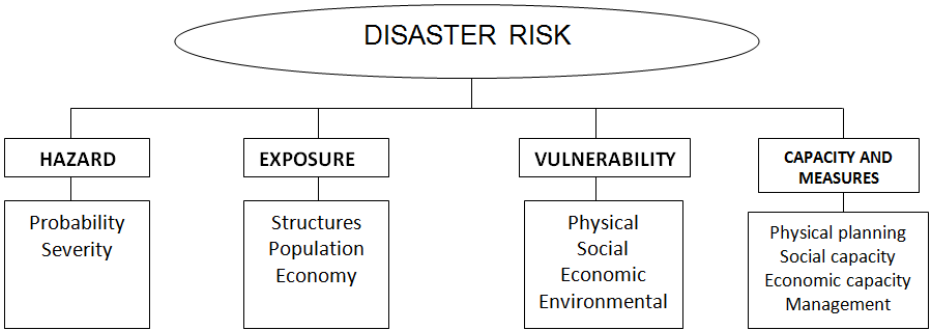
Disasters have the specific feature to be unpredictable and have a substantial public health impact in terms of short and long-term adverse-health effects.



Mathematical modeling plays a key role in hazard assessment, forecasting and warning.There are mainly two categories of Mathematical modeling activities related to disaster mitigation. One is the simulation of the phenomena itself, that can be used in scenario analysis to identify risk and the other is to forecast the future state of an extreme event currently taking place. Currently mathematical modeling is used operationally in weather forecasting, cyclone tracking and strength prediction, flood forecasting, lava flows resulting from volcanic eruptions, forest fire and management modeling, landslide hazard identification, landslide forecasts, behaviour of structures during disasters, relief operations and tsunami modeling.

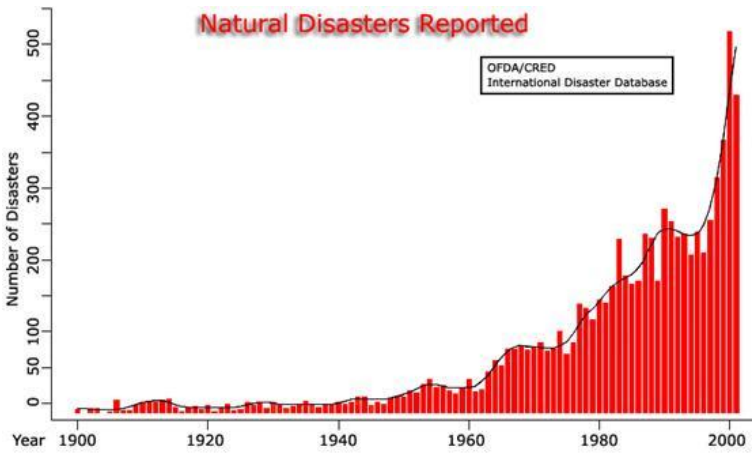
At global scale Mathematical modeling is used in long term climatic modeling. The trends resulting from these modeling provide fundamental information for environmental policies to counteract global climatic changes. At regional scale climatic models are operationally used in the weather forecasts. Volcanic ash, forest fire effects are two other areas where regional scale monitoring and modeling are used for detection and warning. Tsunami warnings are another area where successful predictions have been carried out at global and regional scale.At the national and local levels, mathematical models are used in all most all types of disasters. Mathematical models are approximations of the physical reality that involves many simplifications and assumptions with regards to the natural phenomena being simulated as well as the environment being modeled. Proper use of mathematical models depends on the following information used in model setup and verification.

• Information used to represent the physical and social environment (land cover, topography, population distribution, transportation, etc.)

• Data used to represent the physical phenomena (ex. Rainfall in case of floods)

• Data used to calibrate the models

• Data for verification of the models



In this respect, one of the most important requirements of mathematical modeling for forecasting, warning and risk analysis is the historical data of past disasters as well as long term record of magnitude of natural phenomena, even when they do not cause disasters.A fundamental difficulty of using model forecasts at the national level lies in interpretation of results at this, or at human scale. Due to limitation of computational power and data availability, simulations are generally carried out at a scale much coarser than that is applicable in the day to day life. While various nesting techniques are tested to increase the resolution at the vulnerable areas, unlike in the case of static data, computational methods are not versatile enough to arbitrarily change the resolutions in modeling complex interactions related to natural disasters. Therefore it is necessary to develop methods to translate the model forecasts to the appropriate scale and the predictive capability of the models. In this paper, Mathematical models of the following problems related to Natural disaster are discussed.

Earthquake

An earthquake (also known as a quake, tremor or temblor) is the result of a sudden release of energy in the Earth's crust that creates seismic waves. The seismicity, seismism or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time. Many methods have been developed for predicting the time and place in which earthquakes will occur. Despite considerable research efforts by seismologists, scientifically reproducible predictions cannot yet be made to a specific day or month. However, for well-understood faults the probability that a segment may rupture during the next few decades can be estimated. Earthquake warning systems have been developed that can provide regional notification of an earthquake in progress, but before the ground surface has begun to move, potentially allowing people within the system's range to seek shelter before the earthquake's impact is felt. Strong motion instrument networks have enabled creation of a large number of databanks ranging from small to regional and world ones. This data is of a great importance for the investigations aimed at prediction of strong earthquake ground motion parameters by application of empirical mathematical models fitted to the databanks. These mathematical models are referred to as ground motion models or attenuation laws. They define the relationships between ground motion parameters and factors that affect the amplitudes of ground motion as are the released energy, the regional characteristics, the local soil characteristics, the type of fault, the radiation pattern, etc. Ground motion models are defined by application of the regression analysis method. Regression coefficients and standard deviation are obtained as a

result of the regression analysis. Standard deviation is the measure for the dispersion of the data around the computed medium or median value for which a distribution function defined by the probability density function is assumed. Regression coefficients and standard deviation are the input parameters for the probabilistic seismic hazard analyses. Despite the evident results of the progress made in the use of the seismic hazard methodology, there are still uncertainties by which the hazard curves are computed. The mathematical models of ground motion have a big influence upon the results obtained from the seismic hazard analyses that are applied in practice. This justifies the efforts made by a large number of researchers worldwide toward development of mathematical models that will best fit the available databanks obtained from occurred strong earthquakes. As a result, there is a big number of different mathematical models of ground motion [1, 6, 7, 8, 20, 21, 22].

Cyclone

In meteorology, a cyclone is an area of closed, circular fluid motion rotating in the same direction as the Earth. This is usually characterized by inward spiraling winds that rotate anti-clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere of the Earth. Most large-scale cyclonic circulations are centered on areas of low atmospheric pressure. The largest low-pressure systems are cold-core polar cyclones and extratropical cyclones which lie on the synoptic scale. Weather prediction experts are aware of the existence of several empirical conditions that are necessary but not sufficient for the formation of cyclones. The first of these requires the sea temperature to be at least 26 C through a depth of at least 60 m. A second requirement is the absence of significant vector changes of the mean wind that extends into the troposphere. Relative humidity will have to be 85% or more for a long time throughout the region of storm formation and development. There are other empirical conditions as well, but even when they are satisfied, storm formation usually does not take place. In fact necessary climatic and geographical conditions for the formation of the tropical storms prevail over large areas of the earth during storm seasons, yet the actual occurrence of a storm is a relatively rare phenomenon. This indicates that there must be a rare coincidence of circumstances before development of a storm. The formation always occurs in connection with some kind of preexisting disturbance associated with a deep cloud layer. All of these disturbances do not intensify into tropical storms. Only a small percentage of these systems start intensifying. Numerous studies have been made to clarify the process of their formation, but no general mechanism has yet been accepted. The first experiment starts with a maximum wind of 43.2 km/h. After about three days, the vortex rapidly intensifies to nearly steady state amplitude of about 162 km/h. The second experiment is identical to the first, except that it was started with a maximum wind of only 7.2 km/h. The model storm in this case did not amplify even after 150 h had elapsed. Apparently, the model needs a sufficient “kick” (disturbance) to get a cyclone started. In nature, an asymmetric disturbance, such as an easterly wave, is almost always observed to precede the occurrence of tropical cyclones [4, 11, 14].

Tsunami

A tsunami is a series of water waves caused by the displacement of a large volume of a body of water, generally an ocean or a large lake. Earthquakes, volcanic eruptions and other underwater explosions (including detonations of underwater nuclear devices), landslides, glacier calvings, meteorite impacts and other disturbances above or below water all have the potential to generate a tsunami.

Tsunami waves do not resemble normal sea waves, because their wavelength is far longer. Rather than appearing as a breaking wave, a tsunami may instead initially resemble a rapidly rising tide, and for this reason they are often referred to as tidal waves. Tsunamis generally consist of a series of waves with periods ranging from minutes to hours, arriving in a so-called "wave train". Wave heights of tens of meters can be generated by large events. Although the impact of tsunamis is limited to coastal areas, their destructive power can be enormous and they can affect entire ocean basins; the 2004 Indian Ocean tsunami was among the deadliest natural disasters in human history with at least 290,000 people killed or missing in 14 countries bordering the Indian Ocean.Recent progress in mathematical modeling of tsunami is due to the increasing demand for protection of disaster prone objects. A new generation of national tsunami warning systems is based on the local networks tuned to capture the geographical, morphological and social factors peculiar to the protected coast. Local networks provide an alternative to the larger regional systems developed before. They allow for better response times and higher precision predictions, and not only reduce the overall damage from natural hazards and assure protection of potentially dangerous objects as nuclear power plants situated in the coastal zone or nuclear power driven vessels, but also decrease the probability of a false alert. With the development of such systems new efficient methods for modeling of tsunami waves transformation in the coastal zone and runup on the shore are required [3, 5, 6, 19].

Landslide

A landslide, also known as a landslip, is a geological phenomenon which includes a wide range of ground movements, such as rockfalls, deep failure of slopes and shallow debris flows, which can occur in offshore, coastal and onshore environments. Although the action of gravity is the primary driving force for a landslide to occur, there are other contributing factors affecting the original slope stability. Typically, pre-conditional factors build up specific sub-surface conditions that make the area/slope prone to failure, whereas the actual landslide often requires a trigger before being released. Specific concepts and mathematical techniques associated with nonlinear dynamical systems (NDS) theory have been widely promoted and applied in virtually every scientific discipline including seismology, geomorphology and landslide hazards.

These concepts include chaos, fractal geometry and catastrophe theory. The utility of NDS concepts and techniques in landslide hazards allows us to make deep insights into landslide mechanisms. NDS theory is also a way of attracting many people to pay more attention to the study of the evolutionary process of landsliding [9, 10, 15, 16, 17, and 18].

Flood

A flood is an overflow of water that submerges land which is usually dry. The European Union (EU) Floods Directive defines a flood as a covering by water of land not normally covered by water. In the sense of "flowing water", the word may also be applied to the inflow of the tide. Flooding may occur as an overflow of water from water bodies, such as a river or lake, in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries, or it may occur due to an accumulation of rainwater on saturated ground in an areal flood. While the size of a lake or other body of water will vary with seasonal changes in precipitation and snow melt, these changes in size are unlikely to be considered significant unless they flood property or drown domestic animals.

Floods can also occur in rivers when the flow rate exceeds the capacity of the river channel, particularly at bends or meanders in the waterway. Floods often cause damage to homes and businesses if they are in the natural flood plains of rivers. While riverine flood damage can be eliminated by moving away from rivers and other bodies of water, people have traditionally lived and worked by rivers because the land is usually flat and fertile and because rivers provide easy travel and access to commerce and industry [2, 12, 13].

The disordered occupation of the urban centers is explained by the historical development of the use of free areas. Due to the great difficulty of the way of transportation in the past, the river was used as the main road. In reason of that, the cities began growing close into the margins of the rivers or in coastal areas. However, for the old residents own experience, the population tried to inhabit the highest areas where the river difficultly would arrive. With the disordered growth of the cities, mainly in the second half of the century XX, the areas of considerable risk, as the meadows flooded were occupied, bringing, as consequences, great damages for these populations. To begin the studying of urban planning, close of any river, it is necessary to know the dynamics of the one. In other words, it tries to know as the river answers to an inundation, considering that the propagation of a flood wave, in the space and in the time, is a complex problem.

The Saint-Venant equations represent a good way to describe problems concerning with flood waves propagations in open channels. This is a physical process of high complexity, caused by an intense rain or the breaking of any control structure, which represents an interesting problem to be studied. The solution of this kind of problem passes, invariably, for the development of

methods that allow solving the equations of Saint-Venant. These non-linear equations contain, in its mathematical representation, all elements that, directly or indirectly, is Applied Mathematical Modeling to Study Flood Wave Behavior in Natural Rivers related with the behavior of the flow in the channel. Through those equations it can be determined all the hydrodynamic of the system and it can be verified the possible risk of occurrence of inundations. It is enough that, for that, the function is modeled appropriately. Evidently, the modeling of such functions implicates in more efforts in the process of solution of the equations.

Mathematical Modeling:

A mathematical model is a description of a system using mathematical concepts and language. The process of developing a mathematical model is termed mathematical modeling. Mathematical models are used not only in the natural sciences (such as physics, biology, earth science, meteorology) and engineering disciplines (e.g. computer science, artificial intelligence), but also in the social sciences (such as economics, psychology, sociology and political science); physicists, engineers, statisticians, operations research analysts and economists use mathematical models most extensively. A model may help to explain a system and to study the effects of different components, and to make predictions about behaviour.

Mathematical models can take many forms, including but not limited to dynamical systems, statistical models, differential equations, or game theoretic models. These and other types of models can overlap, with a given model involving a variety of abstract structures. In general, mathematical models may include logical models, as far as logic is taken as a part of mathematics. In many cases, the quality of a scientific field depends on how well the

mathematical models developed on the theoretical side agree with results of repeatable experiments. Lack of agreement between theoretical mathematical models and experimental measurements often leads to important advances as better theories are developed.

Mathematical modeling is the use of mathematics to

- describe real-world phenomena
- investigate important questions about the observed
- world
- explain real-world phenomena
- test ideas
- make predictions about the real world

Mathematical Models of Earthquake Ground Motion

The starting point is a general empirical ground motion model in which ground motion parameter-Y depends on magnitude- M, distance- R and local soil conditions- S. It isgiven in Equation 1

$$\ln Y = b + b_M M + b_R \ln(R_h + C) + b_S S + \sigma_{\ln Y} P \quad (1)$$

where,

Y -peak ground acceleration- PGA, or peak ground velocity- PGV or peak ground displacement- PGD; parameter of dynamic response of a linear or nonlinear model of a single degree of freedom system– SDOF, as well as Fourier Amplitude Spectrum- FS

M -magnitude

R_h -hypocentral distance in km

S -parameter that includes the effect of local soil conditions and has values, for example, 0 for rock, 1 for alluvium, 2 for deep alluvium

C -constant by which is defined the shape of the attenuation in the epicentral zone expressed in km

b, b_M, b_R, b_S -regression coefficients

$\sigma_{\ln Y}$ -standard deviation

P -binary variable, which has the value of 0 and 1 for median and median plus one standard deviation, respectively.

The model is based on the following theoretical assumptions: term $e^{b_M M}$involves the relationship between energy and magnitude; coefficient b_R has a negative value and accounts for the spherical spreading of the seismic wave energy, while term $b_S S$ includes the effect of local soil conditions.

The ground motion model given in Equation 1 is simplified by use of records of occurred strong earthquakes obtained on rock soil type or referent soil with $V_S \geq 700$ m/s, by which the parameter defining the effect of the local soil conditions is omitted. With this, the parameters of ground motion under strong earthquake effect are only a function of distance and magnitude.

Mathematical Model of the Nascent Cyclone

The clouds from the surrounding areas of the eye are curving inward to the eye in log-spiral shape. It is already recognized that the curved cloud bands surrounding the eye of a disturbance indeed take log-spiral shape. This is possible only if there was a preexisting wind vortex to draw clouds toward its center. Here, clouds are taking shape along the drag of the wind converging to the eye. So, the wind tending to converge to the eye is supposed to traverse a log-spiral path in the vicinity of the eye.

To get a model cyclone started, a weak vortex, which decays upward from the surface, had to be superimposed on the basic state (of the model) of formation of the storm. The upward decaying effect may be ignored if the disturbance is considered to be limited within a certain layer of the atmosphere.

Assume that the wind drag toward the center of the vortex will be along log-spiral paths similar to that near the eye of a matured cyclone. Resolving the velocity of the disturbance or the "kick" (which is nothing but wind jet(s) or waves in reality) along the components of the cylindrical coordinates (r,ɵ,z) we get the following:

dr/dt radial component;

$\square \frac{\square\square}{\square\square}$ cross-radial component;

dz/dt vertical component.

To get a log-spiral shape of the vortex, as seen from the top of the cylinder, i.e., along axis downward (negative direction), the following equation must be satisfied:

$$\frac{\frac{\square\square}{\square\square}}{\square\frac{\square\square}{\square\square}} = \square\ \square\square\ \square^{-1}\frac{\square\square}{\square\square} = \square \qquad (1)$$

where m is a constant.

We may assume that the disturbances propagate parallel to the ground, i.e.,

dz/dt=0 (2)

It is important to note that (1) and (2) give a simple dynamical model of only a disturbance leading to the development of a tropical cyclone. Equations (1) and (2) are valid only for a very short time at the very beginning of the genesis of a storm. Once the storm is formed, the model of the storm may be represented by a set of suitable equations

Equation (1) can appropriately model only when (r, ɵ) denotes the precise location of a point. But (1) is intended to model a vortex created by a certain wind jet or wave, where (r, ɵ) denotes the position of an average point on the tip of the wind jet or wave creating the vortex. In reality,

the location of such an average point cannot be determined with great precision. A substantial uncertainty will always remain involved that cannot be ignored.

Mathematical Model of Tsunami Runup on A Shore

The mathematical model is based on nonlinear non-dispersive equations. Let

$$\square = \begin{pmatrix} \square \\ \square\square \\ \square\square \end{pmatrix}, \square = \begin{pmatrix} \square\square \\ \square\square^2 + \dfrac{\square^2}{2} \\ \square\square\square \end{pmatrix}, \square = \begin{pmatrix} H\square \\ \square\square\square \\ \square\square^2 + \dfrac{\square^2}{2} \end{pmatrix}, \square = \begin{pmatrix} 0 \\ \square\square\square_{\square} \\ \square\square\square_{\square} \end{pmatrix}$$

The matrix form of the equations over the components u = u(x,y,t) and v = v(x,y,t) of the depth average velocity is:

$$\square_{\square} + \square_{\square} + \square_{\square} = \square$$

Here h = h(x,y) is the depth measured from the still water level; H(x,y,t) = h(x,y) + η(x,y,t) is the total water depth varying in time; and η = η(x,y,t) is the free surface elevation; and g is the gravitational acceleration.

Consider one-dimensional shallow water equations in a domain with a moving boundary. A number of finite-difference schemes were compared in order to choose a suitable numerical method for the tsunami runup problem.

Among the schemes frequently used to approximate nonlinear shallow water equations are the MacCormack scheme, the Aracawa scheme, the Ousher scheme and the Lax scheme. The former two have the second order of approximation in space and time, while the latter are of the first order.

Mathematical model of landslide evolution

NDS theory can be applied with benefit to the study of landslides. However, there are many problems to be solved in practical applications. A common approach of applying NDS theory to landslide study is as follows: write and resolve a series of dynamical equations, then study the properties of solutions obtained and finally explore the origin of all kinds of complex phenomena. However, the dynamical equations describing the evolution process of landslide have not yet been correctly written. The only information available at present is observation data and description of phenomena. That is to say, we know a series of specific solutions of the dynamical equations. If we regard such solutions as a series of discrete values of the dynamical equations, the quasiideal nonlinear dynamical equations for the evolution of landslide can, thus, be obtained through an inversion algorithm.

Consider the development process of a landslide as a nonlinear dynamical system (NDS). The landslide NDS includes n interacting components q_i, i=1, 2, . . . , n. These q_i might include, for a specific system, various factors or variables describing tectonics, lithology and hydrology, etc. The time behavior of any component is characterized by an ordinary differential equation describing it as a function of the other components. Thus:

$dq_i/dt=f_i(q_1,q_2,\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots q_n)$

where the function fi is a general nonlinear one of $q_1, q_2, \ldots, q_n$.

Mathematical Model to Study Flood Wave Behavior in Natural Rivers

The flow will be considered undimensional, so that, the momentum equation will be applied just in the x direction, along the longitudinal channel. The pressure has a hydrostatic distribution, and the channel will be considered with a rectangular section. The flow field, in the river, is obtained through the numeric solution of the Saint- Venant equations. Those equations, of the continuity and of the momentum, are describedto proceed

Continuity Equation

$$\frac{\partial Q}{\partial x} + \frac{\partial A}{\partial t} = 0 \quad (1)$$

Momentum Equation

$$\frac{\partial Q}{\partial t} + \frac{\partial\left(\frac{Q^2}{A}\right)}{\partial x} + gA\left(\frac{\partial y}{\partial x} - S_0\right) + gAS_f = 0 \quad (2)$$

where x is the longitudinal distance along the channel (m), t is the time (s), A is the crosssection area of the flow (m^2), y is the surface level of the water in the channel (m), S_0 is theslope of bottom of the channel, S_f is the slope of energy grade line, B is the width of the

channel (m), and g is the acceleration of the gravity ($m.s^{-2}$).

In order to calculate S_f, the Manning formulation will be used. Thus,

$$V = \frac{1}{n} R^{\frac{2}{3}} S_f^{\frac{1}{2}} \quad (3)$$

where V is the mean velocity (m/s), R is the hydraulic radius (m) e n is the roughnesscoefficient.

In this hydrodynamic model, there are two dependent variables. The first refers to thecross section area A(x,t), along the channel, for each interval of time. The second onerefers to the flow field Q(x,t) along the channel, for the same previous conditions. As theinvestigation demands the knowledge of two dependent variables, there is the necessity oftwo differential equations: the equation (1) and the equation (3) will compose the model.

Initial Conditions

$$Q(x,0)=Q_0 \quad (4)$$

$$A(x,0)=A_0 \quad (5)$$

where Q_0 is the steady state flow of the channel, and the A_0 is the cross section area for thesteady state conditions.

Boundary Conditions:

$$Q(0,t)=f(t) \quad (6)$$

where f(t) is the hydrograph.

Solution Procedure:

The ever-increasing advances in computer technology have enabled many in science and engineering to apply numerical methods to simulate physical phenomena. In the development of numerical methods simplifications need to be made to progress towards a solution. Numerical methods do not usually give the exact answer to a given problem, they can only tend towards a solution getting closer and closer with each iteration. Numerical methods are commonly used to solve the non-linear partial differential equations. The most popular numerical methods used are

1. Finite Difference Method
2. Finite Element Method
3. Finite Volume Method
4. Boundary Element Method
5. Spectral Element Method

Conclusion:

A mathematical model is systematic, results can be repeated, and the model can be refined. This would be in contrast to prediction systems based on emotion or "soft" events such as observation of human behavior.

Limitations would be difficulty in building a complete model of real processes due to lack of available data. Computational complexity would be another possible limitation - a model sufficiently accurate may require enormous computer power, e.g. weather forecasting models. Mathematical models are used to summarize relationships between the characteristics of natural disasters. They are ultimately used to answer questions that humans have about natural disasters, and predict the results of events that have not occurred, but may be possible or even likely.

References:

1. *Ambraseys et al., "Prediction of Horizontal Response Spectra in Europe", Earthquake Engineering and Structural Dynamics, Vol.25, 1996, pp.371-400.*
2. *Andrade, Marinho G.; Fragoso, Marcelo D.; Carneiro, Adriano A. F. M., "A stochastic approach to the flood control problem", Applied Mathematical Modelling, Brazil, Vol 25, pp. 499–511. 2001.*
3. *Bouthemy P. and Benveniste A.,"Modeling of atmospheric disturbances in meteorological pictures", IEEE Trans. Pattern Anal. Machine Intell., Vol. 6, 1984, pp. 587–600.*
4. *Briggs, M.J., Synolakis, C.E., Harkins, G.S., and Green, D.R., "Runup of solitary waves on a circular island", in H. Yeh, P. H. Liu, and C. Synolakis (eds.), Long Wave Runup Models, World Scientific, Singapore, 1996, pp. 363-374.*
5. *Carrier, G.F. and Greenspan, H.P., "Water waves of finite amplitude on a sloping beach", J. Fluid Mech., Vol. 4, 1958, pp. 97-109.*

6. *Joyner, W.B. &. Boore, D.M., "Measurement, Characteristics and Prediction of Ground Motion", Proceedings of Earthquake Engineering and Soil Dynamics Division, ASCE, 1988, Vol.11 G.T., 1988, pp. 43-102.*
7. *Kannan Suganth, "Innovative Mathematical Model for Earthquake Prediction", Engineering Failure Analysis, Vol. 41, 2014, pp. 89–95.*
8. *Keilis-Borok, V.I., "The lithosphere of the earth as a nonlinear system with implications for earthquake prediction". Rev. Geophys., Vol. 28, 1990, pp. 19– 34.*
9. *Kuzmicheva, T.V., Novikov, V.A., and Fedotova, Z.I., "Comparison of several numerical methods for straight-through calculation of long wave runup modeling", in Yu.I. Shokin (ed.) Proc. of the National Workshop on Numerical Methods in Wave Fluid Dynamics, Krasnoyarsk, 1991 pp. 9-14.*
10. *Liu, S.D., "Simulation on the earth system and chaotic time series", J. Geophys. Vol. 33, 1990, pp. 144-152.*
11. *Majumdar Kausik Kumar, "A Mathematical Model of the Nascent Cyclone", IEEE Transactions On Geoscience And Remote Sensing, Vol. 41, No. 5, MAY 2003, pp. 1118-1122.*
12. *Malanson, G.P., Butler, D.R., Georgakakos, K.P., "Non-equilibrium geomorphic processes and deterministic chaos", Geomorphology, Vol. 5, 1992, pp. 311– 322.*
13. *Moussa, R., Bocquillon, C., "Criteria for the choice of Flood-Routing Methods in Natural Channels", Journal of Hydrology, Vol. 186, 1996, pp. 1-30.*
14. *Ooyama K., "Numerical simulation of life-cycle of tropical cyclones," J. Atmos. Sci., Vol. 26, 1969, pp. 3–40.*
15. *Phillips, J.D., "Nonlinear dynamical systems in geomorphology: revolution or evolution?", Geomorphology, Vol. 5, 1992, pp. 219– 229.*
16. *Phillips, J.D., "Instability and chaos in hillslope evolution", Am. J. Sci., Vol. 293, 1993, pp. 25–48.*
17. *Qin Siqing, Jiao Jiu Jimmy, Wang Sijing, "A nonlinear dynamical model of landslide evolution", Geomorphology, Vol. 43, 2002, pp. 77– 85.*
18. *Qin, S.Q., Jiao, J.J., Wang, S.J., "The predictable timescale of landslides" Bull. Eng. Geol. Environ. Vol. 59, 2001, pp. 307–312.*
19. *Sabetta, F. & Pugliese, A., "Attenuation of Peak Horizontal Acceleration and Velocity from Italian Strong-Motion Records". BSSA , Vol. 77, No.5, October 1987, pp.1491-1513.*
20. *Sabetta, F.& Pugliese, A., "Estimation of Response Spectra and Simulation of Nonstationary Earthquake Ground Motions", BSSA, Vol. 86, No.2. April 1996, pp. 337-352.*
21. *Stamatovska, S.G., "Ground Motion Models - State of the Art", Acta Geodaetica et Geophysica Hungarica, Vol. 43 (2-3), 2008, pp.267-284.*
22. *Stamatovska, S.G., "A New Ground Motion Model – Methodological Approach", Acta Geodaetica et Geophysica Hungarica, Vol. 41 (3-4), 2006, pp.409-423.*

Promoting Corporate Sustainability Through Climate-Mitigation Initiatives: An Emerging Dimension of Discharging Corporate Social Responsibility

25

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Abstract

Though the roots of 'Corporate Social Responsibility' (CSR) lie in philanthropic activities (such as donations, charity, relief work, etc.) of companies, the concept of CSR has evolved over time encompassing all the related concepts such as triple bottom line, corporate citizenship, philanthropy, strategic philanthropy, shared value, corporate sustainability and business responsibility. The practice of CRS in India still remains as a philanthropic activity though it has moved to community development through various projects. The newly introduced Companies Act, 2013 has brought the idea of CSR to the forefront and Schedule VII of the Act, which lists out the CSR activities, suggests though communities should be the focal point, CSR needs to go beyond communities and beyond the concept of philanthropy. Companies need to perceive CSR as being the way through which a business entity achieves a balance of economic, social and environmental imperatives of conducting business (Triple-Bottom-Line Approach), while at the same time addressing the expectations of shareholders and stakeholders. The true spirit of CSR lies in how profit is earned by a corporate entity and not in how much of the earned profit is expended for philanthropic activities. Thus, CSR is now considered as a holistic approach that integrates economic (profit), social (people) and environmental (planet) dimensions of businesses and helps to promote sustainable development.

Thus, promoting corporate sustainability has emerged as one of the major issues of every business of today's world because of apparent contradiction between corporate sustainability and business profitability in the short run. In the present day's extremely competitive business world, cost effectiveness appears to be the most vital issue and sustainability measures seem to adversely affect such effort.

On the other hand, global industrial production and consumption are outpacing the renewal capacity of natural resources and the capacity of governments to manage pollution and wastes. Thus, lowering the carbon footprint through sustainable and more efficient management of natural resources has appeared to be the prime concern of every nation to fight against climate change and its devastating consequences like sea-level rise, more frequent severe weather events, shortages of freshwater, biological extinctions, reduction in agricultural yields and many others leading fundamental changes to Earth's climate system.

Promoting and ensuring sustainable development is thus contravening the nexus between corporate sustainability and corporate profitability at the micro level and economic development and environmental degradation at the macro level. The corporate entities as well as government of our country can address the issue by capitalizing the opportunities offered by the international environmental treaty 'Kyoto Protocol' to developing countries like us. The Protocol has given birth of an innovative business model through which an entity can make synergies between

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economic, social and environmental dimensions of business and as a meritorious corporate citizen, can discharge its responsibility towards the environment and society without jeopardizing its financial sustainability. The government, both central and state/local, can also promote well being of the citizens and sustainable development in a cost-effective manner in line with national sustainability priorities of the country.

***Keywords**: Corporate Social Responsibility, Corporate sustainability, Sustainable development, Climate change, Philanthropy.*

The most serious challenge as well as threat to present global environment ever to face by human race is 'global warming' which means an unusually rapid increase inglobal average surface temperature over the past century due to rapid increase in the concentration of greenhouse gases (most importantly carbon dioxide with others like methane, ozone, nitrous oxide, etc.) in Earth's atmosphere predominantly caused by rising industrial activity, burning of fossil fuel like coal, gas, oil etc. and tropical deforestation.The scientific opinion on the issue as expressed by the United Nations Intergovernmental Panel on Climate Change (IPCC) is that the global average surface temperature rose by about 0.8 degree Celsius in last hundred years and it will increase by another four degree Celsius by the end of 21stcentury.The expected detrimental consequences of such changes mayinclude severe droughts, heavy rain cycles, coastal and small island flooding, increases in extreme weather, more and stronger tropical cyclone and hurricanes, melting of ice caps and glaciers, biological extinctions, spread of vector-borne diseases, damage to vegetation and reduction in agricultural yields and many others leading fundamental changes to Earth's climate system.

To address the issue, countries around the globe came together under an umbrella and committed themselves to reduce theiremission of GHGs under an international and legally binding environmental treaty coined as 'Kyoto Protocol' in 2005. The Protocol supplemented the 'United Nations Framework Convention on Climate Change' (UNFCCC) adopted earlier after 'The Earth Summit' of 1992 held in Rio de Janeiro and by setting targets or limits on maximum amount of emission of GHGs by the industrialized an developed countries aims at stabilizing the concentration of GHGs in the atmosphere at a level that would prevent dangerous human interference with the climate system.. As per the Protocol, however, the prescribed limit of emission level is not applicable to developing and least-developed countries at present, though they emit GHGs in the atmosphere.

India, being a Non-Annex I country to the Protocol, has emerged as one of the largest beneficiaries of the Kyoto Protocol at large and Clean Development Mechanism (CDM) under the Kyoto Protocol in particular,in terms of generation of revenues through sale of carbon credits with a great potential and opportunity for business enterprises, government and investors.The emergence of the opportunity of generating revenues through emission reduction has given birth of an innovative business model through which an entity as a meritorious corporate citizen can discharge its responsibility towards the environment and society without jeopardizing its own financial sustainability. It has given birth of an innovative way through which an entity can make synergies between economic, social and environmental dimensions of business.

Though the roots of 'Corporate Social Responsibility' (CSR) lie in philanthropic activities such as donations, charity, relief work, etc. of companies, the concept of CSR has

evolved over time encompassing all the related concepts such as triple bottom line, corporate citizenship, philanthropy, strategic philanthropy, shared value, corporate sustainability and business responsibility. The newly introduced Companies Act, 2013 has brought the idea of CSR to the forefront and Schedule VII of the Act, which lists out the CSR activities, suggests though communities should be the focal point, CSR needs to go beyond communities and beyond the concept of philanthropy. Companies need to perceive CSR as being the way through which a business entity achieves a balance of economic, social and environmental imperatives of conducting business (Triple-Bottom-Line Approach), while at the same time addressing the expectations of shareholders and stakeholders. The true spirit of CSR lies in how profit is earned by a corporate entity and not in how much of the earned profit is expended for philanthropic activities. Thus, CSR is now considered as a holistic approach that integrates economic (profit), social (people) and environmental (planet) dimensions of businesses and helps to promote sustainable development. Thus, promoting corporate sustainability has emerged as one of the major issues of every business of today's world because of apparent contradiction between corporate sustainability and business profitability in the short run. On the other hand, global industrial production and consumption are outpacing the renewal capacity of natural resources and the capacity of governments to manage pollution and wastes. Thus, lowering the carbon footprint through sustainable and more efficient management of natural resources has appeared to be the prime concern of every nation to fight against climate change and its devastating consequences.

Promoting and ensuring sustainable development is thus contravening the nexus between corporate sustainability and corporate profitability at the micro level and economic development and environmental degradation at the macro level. The corporate entities as well as government of our country can address the issue by capitalizing the opportunities offered by the international environmental treaty 'Kyoto Protocol' to developing countries like us. The Protocol has given birth of an innovative business model through which an entity can make synergies between economic, social and environmental dimensions of business and as a meritorious corporate citizen, can discharge its responsibility towards the environment and society without jeopardizing its financial sustainability. The government, both central and state/local, can also promote well being of the citizens and sustainable development in a cost-effective manner in line with national sustainability priorities of the country.

In the present paper a modest attempt has been made to examine the present position and achievement of our country in exploring the benefits offered by the Kyoto Protocol. Accordingly the paper has been organized in four sections. The next section describes different mechanisms under the Kyoto Protocol with special reference to CDM. Steps involved in setting up and monitoring of a CDM Project (i.e., CDM Project Cycle) have been outline in Section II. Section III evaluates present position and achievement of our country in CDM sector. The proactive role that can be played by the government for successful implementation of CDM projects has been suggested in Section V and finally the last section concludes of the study.

Section II: Mechanisms under Kyoto Protocol

The United Nations Framework Convention on Climate Change (UNFCCC) divides countries into two main groups:

Annex-I Countries-which include industrialized and developed countries those ratified the protocol (like UK, Switzerland, Japan, Netherlands, New Zealand, Sweden, Germany, Spain, France, Italy, Canada, Australia, Austria, etc.); and

Non-Annex-I Countries-which include all other countries those ratified the protocol but not included in Annex-I of the Convention, mostly the developing and least developed countries (like India, Sri Lanka, Afghanistan, China, Brazil, Iran, Kenya, Kuwait, Malaysia, Pakistan, Philippines, Saudi Arabia, South Africa, etc).

Under the Kyoto Protocol, countries with binding emission reduction targets (i.e., Annex-I countries) are issued Emission allowances (carbon credits) equal to the amount of emissions allowed where an allowance (carbon credit) represents an allowance to emit one metric tonne of carbon dioxide equivalent in the atmosphere. To meet the emission reduction targets, binding countries in turn set limits on the GHG emissions by their local businesses and entities. Now, in order to assist the developed countries to meet their emission reduction targets as well as to encourage the developing and least developed countries which do not have any emission reduction target at present (Non Annex-I countries) to contribute towards emission reduction efforts, the Protocol provides three innovative and flexible mechanisms – Joint Implementation (JI), International Emission Trading (IET) and Clean Development Mechanism (CDM).

Under JI, a developed country with a relatively high cost of domestic GHG reduction can set up an emission-reduction project in another developed country that has a relatively low cost of GHG reduction and earn carbon credits which can be counted toward meeting its Kyoto target. Carbon credits earned through JI are called Emission Reduction Unit (ERU).

Under IET, developed countries with binding emission reduction targets can simply trade in the international carbon credit market at the prevailing market price. The entities of developed countries exceeding their emission limits can buy carbon credits from those whose actual emissions are below their set limits. The allowed emissions of developed countries are divided into 'Assigned Amount Units' (AAUs) and IET allows countries that have spare emission units (i.e., emissions allowed but not used) to sale the spare units to countries that crossed their targets.

Under CDM, a developed country can set up an emission reduction project (like generation of electricity with solar panel, installation of more energy-efficient equipments, etc.) in a developing country and earn carbon credits on the basis of emission reductions of the project which can be used to meet a part of the Kyoto target of the entity from developed nation. Besides, the entities of developing and least developed countries can also set up an emission reduction project, generate carbon credits on the basis of emission reduction by the project and then sell such carbon credits at prevailing market prices to entities of developed countries with emission reduction targets. The carbon credit so generated is measured by the unit 'Certified Emission Reduction' (CER) where one CER is equal to one tonne of carbon dioxide equivalent not emitted in the atmosphere. Trading of CERs happens in the form of CER certificate, just like a stock.

The CDM thus helps the developed countries to meet their emission reduction targets as well as encourages the developing and least developed countries with no emission reduction targets at present, towards emission reduction efforts with the ultimate objective to reduce emission of GHGs in the atmosphere and promote sustainable development.

Article 12 of the Kyoto Protocol states the two-fold purpose of CDM as:

i) to assist parties included in Annex 1 (i.e., developed countries) in achieving compliance with

theirquantified emission reduction commitments under Article 3 of the treaty, and

ii) to assist parties not included in Annex 1 (i.e., developing/least developed countries) inachieving

sustainable development and in contributing to the ultimate objective of theconvention.

Apart from promoting sustainable development, the CDM also brings some important co-benefits such as:

- Foreign investments in developing and least developed countries
- Transfer or diffusion of technology and knowledge between countries
- Infrastructural development particularly in developing and least developed countries
- Improvement in air quality and living conditions
- Achieving business competitiveness through reduction of cost
- Increased economic activity
- Access to energy efficient lighting and cooking especially in rural and remote areas
- Poverty reduction by generation of employment and income
- Community development and many others.

Among these three mechanisms, only the CDM is relevant to our country at present as our country presently belongs to Non-Annex-I countries to the protocol having no emission reduction target at present.

Section III: Steps involved in setting up and Operation of a CDM Project

An entity desirous to set up a CDM project and generate carbon credit there from has to follow the following steps:

(i) Registration of the Project with CDM Executive Board of UNFCCC

Clean Development Mechanism (CDM) projects are established in accordance with the procedures and guidelines formulated by the CDM Executive Board of the UNFCCC. An entity desirous to set up a CDM projecthas to get the project registered with the CDM Executive Board and for thatit needs to prepare a Project Design Document (PDD) along with a Project Concept Note (PCN) which contain all the details of the proposed CDM project including viability, additionality, developing baseline study, expected emission reductions and many other technical and non-technical matters. In fact, developing PDD is the most important as well as challenging job in registering a CDM project with the UNFCCC. A CDM project has to be approved first by the Designated National Authority (DNA) of the country in which the project is decided to be established. India's DNA is the National CDM Authority (NCDMA) established under the Ministry of Environment and Forests, Govt. of India. Aftergetting approvalfrom the DNA, the proposed project is required to bevalidated by a Designated Operational Entity (DOE), an independent auditor accredited by the CDM Executive Board and based on the validation report submitted by the DOE, the projectis registered by the UNFCCC.

Thus, registration of a CDM project with the UNFCCC involves the following steps:

1) Preparation of Project Design Document (PDD) along with a Project Concept Note (PCN).
2) Getting national approval from the Designated National Authority (DNA). The DNA for our country is the National CDM Authority (NCDMA) established under the Ministry of Environment and Forests, Govt. of India.
3) Validation ofthe project by the Designated Operational Entity (DOE), anindependent auditoraccredited by the CDM Executive Board of UNFCCC.
4) Submission ofvalidationreport along with allothernecessarydocumentstothe CDMExecutive Board by the DOE for registration of the project.
5) Registration of the project with the CDM Executive Board of UNFCCC.

(ii) Monitoring, Verification and Issuance of CERs

After the project is being registered with the CDM Executive Board of UNFCCC, the performance of a CDM project is monitored and verified periodically (usually once a year) by a DOE to verify the amount of emission reductions by the project. After verification, the DOE submits the verification report to the UNFCCC and accordingly UNFCCC issues CERs in favour of the entity.

(iii) Trading of CERs

Now the entity can sale the issued CERs at the prevailing market prices to the entities who need it in international carbon credit markets. The retail investors, like any other assets, can also buy and sale carbon credits in the carbon credit markets.

Section IV: Present position of CDM sector in India

In accordance with national sustainability policy of the country, India signed and ratified the Kyoto Protocol in August, 2002 and with China and Brazil has emerged as one of the world leaders in reduction of GHGs and generation of revenuesthrough sale of carbon creditsby adopting Clean Development Mechanism projects in the last few years.

Presently, India occupies second position both in Asia and world, behind China, in terms of number of registered CDM projects as well as average annual CERs generated by the projects and nearlythree-fourth of the total CERs generated globally comes from CDM projects of these two countries as on 31.01.2014 (Table-1 & 2). As evident from Table-1, there were 1472 (constituting 19.82% of global total) registered CDM projects in India generating 11.37% average annual CERs of the world as on 31st January, 2014 while these figures were 3737 (50.32%) and 61.29% for China. Again, at the end of the year 2013, 29.30% of the total registered CDM projects in Asia were situated in India generating 17.30% of total CERs generated in Asia until 2012 (Table-2). Moreover, at present India ranks one for having highest number of unilateralCDM projects (i.e., projects without foreign stake) in the world. From Table-4 it is evident that CDM projects in India are now expanded to eleven different sectors though the projects are attached predominantly to energy industries and the average size of CDM project in India were 63,061 CERs, 34,217 CERs, 84,367 CERs and 67,831 CERs in the years 2010-2013 respectively. Thus, the Indian CDM sector is expanding rapidly in term of number of projects, sectoral distribution of the projects as well as reduction of emission of GHGs and generation of revenues through sale of carbon credits.

But, in spite of remarkable achievement of the country, a great potential and opportunity still awaiting India to explore and utilize the benefits of Clean Development Mechanism.

From Tables- 5, it is evident that the governmental participation (both Central and State/Local) in CDM Projects is quite unsatisfactory with only 5.1%,5.5%, 7.4% and 5.9% of the total projects were being executed by the Central and State/Local Government together in the year 2010, 2011, 2012 and 2013 respectively. Again, the projects executed by the Central and State/Local Governments so far, belong to only six sectors and predominantly to three sectors namely, Energy Industries, Manufacturing Industries and Energy Demand(Tables 6& 7). Thus, the government has ample opportunity to develop good quality and highly relevant CDM projects in various sectors to capitalize its CDM potentials.

Power generation is one of such promising sectors which is directly linked to economic growth and well-being of the nation. In India, where demand for electricity is increasing significantly (presently 8% per annum) along with healthy growth of industries and populationand per capita consumption of electricity is much lower than the global average (only 478 kWh compared to global average of around 2900 kWh), low carbonization of the power generation sector (through increasing the proportion of non-conventional energy sources and fuel switching) need to be pursued through multi-pronged approach in line with fulfilling country's commitment to promote sustainable development in general and curb greenhouse gas emissions in particular. Again, besides augmenting power generation capacity, conservation of energy through efficient utilization of energy resources has emerged as one of the major issues in recent years as apart from being environmentally benign, it is the quickest, cheapest and most practical way of bridging or at least narrowing the gap between requirement and availability of energy of the country in short-term.Thus, the opportunities of CDM can fruitfully be utilized in that direction by implementing energy efficiency enhancement measures in various energy-intensive industries as well as in domestic sector. Power generation from 'Municipal Solid Waste' (where produced methane is used as the fuel for the power plant) has emerged as an important process for GHG emission reductions worldwide. But, in case of 'Waste handing and disposal', India's position is very poor with only 1.71%, 1.83%, 2.60% and 1.30% projects from this sector in the years 2010, 2011, 2012 and 2013respectively [Tables- 4]. Thus, there exists a vast potential for the government, more importantly the State/Local government (i.e., Corporation, Municipality, Panchayat, etc.) as well as the private entities to capitalise the benefits of CDM in handling municipal solid wastes in an environment-friendly and cost effective way. In recent years solid waste management, especially in the rapidly growing cities is becoming a more and more urgent issue as it is estimated that post-consumer waste accounts for almost 5% of total global GHG emissions and methane from landfills represents 12% of total global methane emissions. Thus, our country, which is urbanizing at an increasing rate, can approach the issue in a comprehensive manner by implementing CDM-based integrated solid waste management plan in all cities (large as well as small) of the country. On the other hand, distribution of CDM projects in India among various sectors also differs significantly from global scenario. For instance, while global projects come from thirteen sectors, CDM projects in India are attached to only six sectors [Tables- 3 &4], implying scope for expanding project activities in many other promising sectors. Another feature of Indian CDM sector is that the proportion of small and medium-size projects is comparatively higher than that of other countries like China, Brazil, Mexico etc. For that reason, percentage of CERs generated in India is much lower than percentage projects situated in India

(For instance presently 19.82% of total CDM projects are situated in our country but their contribution in generating CERs is only 11.21% of global total[Table-1].

Section V: Role to be played by the Government

For exploring the CDM potential of the country successfully the government has to play a more proactive role including the following:

- Capacity building at both individual and institutional levels
- Developing CDM projects in highly relevant and demanding sectors like Power Generation, Energy Efficiency, WasteManagement etc.
- Helping the project developers in securing finance as well as financing CDM projects particularly those with high development potentials
- Mitigating CDM-related project risks
- Formulating national policy and legislative framework on CDM-related issues
- Making national approval of CDM projects simple, dynamic and straightforward
- Assisting the project proponents in registering the projects with the CDM Executive Board
- Formation 'National CDM Fund' to support good quality and highly relevant CDM projects similar to 'CDM Loan Scheme' launched recently by UNFCCC.
- Developing corporate awareness on CDM to attract more projects into this challenging as well as lucrative business sector through which synergies can be made between economic, social and environmental dimensions of business

Section V: Conclusion

The concept of carbon credit came into existence as a result of increasing awareness of the need for pollution control. Carbon credit by assigning a monetary value to the cost of polluting atmosphere creates a market for reducing emission of greenhouse gases. This means, carbon emission becomes an input cost to those entities that pollute much and at the same time an important source of revenue to those who pollute less.

India, being a non-Annex-I country to the Kyoto Protocol, has emerged as one of the largest beneficiaries of Clean Development Mechanism of the Protocol with a great potential and opportunity for business enterprises, government and investors. The Indian CDM market has already passed a milestone and isgrowing rapidly towards becoming the world leader in exploring the opportunities offered by the Clean Development Mechanism as well as discharging its responsibility towards the environment and society in line with national sustainability priorities of the. And the uniqueness of CDM is that to make this vision into reality, an entity need not to sacrifice its financial or economic interest, rather by undertaking CDM projects, an enterprise, as a meritorious corporate citizen, can discharge its responsibilities towards the environment and society without jeopardizing its own financial sustainability.

Table- 1: Number of registeredCDMprojects and expected average annual CERs by country (Top ten countries) as on 31st January, 2014

Sl	No. of Regisered Projects			Annual CERs		
	Country	No. of projects	Percentage of total	Country	Average annual CERs	Percentage of total
1	China	3737	50.32	China	59,38,12,029	61.29

2	India	1472	19.82	India	11,01,06,448	11.37
3	Brazil	321	4.32	Brazil	4,73,99,069	4.89
4	Mexico	249	3.35	Republic of Korea	2,01,67,569	2.08
5	Malaysia	189	2.55	Mexico	1,91,45,326	1.98
6	Viet Nam	143	1.93	Indonesia	1,74,88,808	1.81
7	Indonesia	142	1.91	Viet Nam	1,74,17,618	1.80
8	Republic ofKorea	142	1.91	Chile	1,06,77,403	1.10
9	Thailand	99	1.33	Peru	1,03,12,012	1.06
10	Philippines	91	1.23	South Africa	96,51,395	1.00
	Total	**6585**	**88.67**	**Total**	85,61,77,677	**88.38**
	Others	**841**	**11.33**	**Others**	**11,26,40,114**	**11.62**
	Global Total	**7,426**	**100.00**	**Global Total**	**96,88,17,791**	**100.00**

Source: UNFCCC (www.cdm.unfccc.int), Dated31.01.2014

Table- 2: Registered CDM projects as on 31.12.2013 (Top ten countries) and estimated CERs until 2012 by country in Asia

Sl	Country	Percentage of total CDM projects in Asia	Percentage of total CERs until 2012 in Asia
1	China	55.70	71.10
2	India	29.30	17.30
3	Vietnam	3.60	0.90
4	Indonesia	2.40	1.60
5	Thailand	2.30	0.80
6	Malaysia	2.30	1.50
7	South Korea	1.30	5.50
8	Philippines	1.10	0.40
9	Pakistan	0.60	0.40
10	Sri Lanka	0.40	0.10.
	Total	**99.00**	**99.60**
	Others	**1.00**	**0.40**
	Grand Total	**100.00**	**100.00**

Source: UNEP Risoe Centreon Energy, Climate and Sustainable Development, Denmark (www.cdmpipeline.org),
Dated: 31.12.2013

Table- 3: Sectoral distribution of registered CDM projectsin the world

Sl	Sectoral Scope*	No. of projects*	Percentage of total
1	Energy Industries (Renewable /Non-renewable sources)	6203	74.56
2	Waste Handling and Disposal	906	10.89
3	Manufacturing Industries	353	4.24
4	Fugitive Emissions from Fuels	216	2.60

	(Solid, Oil and Gas)		
5	Agriculture	203	2.44
6	Chemical Industries	115	1.38
7	Energy Demand	109	1.31
8	Mining/Mineral Production	84	1.01
9	Afforestation and Reforestation	52	0.63
10	Fugitive Emissions from Production and Consumption of Halocarbons and Sulphur hexafluoride	29	0.35
11	Transport	29	0.35
12	Metal production	13	0.16
13	Energy Distribution	7	0.08
	Total	**8319**	**100.00**

** A project activity can be linked to more than one sectoral scope*
Source: UNFCCC (www.cdm.unfccc.int), Dated 31.01.2014

Table- 4: Sectoral distribution of registered CDM projects in India

Sl	Sector	2010		2011		2012		2013	
		No. of projects	**Annual CERs**	**No. of projects**	**Annual CERs**	**No. of projects**	**Annual CERs**	**No. of projects**	**Annual CERs**
1	Energy Industries (Renewable/ Non-renewable Sources)	100 (85.47)	69,81,943	288 (87.80)	89,76,096	534 (81.78)	48,594,028	141 (91.56)	8,030,389
2	Manufacturing Industries	7 (5.98)	96,353	16 (4.88)	6,14,078	27 (4.13)	849,749	3 (1.94)	852,253
3	Energy Demand	8 (6.84)	1,04,935	15 (4.57)	2,46,211	62 (9.49)	2,469,373	4 (2.60)	52,426
4	Waste Handling and Disposal	2 (1.71)	1,94,940	6 (1.83)	5,87,918	17 (2.60)	1,462,423	2 (1.30)	26,875
5	Transport	-	-	2 (0.61)	390	2 (0.31)	136,974	1 (0.65)	632,256
6	Metal Production	-	-	1 (0.31)	7,98,347	1 (0.15)	56,251	1 (0.65)	23,156
7	Afforestation and Reforestation	-	-	-	-	4 (0.61)	178,512	1 (0.65)	768,685
8	Fugitive Emissions from Fuel (Solid, Oil and Gas)	-	-	-	-	1 (0.15)	56,400	-	-
9	Chemical Industries	-	-	-	-	3 (0.47)	320,114	-	-
10	Energy Distribution	-	-	-	-	2 (0.31)	967,681	-	-
11	Agriculture	-	-	-	-	-	-	1	59,988

							(0.65)	
Total	**117 (100)**	**73,78,171**	**328 (100)**	**1,12,23,040**	**653 (100)**	**55,091,505**	**154 (100)**	**10,446,028**
Average size of the project	**63,061 CERs**		**34,217 CERs**		**84,367 CERs**		**67,831 CERs**	

Source: National CDM Authority, India (www.cdmindia.gov.in)
Note: Figures in the parentheses indicate percentages

Table- 5: Registered CDM projects executed by the CentralGovernment, State/Local Government andPrivate Entity in India

Projects executed by	2010		2011		2012		2013	
	No. of projects	**Percentage of total**	**No. of projects**	**Percentage of total**	**No. of projects**	**Percentage of total**	**No. of projects**	**Percentage of total**
Central Government	3	2.56	06	1.83	17	2.60	4	2.60
State/Local Government	3	2.56	12	3.66	31	4.75	5	3.25
Private Entity	111	94.88	310	94.51	605	92.65	145	94.15
Total	**117**	**100.00**	**328**	**100.00**	**653**	**100**	**154**	**100**

Source: National CDM Authority, India (www.cdmindia.gov.in)

Table-6: Sectoral distribution of registered CDM projects executed by the Central Govt. in India

Sl	Sector	2010		2011		2012		2013	
		No. of projects	**Annual CERs**	**No. of projects**	**Annual CERs**	**No. of projects**	**Annual CERs**	**No. of projects**	**Annual CERs**
1	Energy Industries (Renewable/ Non-renewable Sources)	3 (100)	22,482	1 (16.67)	54,464	9 (52.95)	3,35,234	2 (50.00)	96,572
2	Manufacturing Industries	-	-	3 (50.00)	1,12,873	2 (11.76)	1,25,551	1 (25.00)	6,92,977
3	Energy Demand	-	-	2 (33.33)	3,512	4 (23.53)	87,337	-	-
4	Fugitive Emissions from Fuel (Solid, Oil and Gas)	-	-	-	-	1 (5.88)	56,400	-	-
5	Metal Production	-	-	-	-	1 (5.88)	56,251	-	-
6	Waste Handling and Disposal	-	-	-	-	-	-	1 (25.00)	22,306
Total		**3 (100)**	**22,482**	**6 (100)**	**1,70,849**	**17 (100)**	**6,60,773**	**4 (100)**	**811,855**
Average size of the project		**7,494 CERs**		**28,475 CERs**		**38,869 CERs**		**3,50,933 CERs**	
Country average		**63,061 CERs**		**34,217 CERs**		**84,367 CERs**		**76,917 CERs**	

Source: National CDM Authority, India (www.cdmindia.gov.in)
Note: Figures in the parentheses indicate percentages

Table-7: Sectoral distribution of Registered CDM projects Executed by State/Local Govt. in India

Sl	Sector	2010		2011		2012		2013	
		No. of	**Annual**	**No. of**	**Annual**	**No. of**	**Annual**	**No. of**	**Annual**

		projects	CERs	projects	CERs	projects	CERs	projects	CERs
1	Energy Industries (Renewable/ Non-renewable Sources)	3 (100)	23,10,053	6 (50.00)	5,36,984	13 (41.93)	2,420,710	4 (80.00)	61,214
2	Manufacturing Industries	-	-	-	-	1 (3.23)	10,432	-	-
3	Energy Demand	-	-	-	-	15 (48.38)	229,287	-	-
4	Waste Handling and Disposal	-	-	6 (50.00)	5,87,918	1 (3.23)	3,545	-	-
6	Afforestation and Reforestation	-	-	-	-	1 (3.23)	12,927	1 (20.00)	768,685
	Total	**3 (100)**	**23,10,053**	**12 (100)**	**1,12,4902**	**31 (100)**	**2676901**	**5 (100)**	**829,899**
	Average size of the project	**7,70,018 CERs**		**9,3742 CERs**		**86,352 CERs**		**2,02,940 CERs**	
	Country average	**63,061 CERs**		**34,217 CERs**		**84,367 CERs**		**76,917 CERs**	

Source: National CDM Authority, India (www.cdmindia.gov.in)

Note: Figures in the parentheses indicate percentages

Table- 8: Sectoral distribution of registered CDM projects executed by Private Entity in India

Sl	Sector	2010		2011		2012		2013	
		No. of projects	Annual CERs	No. of projects	Annual CERs	No. of projects	Annual CERs	No. of projects	Annual CERs
1	Energy Industries (Renewable/ Non-renewable Sources)	94 (84.68)	4649408	281 (90.65)	8976096	512	45,838,084	135 (93.10)	7,872,603
2	Manufacturing Industries	7 (6.31)	96353	13 (4.19)	614078	24	713,766	2 (1.38)	159,276
3	Energy Demand	8 (7.21)	104935	13 (4.19)	798737	43	2,152,749	4 (2.76)	52,426
4	Waste Handling and Disposal	2 (1.80)	194940	-	-	16	1,458,878	1 (0.69)	4,569
5	Afforestation and Reforestation	-	-	-	-	3	165,585	-	-
6	Metal Production	-	-	1 (0.32)	246211	-	-	1 (0.69)	23,156
7	Transport	-	-	2 (0.65)	587918	2	136,974	1 (0.69)	632,256
8	Others	-	-	-	-	6	1296526	1 (0.69)	59,988
	Total	**111 (100)**	**5045636**	**310 (100)**	**11223040**	**606 (100)**	**51762561**	**145 (100)**	**8,804,274**
	Average size of the project	**7,70,018 CERs**		**93,742 CERs**		**86,352 CERs**		**2,02,940 CERs**	
	Country average	**63,061 CERs**		**34,217 CERs**		**84,367 CERs**		**76,917 CERs**	

Source: National CDM Authority, India (www.cdmindia.gov.in)

Note: Figures in the parentheses indicate percentages

References:

Boyd, E., Hultman, N., Roberts, J., Corbera, E., Cole, J., Bozmoski, A., Ebelling, J., Tippman, R., Mann, P., Brown, K. and Liveman, D. (2009), "Reforming the CDM for sustainable development:Lessons learned and policy future", Environmental Science & Policy, Vol.12, No.7, pp.820-31.

Cohen, S., Demeritt, D., Robinson, J. and Rothman, D. (1998), "Climate change and sustainable development: Towards dialogue",Global Environmental Change, Vol.8, No.4, pp.341-71.

Dechezlepretre, A., Glachant, M. and Meniere, Y.(2009),"Technology transfer by CDM Projects: A comparison of Brazil, China, India and Mexico", Energy Policy, Vol. 37, No. 2, pp.703-11.

Fenhann, J. and Hinostroza, M. (2011), CDMInformationsandGuidebook (3rd ed.), UNEP Risoe Centre on Energy, Climate and Sustainable Development, Roskilde, Denmark.

Fleming, J.R. (1998), Historical Perspectives on Climate Change, OxfordUniversity Press, New York.

Gundimeda, H. (2004), "How 'sustainable' is the 'sustainable development objective' of CDM in developing countries like India?", Forest Policy and Economics, Vol.6, No.3-4, pp. 329-43.

Markandya, A.and Halsnaes, K. (2002), Climate change & sustainable development: Prospects for developing countries, Earthscan Publications Limited, London.

Ministry of Power, Govt. of India, Annual Report for the years 2010-2011 & 2009-2010.

Nussbaumer,P. (2007),"Working of Carbon Market", Economic and Political Weekly, July 28, 2007,pp.3081-85.

Okubo, N. and Pandey, N. (2011), Linking Ground Experience with CDM Data in the Power Generation Sector in India, IGES-TERI CDM Reform Paper, March.

Olsen, K.H.(2007), "The CleanDevelopment Mechanism'scontributiontosustainable development: A review of theliterature", Climatic Change, Vol.84, No.1, pp.59-73.

.....and Fenhann, J. (2006), "Sustainable DevelopmentBenefits of Clean Development Projects", CD4CDM Working Paper Series, No.2,UNEP Risoe Centre on Energy, Climate and Sustainable Development, Roskilde, Denmark.

Oza, H.S. and Fenhann, J. (2008), "Sustainabledevelopment benefits ofclean development mechanism projects: A new methodology for sustainability assessment based on text analysis of the project designdocuments submitted for validation,"Energy Policy,Vol.36, No.8, pp.2819–30.

Pandit, P.N. (2006), "Carbon Credits: Silver Lining to Global Warming", The Hindu Business Line, Jun.

Sunbhag, S. (2010), "Crediting on Carbon: The Carbon Market offers a Promising Future for India", Dataquest, March 31.

UNEP Risoe Centre on Energy, Climate and Sustainable Development (2010), CDM Technology & Methodology Overview, Roskilde, Denmark.

United Nations Framework Convention on Climate Change (UNFCCC), 1998,Kyoto Protocol.

....., 2005, Caring for climate: A guide to the Climate Change Convention and the Kyoto Protocol.

....., 2007, Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries.

....., 2007, Uniting onclimate: A guide to the Climate Change Convention and the Kyoto Protocol.

....., 2008, Clean Development Mechanism in brief.

....., 2008, Guidelines forCompleting the ProjectDesign Document (CDM-PDD) and the Proposed NewBaseline and Monitoring Methodologies (CDM-NM), Version 07.

----------, *2009, Glossary of CDMTerms, Version 05.*
----------, *2011, Benefitsof CleanDevelopment Mechanism.*
United Nations Intergovernmental Panel on Climate Change(IPCC), 2001,Climate Change: The scientific basis,Third Assessment Report, Cambridge University Press, Cambridge.

Websites:

www.unfccc.int *[United Nations Framework Convention on Climate Change]*
www.cdm.unfccc.int *[Clean Development Mechanism (CDM) to UNFCCC]*
www.cdmindia.gov.in *[National CDM Authority, India]*
www.moef.nic.in *[Ministry of Environment and Forests, Govt. of India]*
www.commin.ic.in *[Ministry of Commerce & Industry, Govt. of India]*
www.powermin.nic.in *[Ministry of Power, Govt. of India]*
www.beeindia.in *[Bureau of Energy Efficiency, Ministry of Power, Govt. of India]*
www.worldbank.org.in *[World Bank]*
www.teriin.org *[The Energy and Resources Institute, New Delhi]*
www.iges.or.jp *[Institute for Global Environmental Strategies, Kanagawa, Japan]*
www.cd4cdm.org *[UNEP Risoe Centre on Energy, Climate and Sustainable Development, Roskilde, Denmark]*

Sustainability Appraisal and Economic Valuation of North Delhi Ridge Using Participatory Research Approach

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Alok Sharma**
Ishani Gupta***
PratibhaBaveja****

Abstract

The Delhi Ridge is the Northern extension of the Aravalli hill ranges and is a prominent landscape feature of the National Capital Territory (NCT) of Delhi. The presence of Delhi Ridge, along with River Yamuna, has been of strategic significance in the selection of Delhi as a 'capital city' since ancient times. Located between the hilly terrain of the Ridge on one side and the expanse of River Yamuna on the other, the Delhi of earlier times was provided with the necessary protection (and water) much needed in those days. Modern Delhi has grown beyond the physical boundaries of the Ridge and the Yamuna. The once barren Ridge has now been transformed into a forest, which provides useful ecosystem services to Delhi. The Delhi Ridge acts as a buffer for the rapidly increasing air pollution and as a haven for the urban biodiversity of Delhi. The Ridge acts as a recharge zone for the ground water aquifer while also providing an aesthetic 'sense of place' to Delhi.

Despite the large number of benefits provided by the Delhi Ridge, the latter is under a constant threat of encroachment and degradation. This is because land is a highly priced natural resource in the NCT of Delhi. The approximately 78 sq. km area of the Delhi Ridge in Delhi is thus also seen by many as an area that could be converted into concrete 'commercial' or 'residential areas'. It is because of this reason that several legal and illegal building and other structures have been installed inside the Delhi Ridge in the last few years. The once continuous Delhi Ridge is now found in four unevenly fragmented parts. These are: 1) Northern Ridge Forest (0.9 sq km), 2) Central Ridge Forest (8.6 sq km), 3) South-Central Ridge Forest (6.3 sq km) and 4) Southern Ridge Forest (62 sq km). There is also considerable ambiguityin the demarcation and governance of the Delhi Ridge and a large part of this forest land does not even come under the supervision of the Forest Department of the Government of NCT of Delhi.

The present research contribution is an attempt to carry out a sustainability appraisal of the Delhi Ridge by using the principles of environmental economics and participatory research. We focus on the North Delhi Ridge and have carried out an economic valuation of this part of the Ridge using survey based methods. The 'economic benefits of biodiversity' have also been calculated using Natural Capital Accounting modules. A participatory-GIS approach has been followed to highlight the physical boundary of the North Delhi Ridge along with the areas of encroachment. We find that the economic value of the North Delhi Ridge is much greater than the benefits that may be drawn by modifying its land use land cover to concrete. We also find that in the absence of existing notification on the extent of the North Delhi Ridge, there is rampant encroachment on its eastern and southern side. We recommend a more stringent

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protection of the perimeter of the North Delhi Ridge through more effective governance and stakeholder involvement.

Keywords: *ecosystem services, environmental economics, Delhi Ridge, urban ecology, participatory research.*

1. Introduction

The 'Delhi Ridge' is the vernacular name given to the Northern extension of the Aravalli Range as it passes through the Delhi megacity. The Delhi Ridge is also known as the 'green lungs' of Delhi and is a rocky hilly, reserved forest area, which lends a unique geographic character to Delhi (Mann and Sehrawat, 2008).The Ridge plays a vital role in maintaining salubrious environment in Delhi by acting as a barrier against the hot winds coming from Rajasthan. It also provides critical ecosystem services such as recharging the ground water, absorbing air pollution, purifying the air, providing habitat for urban biodiversity and giving Delhi a 'sense of place'as well as aesthetic beauty.

The rapid pace of urban growth in Delhi is having a significant impact on the Delhi Ridge in the present day. This impact has been even more prominent in the last few decades and the Ridge is facing threats like encroachment, illegal construction, deforestation and garbage dumping. This is resulting in a gradual degradation of the Ridge (Mohan et al, 2000; Nath et al, 1993). It is interesting to note that the air quality in Delhi has simultaneously degraded in the same time period. While the degradation of air quality in Delhi may not be a direct result of the degradation of the Delhi Ridge, it is certain that the protection of the Ridge is certainly a pre-requisite for ensuring clean air in Delhi. The Delhi Ridge therefore needs to be conserved and maintained in order to ensure the environmental health of Delhi.

According to the Geological Survey of India (GSI), 'the Ridge must be maintained in its pristine glory and no further infringements should be permitted'. Recent media reports indicate that the first step towards the conservation of Delhi Ridge is its demarcation. The National Green Tribunal (NGT) had already ordered Government of Delhi to carry out the demarcation of the Ridge in 2013. However, due to reasons that are yet to be established, the demarcation exercise is yet to be completed. It is therefore difficult to conserve the Delhi Ridge in a situation when its perimeter is not adequately mapped out. At the same time, land is a highly priced resource in a megacity like Delhi. Lack of demarcation as well as public interest and pressure could well lead to the modification of the land-use of Delhi Ridge from 'forest area' to 'residential' or 'commercial'. Indeed such modifications have begun to take place leading to a reduction in the overall area of the Delhi Ridge (based on media reports and personal visits).

The present research contribution is at an attempt at carrying out the sustainability appraisal of the Northern part of the Delhi Ridge.The boundary of the Ridge has been identified using Participatory-GIS approach. Such an approach has been used previously for identifying the benefits of green spaces (Brown, 2014). The political status of the North Delhi Ridge (NDR) was ascertained along with carrying out a spatial vulnerability assessment of this study area. Various stakeholders of the NDR have also been identified along with attempting to carry out its economic valuation.

The Delhi Ridge is a natural heritage of Delhi and India and it provides some very useful services to the people at large. Despite this, its existence has now become threatened. There is thus a great disconnect between citizens and the very natural resources that support them which has been highlighted in this paper. Since land is a highly priced resource, greater efforts are needed to protect the Ridge. We have attempted to evaluate the economic benefits of the NDR which may prove useful in developing a conservation strategy for Delhi's life supporting system.

2. The Study Area

The North Delhi Ridge is located in the North Delhi District of the National Capital Territory (NCT) of Delhi between 28°41′34.8″N 77°13′12.9″E and 28°40′04.8″N 77°12′34.4″E. The North Delhi Ridge (NDR) is also called the Kamala Nehru Ridge and is the smallest among the four parts the Delhi Ridge. According to Government of Delhi, NDR occupies an area of 87 ha and constitutes 1.13 % portion of total Delhi Ridge area (DoE-GNCTD, 2014).There is, however, ambiguity on the total area of the NDR and the Survey of India has previously reported it to be 82 ha (SOI, 1976). NDR consists of quartzite rocks formation and is the rocky outcrop of the Aravalli Hill range. The NDR part of the Ridge has University of Delhi on its Western and South-western side, Civil Lines on its East side and *Timarpur* residential area on its Northern side (Fig. 1).

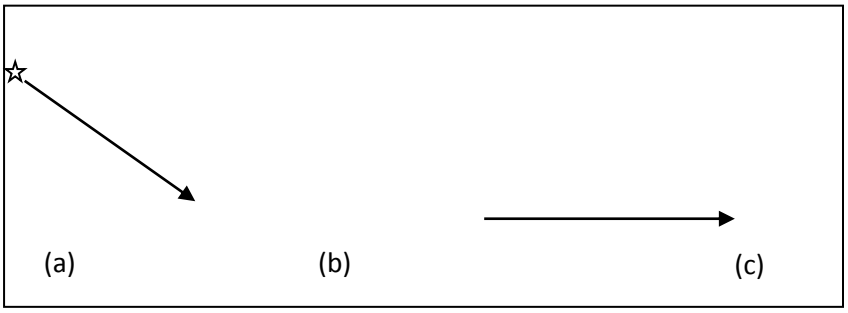


Figure 1. Map showing (a) location of NCT of Delhi on map of India, (b) location of North Delhi Ridge on map of Delhi and (c) North Delhi Ridge.

2.1 Ridge Management

Three different agencies manage different parts of the North Delhi Ridge and the parts are unequally divided. The Delhi Development Authority (DDA) manages the largest among these parts (73 ha) while the North Delhi Municipal Corporation manages 11 ha of total 87 ha. Interestingly, the Forest Department of the Government of Delhi manages only about 3 ha of the total NDR area. It needs to be noted here that the Delhi Ridge has been notified as a 'Reserve Forest' under Section 4 of the Indian Forest Act, 1927 vide Notification No.F.10(42)-

1/PA/DCF/93/2012-17(I) dated 24th May, 1994. At the same time, theHon'ble Supreme Court of India has directed that the Ridge should be maintained in its pristine glory (DoE-GNCTD, 2014).

2.2 Historical Importance

Delhi has a rich history which still remains unexplored. Delhi is known to beconsisting ofseven (+2) cities which have influenced its history and urban planning from time to time. The North Delhi Ridge (earlier a continuous part of the Delhi Ridge) is of considerable significance with respect to the history of Delhi. The oldest structure present inside the NDR can be attributed to the reign of FerozshahTughlaq. Historians believe that Tughlaq had also made attempts to carry out afforestation activity in the Northern ridge in addition to developing it as a game reserve (Horton, 2008). The structures remaining inside the NDR from Tughlaq period are *Chauburja* Mosque, *Kushk-i-shikar* or Pir Ghaib and Ashokan Pillar. TheAshokan Pillar is 10meter high and was brought to Delhi from Meerut in 1356 as part of a beautification project (WMF, 2014).

It is believed that reckless deforestation of NDR took place during the Mughal period and continued till early nineteenth century. In the British period, the first efforts to plant the NDR were undertaken by J.R. Maconachie and Dr. Ross. This was followed by few others like Rev. G.A. Lefroy and Deputy Commissioner C.A. Barron, all of whom attempted to increase the vegetation cover of NDR (Mann and Sehrawat, 2008).The Ridge holds tremendous relevance from the point of view of the First War of Independencein 1857. The British camped in and around the Northern Ridge after the mutiny took place. NDR was the centre of attention during the British period even before the mutiny. The British Cantonment was located in Civil Lines. The area around the NDR was the administrative hub and hosted buildings such as the Old Secretariat (present day *Vidhan Sabha*) and the Vice Regal Lodge (present day University of Delhi Secretariat). A flagstaff tower was constructed inside the NDR in the year 1826. NDR and the structures inside the Ridge provided refuge to the British army during the mutiny of 1857. A 29.5 meter tall 'Mutiny Memorial' was constructed inside the NDR in 1863 after the British regained power.

2.3 Ecological Significance

Ecosystem services are of critical importance in rapidly urbanizing megacities like Delhi. The city of Delhi has an alarmingly high population of 16.7 million (Census of India, 2011) and an increasingly consumerist culture. A recent study by Yale University has placed Delhi as the worst polluted city in the world. According to this study, Delhi has surpassed Beijing (EPI, 2014), the latter of which has been known for its pollution problems since a long time (Down to Earth, 2014). This makes it even more important for us to understand and appreciate the ecosystem services provided by the Delhi Ridge. The role of Delhi Ridge as the 'Green Lungs' of Delhi needs to be revisited. The 'green lungs' metaphor is very relevant as the Delhi Ridge has been preventing the deleterious impacts of air pollution in Delhi to the greatest possible extent. The ecosystem services tendered by the Ridge can be classified broadly into four categories.

Provisioning Services are the supply of goods of direct monetary value to the people for example timber, fish, fiber, fruits etc. These are of immediate benefit to communities living on the fringes of the ridge or those who are encroaching up on it. ***Regulating services*** underscore the range of functions performed by the ecosystem that cannot be defined in monetary terms but are of great value. The regulating services of the Delhi Ridge are paramount for survival of the citizens of Delhi. The Ridge protects Delhi from the searing winds and sandstorms of Rajasthan

and helps in lowering the temperature by retaining moisture. It checks soil erosion, purifies the polluted air, regulates rainfall and recharges the depleting groundwater resource. It also regulates global warming by sequestering carbon. These functions are of enormous significance to present day Delhi, which is highly polluted and faceschallenges like air pollution water scarcity regularly.

Cultural servicesare not defined in terms of material benefits but are understood as the needs of society or are understood for the aesthetic benefits that they provide. The Ridge is the only cherished refuge to the threatened urban biodiversity in Delhi. This makes the Ridge an ideal spot for birding. The Ridge enhances the landscape and was in fact landscaped by the British for the beautification of the capital. NDR is inundated with morning walkers who profit from these cultural services. ***Supporting services***are difficult to perceive as they are of no direct benefit to the people. They are basically services that form the basis for provision of all other services and are crucial for the functioning of the ecosystem. Formation of soil, process of plant growth, habitat for species, oxygen from plants, nutrient cycling, primary productivity etc. are some of the supporting services provided by NDR.

3. Methodology

The objective of the present research contribution was to carry out a sustainability appraisal of the NDR using survey, participatory GIS and economic valuation tools. Three different survey sheets were prepared, one each for morning walkers, students and tourists visiting the NDR. A random survey was carried out (between 7.00 am to 8.30 am for morning walkers, 12.00 pm to 2.00 pm for students and tourists) to understand the public perception towards the Ridge. This was followed by carrying out an exploratory vulnerability assessment of the Ridge using GPS. Encroachments and other breach of the Ridge wall, as well as structures like waste disposal sites were noted and marked on the map of the NDR using MapInfo GIS software (v.10.0). An attempt has also been made to carry out the economic valuation of the NDR using rapidly developing environmental economics methods.

4. Public Perception about NDR

Preliminary survey conducted for identifying the population universe indicated that approximately 300-400 people visit the Ridge as morning walkers every day. Approximately 100-200 students/ day visit the Ridge on a regular basis while approximately a similar number of tourists visit the Ridge on a daily basis. A sample size of n=20, 15 and 15 was then selected for morning walkers, students and tourists populations. The random survey encountered 85% males and 15% females among the morning walkers, 27% males and 73% females among the students and 60% males and 40% females among the tourists (Fig. 2).

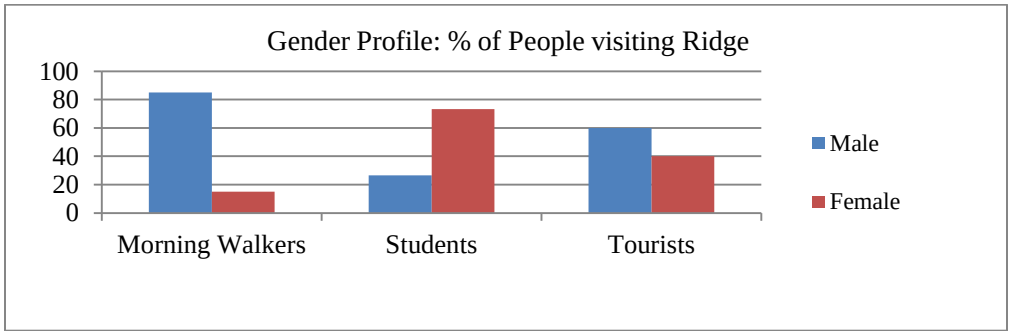


Figure 2. Gender profile of the surveyed population visiting North Delhi Ridge.

Amoung all males visiting the NDR, maximum percentage of visitors are between the age group of 20 to 30 years, whereas in females, maximum percentage of visitors lie in the 10 to 20 years age group (Fig. 3). Most of the visitors to Noth Delhi Ridge are youth under the age of 30 years. The main reason behind this could be the proximity to the North Campus of University of Delhi.

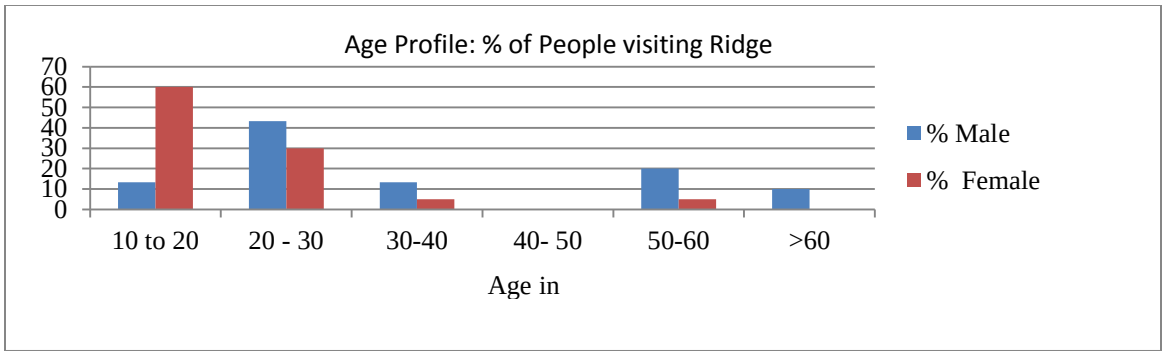


Figure 3. Age profile of the surveyed population visiting North Delhi Ridge.

People visit the NDR largely due to its natural beauty and for obtaining health benefits (Fig. 4). Apart from this, the Ridge also provides recreational space for college students and a peaceful place for couples (who visit the Ridge as tourists).

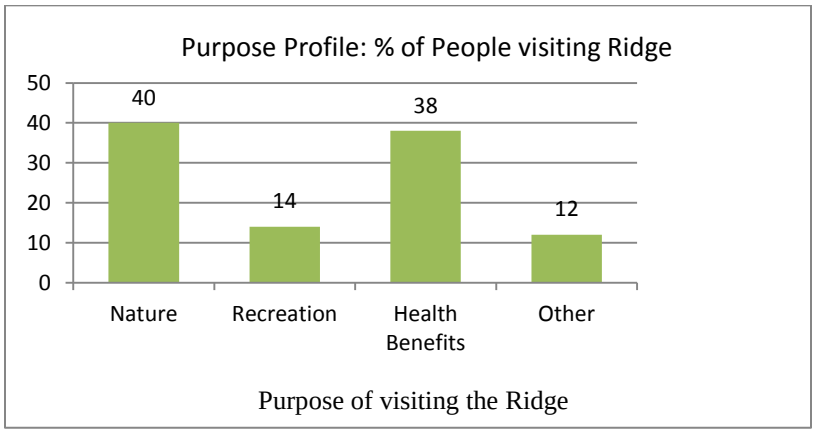
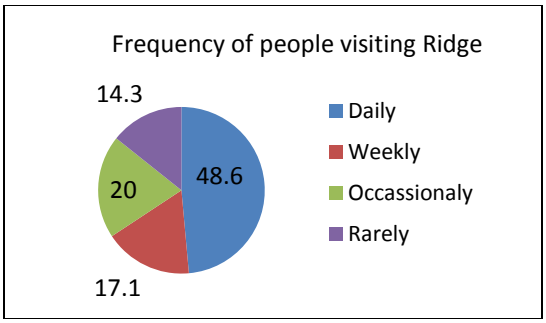


Figure. 4. Surveyed population' purpose of visiting the North Delhi Ridge.

Around 49% of total surveyed people visit theNDR daily, mainly for the purpose of morning walk(Fig. 5). 17% of sampled visitors visit the Ridge weekly while 20% were found to be occasional visitors. Among the total sample size, 56% visitors prefer to reach the Ridge on foot while 16% use public transport. 28% of the surveyed population commuted to the NDR using their personal vehicle (cars and bikes).



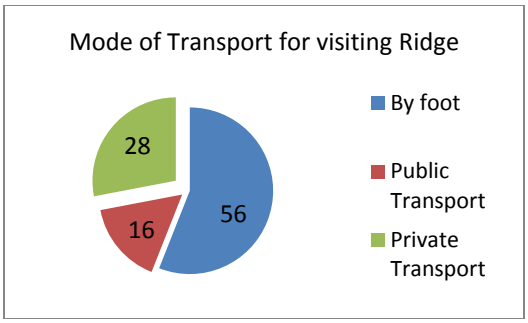
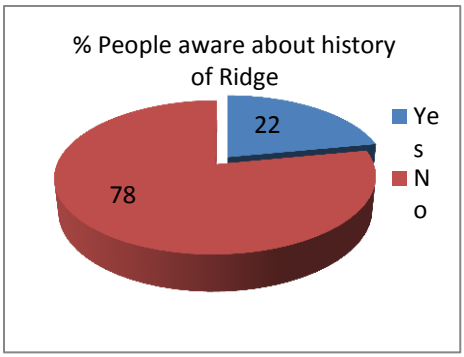


Figure 5. Frequency of visiting the NDR. **Figure 6.** Mode of transport for visiting NDR.

Only 22% of the sampled population was aware about the history associated with the NDR (Fig. 7). Detailed analysis revealed that those below the age of 30 years are less aware about the history of NDR as compared to those above this age. More than 50% of all visitors feel that the Ridge is threatened with encroachment and degradation (Fig. 8). Littering (especially plastic waste) by visitors,municipal waste dumping as well as problems of law and order such as chain snatching and eve teasing are perceived by the sampled population.



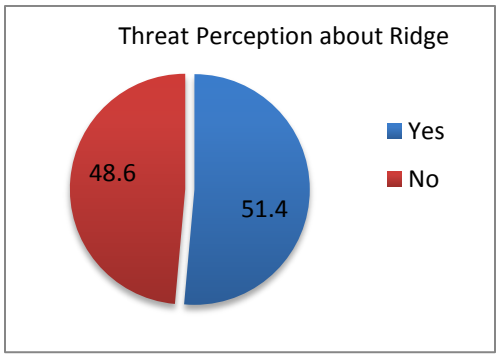


Figure 7. Awareness on history of NDR. **Figure 8.**Threat perception assessment of NDR.

Among the total sampled population, 66 % of people are willing to work for the conservation of the NDR. This percentage of population is keen to get involved with any conservation program initiated for the protection of the Ridge (Fig. 9).

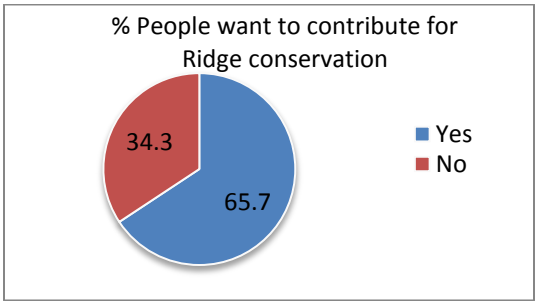


Figure 9. Surveyed populations' willingness to contribute in Ridge conservation.

50% of the sampled population is willing to pay for entering the Ridge, if such a conservation strategy is implemented. Those opposing such a measure are of the opinion that the poor will be severely affected and the NDR will become a public space for elite only. It was interesting to note that a large proportion of the sampled population consider the NDR as rejuvenation place which should not be regulated for any section of the people.

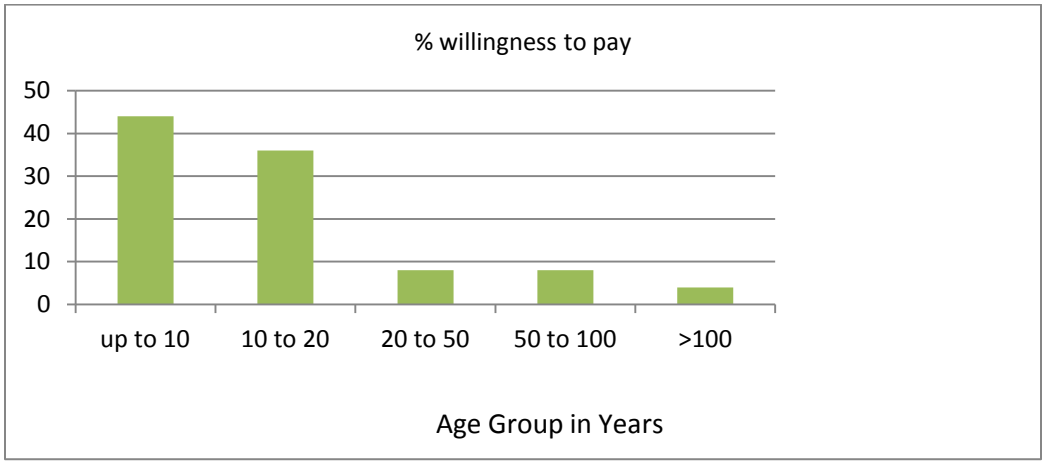


Figure 10. Surveyed populations' willingness to pay for entering the NDR.

50% of the people, who are willing to pay to enter the NDR, are largely below 30 years age (Fig. 10). The amount opined by more than 90% of this population, as entry fees for the NDR, is Rs. 20/-.

5. Participatory-GIS Analysis

A participatory-GIS process is a relatively new concept involving the integration of inputs from multiple stakeholders and technical experts with Geographic Information System (GIS) to establish pre-defined objectives (Zhang et al, 2013). The objectives in this case were to carry out a threat perception and vulnerability assessment of the NDR. It was deduced that the boundary of the NDR was yet to be demarcated (personal communication with Forest Officials). It was also found that the process of the declaration of the NDR as a "Reserve Forest" has not been completed. This implies that the protected status of the NDR does not hold true and required further investigation of encroachments around its entire perimeter. The latter was done using personal visits to the entire perimeter of the NDR while simultaneously using inputs from daily visitors and management authorities of the NDR. A thematic map was prepared based on the participatory-GIS data (Fig. 11).

While existing management of the NDR considers it to be a single entity, participatory GIS research indicates the existence of at least eight distinct zones (Fig. 11). The zones are formed due to the road network that exists inside the NDR and are enclosed by a prominent boundary wall. An auxiliary zone of the NDR was also discovered during the participatory-GIS exploratory research.

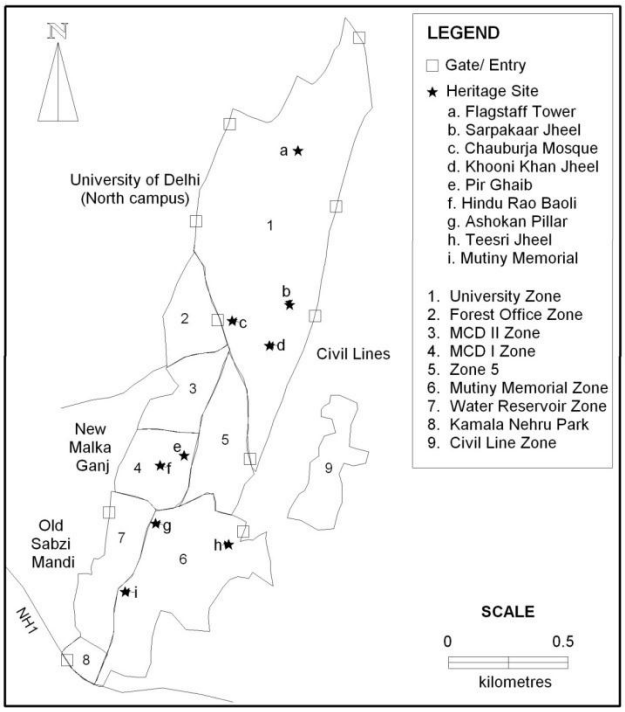


Figure 11. A Participatory-GIS map showing the identified zones and heritage sites of the NDR.

The first zone is the largest among all zones and has been christened the **University Zone** based on its location. This is the zone which is frequented more often by morning walkers as well as students. The second zone houses the office of the Forest Department as well as a nursery. This is the zone managed by the Forest Department and has been christened as the **Forest Office Zone**. The third and the fourth zones are managed by the Municipal Corporation of Delhi. The third zone is forested while the fourth zone houses the Hindu Rao hospital complex. These third and the fourth zones have been named **MCD II Zone** and **MCD I Zone**respectively. MCD II Zone is also interesting since a large solid waste dumping *dhallaon* (bin) is located in it. Preliminary investigation of the *dhallaon* indicates that both solid waste as well as hospital waste is dumped here.

The fifth zone is forested and has been christened **Zone 5** due to the lack of any prominent feature. The sixth zone is the second largest among all zones and is being called the **Mutiny Memorial Zone** due to the presence of the Mutiny Memorial in its vicinity. The seventh zone houses a large water reservoir and is being called the **Water Reservoir Zone**. The southern most part of the NDR has been converted into a public park which is known as the **Kamala Nehru Park**.

The participatory-GIS approach identified a zone of the NDR which is no longer part of it. This zone lies in the adjacent Civil Lines area and has been christened the **Civil Lines Zone**. More than 90% of this zone is still forested and the zone like approx. 250 m. from the perimeter of the present NDR. Residential and commercial structures exist between the present perimeter of the NDR and this zone. Encroachments on the South-eastern perimeter of the NDR were observed at several places. These were more prominent in the area between the Mutiny

Memorial and the outer-wall perimeter towards Civil Lines where cattle grazing inside the NDR was also spotted.

5.1 Tourism Potential of NDR

The participatory-GIS analysis also revealed the tourism potential of the NDR. Participatory-GIS mapping added the logistic perspective to exiting knowledge in the development of a tourism package for the NDR. The different heritage structures inside the NDR have attracted citizens of all age groups as well as tourists visiting the city. However, no concrete efforts have been made to promote tourism in the NDR. We would like to maintain here that while tourism in itself could lead to adverse exploitation of the natural beauty of the NDR, the NDR can become a hotspot for ecotourism. An experimental attempt to initiate urban ecotourism in the NDR has carried out by Delhi Greens NGO and is discussed elsewhere (Singh, 2011).

The participatory-GIS approach indicated two distinct sectors for carrying out ecotourism in the NDR. The first Sector includes Zone 1, which further includes the following heritage structures: a) Flagstaff Tower, b) *Sarpakaar Jheel* wetland, c) *Chauburja* mosque and d) *Khooni Khan Jheel* wetland (Fig.11). The second sector includes geographically linked Zone 4 and Zone 7 and includes the following heritage structures: e) *Pir Ghaib*, f) *Hindu Rao Baoli*, g) Ashokan Pillar, h) *Teesri Jheel* wetland and i) Mutiny Memorial. A third and larger Sector can be conceived which could include both these sectors. Each of the aforementioned structures are part of the natural and historical heritage of Delhi and India, and have tremendous economic potential with respect to conducting ecotourism.

6. Economic Valuation of NDR

The knowledge of ecosystem services has long existed (Tallis, 2013). The methods for the economic valuation of such services are now being developed (Whitehead, 2013; Laurans, 2013). The success of such an approach is validated by the fact that it has also been extended to valuing historic environments (Provins et al, 2008). The present research contribution attempts to initiate an economic valuation of the NDR. While the economic valuation methods could be used on several attributes i.e. above discussed tourism potential, ground water recharge ecosystem service etc., the oxygen producing service was selected as the chosen attribute. This was based on a previous study on the economic valuation of healthy trees (Delhi Greens, 2013).

There is no official census of the trees exists for the NDR. Consequently, a tree census was made in the fourth zone (MCD I Zone) which has the least tree density due to the presence of Hindu Rao Hospital complex. A total of 68 healthy trees were counted in this zone. Since this is the pilot investigation, the age of the tree was not taken into account. The latter will play an obvious role in the oxygen generating capacity of the tree. The figure so obtained was multiplied by the economic value (EV) of one tree with respect to (maintenance free) oxygen production (~Rs. 23,72,50,000/-) (Delhi Greens, 2013).

$EV_{MCD\ I\ Zone}$ = 68 x Rs. 23,72,50,000 = Rs. 16,13,30,00,000

We deduce that the economic valuation of the ‘oxygen producing’ ecosystem service of the most disturbed zone of the NDR is one thousand six hundred and thirteen crore rupees. The EV so obtained will increase multifold if other ecosystem services of this zone are calculated and included in the valuation. The EV of the other zones of the NDR (which are both larger and less disturbed) is bound to be several times more than the above calculated EV.

6. Discussion

The North Delhi Ridge provides useful ecosystem services to the student population and the residents living close to it. However, there is a need to recognize these services and understand the importance of the NDR with respect to these services. There is a good level of understanding of the importance of the NDR with the residents living in its vicinity. A similar level of understanding is wanting with the administrative authorities managing the North Delhi Ridge. The NDR and the entire Ridge was notified as Reserve Forest on 24 May, 1994. But the process has not been completed due to pending land dispute cases and the Ridge continues to be managed by agencies other than the Forest Department. The NDR is managed by three agencies, out of which the Forest Department manages only a small part of the entire NDR. Interestingly, this is also the part of the NDR which is most conserved and has least encroachment. Consequently, it is reasonable to believe that the complete transfer of the NDR to the Forest Department will aid in the conservation of the NDR. The study recommends the speedy settlement of all pending land disputes and the transfer of the Ridge Forest to the Forest Department.

The NDR has been found to exist in eight distinct and continuous zones based on the participatory-GIS analysis. These zones are divided by roads and have variable pressures. Consequently, it is suggested that the management of the NDR need to be carried out in a zone wise manner. Such a micro-management of the NDR will help enhance the green cover and also address environmental challenges such as habitat fragmentation and loss of biodiversity. Absence of clear demarcation of the ridge limits any methodological approach in its conservation. The ninth zone of the NDR, as identified in the participatory-GIS approach, is an interesting find. It is an indicative that there exist areas in the vicinity of the Ridge, which have retained the Ridge Forest character, but have been fragmented due to urbanisation. These areas could serve the purpose of ecological corridor and could aid in the enhancement of the urban biodiversity.

Encroachment from the South-east perimeter and heavy traffic movement are some other challenges being faced by the NDR. While littering is observed as a problem, the presence of an open-air waste disposal municipal *dhallaon* adjacent to the Hindu Rao hospital is an indirect public health hazard. It is highly recommended that either this municipal *dhallaon*shouldbe removed outside the NDR or it be covered and frequently emptied. Preliminary economic valuation of the NDR shows that it provides high economic gains. Indeed, a more comprehensive economic valuation is needed to identify the exact economic benefits derived from the NDR. Such a study is much needed and should be carried out by (or in collaboration with) the Government for more effective results. Such a study will also aid in developing education and awareness programmes on the benefits of the NDR. This will then sensitize the people and the administration machinery about the importance of protecting and preserving the NDR in its present state.

The participatory-GIS assessment also highlighted the tourism potential of the NDR. Almost 1.89 million foreign tourists visitDelhi every year, making it the third most preferable tourist destination among all states in India (ITS, 2010). In addition to the foreign tourists, a large number of Indians also visit their state capital each year. According to 'Identification of Tourist Circuits across India' Interim report, the top four most visited places in Delhi are Qutub Minar, Red Fort, Delhi Zoo and Pragati Maidan (IL&FS, 2012). Strangely, the Northern Ridge and its

monuments do not find mention in the list of the tourist destinations of Delhi in this report.This highlights the lack of awareness in the people and in the administrationabout the North Delhi Ridge and its historical importance. This lack of awareness has indeed robbed the ridge of its tourism potential. The NDR has immense tourism potential and is already frequented by those who are aware of its ecological and heritage importance. Hence, it can be inferred that if more awareness is generated in this direction, the North DelhiRidge will certainly see a spurt in the number of (eco)tourists. The latter could also boost conservation measures taking place for protecting the NDR and enhance its ecosystem services.

7. Conclusion

The conservation of NDR is critical to the sustainability of the urban growth of Delhi. However, concrete efforts towards sustainable management of the NDR are wanting and there is ambiguity in its political status. While the entire NDR should be under the supervision of the Forest Department, that is not the case. Only a small fragment of the NDR is under the Forest Department, which was found to be the most protected among all zones appraised in this study. The entire NDR must be brought under the Forest Department before any further conservation measures can be taken.

Participatory GIS has been found to be useful tool for promoting people based conservation efforts. The NDR was found to be divided into eight continuous zones largely due to the presence of a road network traversing through it. These eight zones are of unequal sizes and are marked by the presence and absence of concrete structures. There is also a difference in the number of visitors frequenting the different zones. Consequently, individual zones face unique anthropogenic pressures thereby requiring zone specific management strategy for the conservation of the NDR.

The NDR is of greater relevance today due to ever increasing number of vehicles in NCT of Delhi.The inability of the state administration to put a check on unsustainable growth in the number of vehicles is concerning and further highlights the significance of the NDR in the present day.The NDR is located adjacent to the University of Delhi and acts as a buffer to the air pollution contributed by vehicular exhaust and other emissions. In doing so, it acts as a green belt which absorbs the air noise pollution and protects the health and well being of a large number of youth who frequent the University of Delhi for education purpose.

The exact economic valuation of the NDR requires a detailed study of all the ecosystem services provided by it. Preliminary investigation of just one ecosystem service (oxygen production) reveals that the total economic valuation of the NDR may well be above two thousand crore rupees. Despite such high economic benefits being provided by the NDR, there seems to be lack of concerted efforts towards its protection and preservation. There is thus a need carrying out a rigorous economic valuation of the entire Ridge. Such a research work needs to be complemented with awareness generationon the ecosystem service benefits of the Ridge to the people of Delhi.

8. References

Brown, G., Schebella, M., Weber, D. 2014. Using participatory GIS to measure physical activity and urban park benefits. Landscape and Urban Planning. (121): 34-44.

Census of India, 2011. Census of India. Government of India.

Delhi Greens. 2013. Report on Oxygen Supplying Ecosystem Service of Health Trees. Delhi Greens, Delhi, India.

Department of Environment, Govt. of NCT of Delhi. Recorded forests (Notified forest areas in Delhi). Accessed from http://forest.delhigovt.nic.in Forest on 15 February, 2014.

Down to Earth. 2014. Delhi's dream of clean air goes up in smoke. Down to Earth. February 16-28, 2014. Center for Science and Environment.

Environmental Performance Index (EPI) Report 2014. Accessed from http://epi.yale.edu/epi/country-profile/india on 26 February, 2014.

Horton, P. 2002. Delhi. (Lonely Planet Publications Pty Ltd).

IL&FS. 2012. Interim Report: Identification of Tourist Circuits Across India. IL&FS.

India Tourism Statistics (ITS). 2010. Annual Report. Ministry of Tourism, Government of India.

Laurans, Y., Rankovic, A., Billé, R., Pirard, R., Mermet, L. 2013. Use of Ecosystem Services Economic Valuation for Decision Making: Questioning a Literature Blind spot. Journal of Environmental Management. 119: 208-219.

Mann, M. and Sehrawat, S. 2009. A City With a View: The Afforestation of the Delhi Ridge. Modern Asian Studies.43(2): 543–570.

Mohan, M. 2000. Climate Change: Evaluation of Ecological Restoration of Delhi Ridge Using Remote Sensing and GIS Technologies. International Archives of Photogrammetry and Remote Sensing.Vol. XXXIII, Part B7.

Nath, V. 1993. Planning for Delhi. GeoJournal. 29(2): 171-180.

Provins, A., Pearce, D., Ozdemiroglu, E., Mourato,S.,Jones, S,M. 2008. Valuation of the historic environment: The scope for using economic valuation evidence in the appraisal of heritage-related projects, Progress in Planning.69(4): 131-175.

Singh, G., Ghosh. C., Deb, M. (2011).'Urban ecotourism' for promoting stakeholder participation in urban landscape transformation. In P. Soni and L. Singh (Eds.), Landscape Fragmentation and Restoration Researches in India (290-316). Saarbrücken, Germany: Lambert.

Survey of India (S.O.I). 1976. Delhi, Haryana, Topographical Sheet No. 53 H/ 2 & 3, Scale 1: 50,000. Government of India.

Tallis, H.,Guerry, A., Gretchen C. 2013. Daily, Ecosystem Services, In Encyclopedia of Biodiversity (Second Edition), edited by Levin, S.A., Academic Press, Waltham. p 96-104.

Whitehead, J.C.,Haab, T.C. 2013. Contingent Valuation Method, In Encyclopedia of Energy, Natural Resource, and Environmental Economics, edited by Shogren, J.F,. Waltham, E.Pages: 334-341.

World Monuments Fund. 2014. Civil Lines and the Northern Ridge. Accessed from http://www.wmf.org on 15 February, 2014.

Zhang, Z., Sherman, R., Yang, Z., Wu, R., Wang, W., Yin, M., Yang, G., Ou, X. 2013. Integrating a participatory process with a GIS-based multi-criteria decision analysis for protected area zoning in China. Journal for Nature Conservation. 21(4):225-240.

Climate Change and Water poverty at The Household Level: Enhancing adaptive Capacity Through Communication for Development

27

Sakshi Saini

Introduction

Water is one of the most important resources required for multiple uses across societies and cultures. Water is used for domestic, agricultural industrial and environmental purposes. Inadequate access to safe water profoundly affects lives and livelihoods of most people especially the poor. Access to safe water is therefore imperative to quality of life of people, for sustainable development and poverty alleviation. This is apparent by the fact a large majority of the population without access to safe water lives on less than two dollars a day (Human Development Report, 2006). Globally 1.1 billion people lack access to safe water, almost all of them live in the developing world (UNDP, 2006). In India also a large number of households do not have safe water supply resulting in significant loss of time and effort especially on the part of women, who most often bear the burden of water collection.

The role of women as water managers for the family is undisputed in most of the developing world. A study conducted by WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation in 35 developing countries in 2005-06, confirm the evidence that women (64%) shoulder the bulk of the water collection (JMP, 2008). A study on time use pattern across 18,000 households spread across six states in India, indicated that water collection is a deeply gendered task. Women are primarily responsible for water collection and bear 87% of the work burden of water collection, the rest being borne by men and children (MOSPI, 1998-99). This fact is corroborated by another study commissioned by UNICEF and conducted by Rajiv Gandhi National Drinking Water Mission, 1990 that women are the principal collectors of water in Indian households, as they bear 86% of the water collection load (Venkateshwaran, 1995).

Translating the losses borne by girls and women in terms of man (woman) hours and economics shows a loss of human capital and reduces the ability of the household to capitalize fully on its other resources. It is estimated that in India, women fetching water spend about 150 million work days per year. Translated into monetary terms, it is equivalent to a national loss of income of nearly 10 billion rupees (Srivastava, 2003).

Climate Change and water

While on the one hand demand of water is increasing due to demographic, socio-economic and technological changes, on the other hand, the availability of water faces serious threat from human induced climate change. During the past century, mean world temperature has increased by 0.74 ^{o}C and it is likely to increase by 1.1 to 6.4^{0}C in the next century (IPCC, 2007). It is projected that in future, rainfall will become more variable and uncertain leading to increased

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frequency of droughts and floods. At the same time, glaciers would be impacted and sea levels would rise considerably. All these would have an impact on the spatial and temporal availability of water in many parts of the world. Globally, an additional 1.1 to 3.2 billion people may face increased water stress for a 3-4^{0}C rise in temperature out of which 0.2 to one billion people would be from Asia. (IPCC, 2007).

The requirements of water are continuously increasing due to strong physical and industrial growth of the cities as well as rapid rural to urban migration. According to UN projections, by 2030, almost 60% of the global population will come to reside in the cities and put an additional pressure on the resources including water. Also a large proportion of the growth in urbanization will occur in the developing world with over two billion people moving to the cities between 2000 and 2030 (United Nations, 2005). This will further push the demand for water and other resources in the urban areas, thereby aggravating the already complex situation.

It is thus expected that in the coming years, problems of climate change coupled with urbanization will put increased pressure on water as well as other resources. The decreased availability of overall water supply in future will negatively impact the quality of life of people and more so the women who are hitherto responsible for procurement and management of water.

Differential impact of Climate Change on Women

Globally women are more vulnerable to the impacts of Climate Change their limited adaptive capacities arise from prevailing social inequalities and ascribed social and economic roles that manifest itself in differences in property rights, access to information, lack of employment and unequal access to resources. As per Women's Manifesto on Climate Change, 2007, 70% of the world's poor who are far more vulnerable to environmental damage are women.

Thus Climate change hits women harder due to their different roles, access to rights and information and strict gendered codes there by limiting their mobility. In urban areas it is the poor women who are impacted the most by such climatic changes since they represent the marginalized section of society with low or poor education, limited income as well as poor awareness and knowledge levels about environment. Mega cities such as Delhi, Mumbai, and Kolkata are considered to be especially vulnerable due to their large populations, rapid migration, and widespread poverty, competition for land and water and increasing multiple stresses. .

Need to adapt to climate change

It has been projected that even if we stop all GHG emissions now, global temperatures will continue to rise for quite some time. It is therefore imperative that efforts be made for the adjustment in the natural or human systems to minimize the negative effects of climate change.

Adaptive capacity is the ability of a system to adjust to climate change in order to moderate the potential damages, to take advantage of opportunities, or to cope with the consequences. Some of the adaptive strategies are reactive in response to past or current events, others are anticipatory based on the assessment of future conditions. Adaptive measures can be undertaken by individuals or groups for themselves or by the Government or public institutions. It is important

to actively engage women in areas of preparedness, risk reduction, adaptation and mitigation. The eighth Conference of Parties of UNFCCC in 2002 stated that 'Adaptation is of high priority for all countries and requires urgent attention and action on part of all the countries' (Adger et.al. 2005). Adaptive Capacity of people to climate change can be enhanced by increased access to monetary resources, infusion of technology, increasing awareness as well as knowledge level of people specially the vulnerable groups.

C4D for enhancing Adaptive Capacity

The Nobel Peace prize to the IPCC in 2007 did sensitize urban literate population about climate change and its impacts. Yet there is considerable lack of awareness among less educated and privileged section of the population even in the urban areas.

Communication is an essential part of human interaction. Dissemination of knowledge and information are important for people to successfully respond to opportunities and challenges of social, economic and technological changes. Effective communication is a tool that can be used to identify problems, encourage participation, invite innovation in problem solving and promote adaptation and mitigation. Communication for Development (C4D)is a participatory approach that integrates the use of communication strategies, media and processes to enable people and institutions to share knowledge and information and reach consensus towards common action. Isolated studies conducted in different parts of the world indicate that communication for development (C4D) can be very successfully used to enhance awareness and knowledge of people, facilitate behavior change and thus enable people to mitigate and adapt to climate change.

Methodology

Keeping the above in view, the present study has been conducted on the urban poor residing in the slum areas of a metropolitan city of Delhi. A primary survey was conducted on statistically defined sample (300 families), in the slum clusters drawn from all the five zones of New Delhi. A two stage stratified sampling technique was used to select families residing in the slums. Information was gathered from the poor women residing in slums related to their knowledge of climate change, water and sanitation practices as well as management of natural and other resources available to the families. The women were also interviewed about the common coping strategies followed by them during environmentally stressful periods. A major finding of the survey was that barring a few isolated cases, majority of the women (more than 95%) were not aware of any phenomenon such as, 'Climate Change'. The survey was also a useful tool to gauge the information needs of women as well as the level of complexity of information desired for planning appropriate communication strategies for them in order to build/enhance their adaptive capacity to climate change.

Various traditional and modern media were developed to impart knowledge and skills related to climate change and various adaptation strategies to women residing in slums. This was done because an assessment of the available communication materials related to climate change adaptation and mitigation revealed that, the materials were too complex and scientific for the poor urban women who were semi- literate or illiterate. ICTs such as short films, documentaries,

public service announcements and camera mediated exercises were scripted and produced. These were combined with print and traditional media such as posters, flip charts, flash cards, and puppetry and packaged into a communication module in consultation with experts on climate change, gender, grassroots level trainers as well as people from the community. The standardized communication module on 'enhancing adaptive capacity of women to climate change' was then administered to a statistically defined sample of 150 womwn spread over 10 slums in the five selected zones of Delhi. The group size of each campaign was 15-20 women to enable face to face interaction. The change in the knowledge level of women related to climate change and adaptation strategies was gauged by a knowledge assessment tool.

Results and Discussion

Profile of the respondents

Most respondents had been living in Delhi for more than three years and were below the poverty line. The state of women's education was dismal as almost three-fourths of the women were illiterate. Among the rest, 18% women had education up to primary level, 6% up to secondary level and less than 1% women had any form of higher education. The differences in level of education across the five zones of Delhi were very minor (Table 1). As highlighted by the Focus Group Discussions, most women who had been to school also reported that they were at best semi-literate, since they had dropped out of school in first, second or third grades and had never attempted to read anything after that.

Table 1: *Educational Level of respondents*

Educational Level	Zones of Delhi (percentages)					Average % (Delhi slums)
	East	West	North	South	Central	Delhi
Illiterate	73.33	80.00	76.67	71.67	78.33	76.00
Primary Level	21.67	13.33	16.67	18.33	18.33	17.67
Secondary Level	5.00	6.67	6.67	8.33	1.67	5.67
Higher Education	0.00	0.00	0.00	1.67	1.67	0.67

Three fourths of the women were housewives and had not taken up paid employment because it was not easy to find suitable employment coinciding with their free time. The remaining slum women were gainfully employed, as domestic helpers, petty sellers or as daily wagers in construction or in factories.

The communication based assessment revealed that the knowledge level of the women regarding climate change was extremely poor as majority of the respondents said there was no change in climate and they had not even heard of the term 'climate change'. They said had they been educated, perhaps they would have known about it. The awareness as well as knowledge level of the respondents regarding climate change was extremely poor, as a large majority of the respondents (98%) had not even heard of the term 'climate change'. They said that they did not know about the issue, were not educated and therefore could not say anything about it. A few women said that the rainfall had become very erratic which affected the crops. There were

droughts quite often, which caused great losses to agriculture in their respective villages. The women said that these changes in weather were due to God's will and humans had no control over them (Table 2).

Table 2: *Response of the Respondents regarding awareness of climate change*

Do you think the climate is changing	**Regions of Delhi (percentages)**					**Average (%)**
	East	West	North	South	Central	Delhi
Yes	3.33	0.00	0.00	5.00	1.67	2.00
No/can't say	96.67	100.00	100.00	95.0	98.33	98.0

Knowledge level of the Respondents regarding Impacts of Climate Change

Since the women had not even heard of the term climate change it was very difficult for them to perceive the possible impacts of climate change. A very small fraction of the 40 years plus women (0.33-.69%) said that increase in heat waves and longer summers are the impacts of climate change, already being experienced by people and will be so in future too (Table 3). There were hardly any differences about the perception of women across the five regions in Delhi.

Table 3: *Knowledge regarding the impacts of climate change*

Impacts of climate change	**Regions of Delhi (percentages)**					**Average (%)**
	East	West	North	South	Central	Delhi
Increased heat waves	0.00	0.00	0.00	1.67	0.00	0.33
Longer summers	0.00	0.00	0.00	1.67	1.67	0.67
Can't Say	100.00	100.00	100.00	96.66	98.33	99.00

Considering the ignorance of the women towards the issue of climate change and its negative impacts on them, it was necessary to build their knowledge base on the issue to enable them to adapt to climate change as well as water related stresses. Based on the assessment, a communication module was planned to impart knowledge and skills of appropriate and contextually suitable (at the household level) adaptation and mitigation strategies related to climate change.

The communication module focused on various aspects of climate literacy such as the phenomenon of climate change itself, its causes and impacts on the lives and livelihoods of people including gender specific vulnerabilities, impact on resources such as water, contextual and sustainable adaptation and mitigation strategies. The key components of the module were as follows:

- Ice breaking games to increase the comfort level of the group and get them talking on the issue

- Causes and impacts of climate change on lives and livelihoods of people
- Linkage between climate change, water and women
- Vulnerability of women to climatic stresses and extremes
- Contextual adaptation and mitigation strategies with special reference to water for domestic use
- Adaptation strategies to deteriorating quality of water- demonstration on water disinfection/purification techniques at the household level
- Recapitulation, question and answer sessions, competitions and quiz on climate change
- Administration of the knowledge assessment tool

The various media used were modern (films, video clips, documentaries, camera mediated exercises, public service announcements), print (posters, flash cards, flip charts) and traditional (puppets, skits and demonstrations).

Assessment of change in awareness, knowledge, attitude and behaviour after the Communication intervention

Before and after the communication intervention, the AKAB assessment tool was administered to the women in order to assess the change in their awareness, knowledge, attitudes and potential behavior of the urban poor women towards various aspects of climate change.

***Changes in awareness to climate change*:** Before the intervention, the women had not heard of the term climate change either through the mass media (radio/television) or interpersonal networks and were also not aware of its causes and impacts. It was heartening to note that after administering the communication module there was a dramatic change in overall awareness of women about the phenomenon of climate change and its related aspects. Whereas, initially only 1-2% of the respondents said that they had been experiencing extreme heat, erratic rainfall patterns and increased frequency of droughts and floods especially in their respective villages but did not know about the term 'climate change' as well as its causative factors. They also said that lack of education was a cause for their lack of awareness about the issue. But after the communication intervention, all the respondents (100%) said that climate change was indeed a reality to which they themselves could now relate.

Change in Knowledge of women about climate change and related issues:

The knowledge of women to climate change was very dismal prior to the communication intervention. The women did not know about the phenomenon of climate change, its causes and impacts. However, after the communication intervention there was a substantial change in the knowledge of women about different aspects of climate change.

Causes of climate change

After the intervention almost half of the respondents said that a combination of factors such as burning coal for electricity generation, excessive use of petrol and diesel for vehicles were the major causes of climate change. More than one- third of the women said that deforestation was the major cause of climate change, whereas one-fourth of the women attributed climate change to increasing number of cement and steel industries because of increasing population. Only 12% women thought that climate change was due to natural causes. A very

small fraction of women said that farm animals and agriculture were responsible for climate change (Figure 1). They were closely involved with agricultural activities in their villages and felt that agriculture was essential to feed everyone and therefore could not be considered as a contributor to climate change.

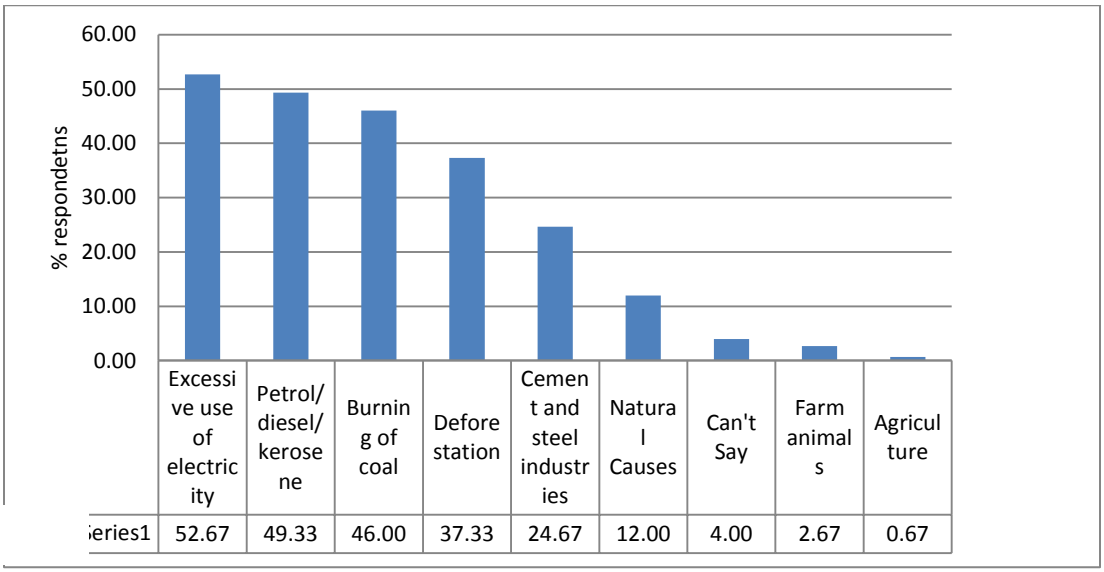

Figure 1 Knowledge of respondents about causes of climate change (n=150)

Impacts of climate change

The communication intervention resulted in considerable gain of knowledge about the impacts of climate change and most of the women said that climate change had several impacts. More than 46% women reported at least three impacts of climate change, another 49% knew about four to six impacts and a much smaller number (4.67%) knew of seven or more impacts of climate change. Majority of the women (73%) said that increase in the temperature would be the main impact of climate change followed by 67% of the respondents who said that change in rainfall would be the major impact. An equal percentage of respondents (40%) said that climate change would bring about change in river water flow and consequently the availability of water. About 30% women feared that climate change would lead to deterioration in the quality of water and would also lead to reduction in the size of glaciers (Figure 2).

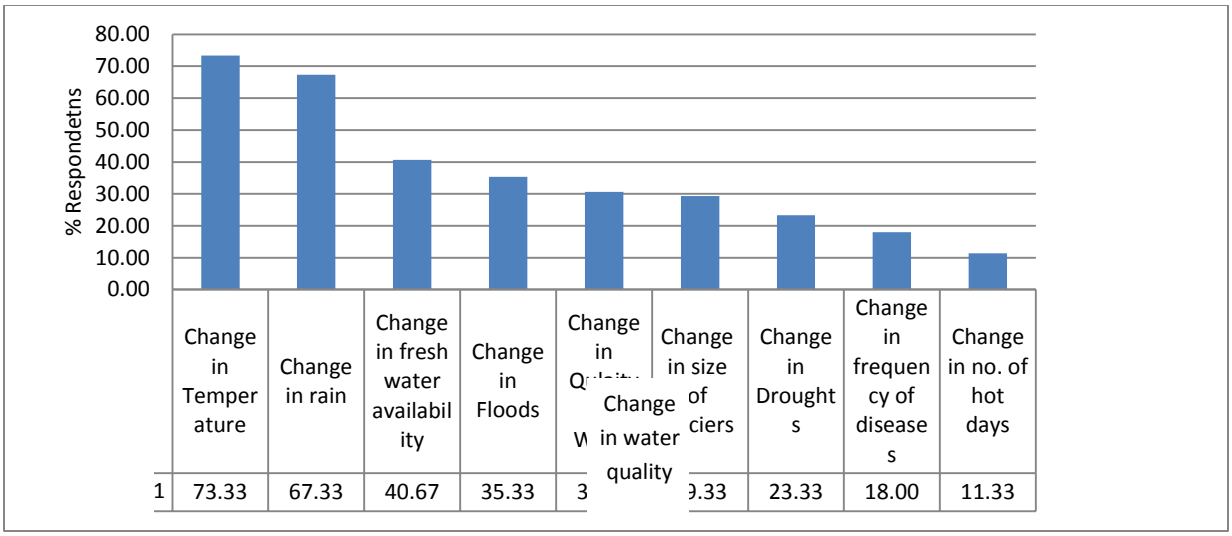

Figure 2: Knowledge of respondents about impacts of climate change-post intervention (n=150)

Mitigation strategies for dealing with climate change

Before the communication intervention, the women could not relate to the measures to reduce the pace of climate change since they did not understand the phenomenon itself. A few women had said that increasing pollution in the cities was the cause of changes in the environment and therefore needed to be reduced while a few women had said that planting trees was important. After the conduct of the communication intervention there was a remarkable gain in knowledge of women with regard to the strategies for climate change mitigation. Almost three-fourths of the women reported that saving electricity and fuels such as petrol, diesel, kerosene etc. as well as planting of trees were important for reducing the pace of climate change (Figure 3).

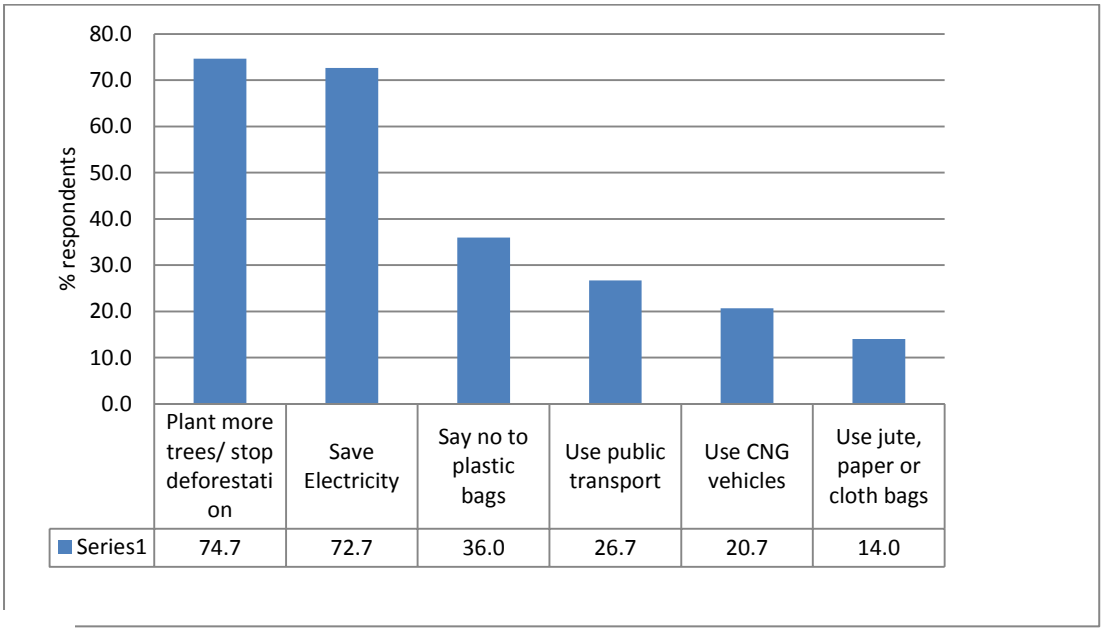

Figure 3: Knowledge of climate change mitigation strategies-post intervention (n=150)

Adaptation strategies to deal with climate change with special emphasis on water management at the household level: Almost all the respondents felt that since the climate was changing there was an urgent need for everyone to adapt to it. All the women said that there was a need to purify or disinfect water especially for drinking purpose. More than 88% women said that water was already in short supply and must be conserved for future use. A large number of women (72-81%) felt that they should use simple technologies to collect and store water such as the use of plastic pipes, carts and cycles, proper storage containers and tanks. The women said that these equipments could make their lives much easier. More than 60% respondents felt that women were overburdened with water management responsibilities and a redistribution of water related roles within the household and involvement of other family members could provide relief to them (Figure 4).

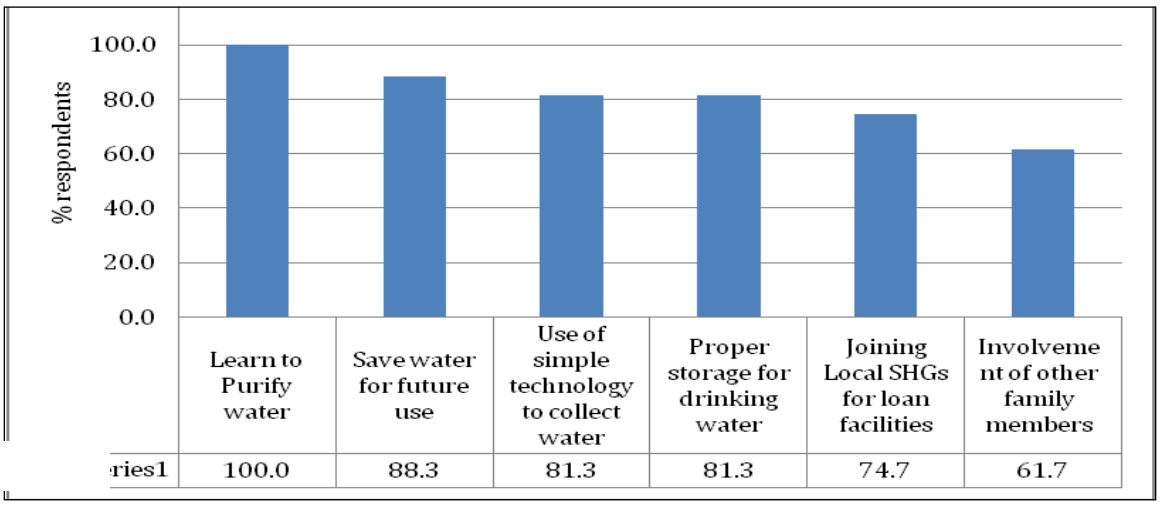

Figure 4: Knowledge of women regarding water mediated adaptation strategies-post intervention (n=150)

4.3.3.3.Changes in Attitude of women:

Climate change

Before the intervention, majority of the respondents were either neutral or disagreed to the occurrence of climate change but this changed drastically after the communication intervention. A large majority (82-98%) of the women agreed that climate was changing due to which people were facing problems. They also agreed that if people continued to use oil and gas at the present rate, the problem of climate change would be aggravated. However, it was interesting to note that only half of them felt climate change was a serious problem. They felt that there were other more serious issues such as unemployment, poor income, inadequate housing, lack of medical and education facilities which required more urgent attention (Table 7).

Table 7: Attitude of women to climate change pre and post intervention

Statements of Attitudinal Scale	Pre Intervention			Post Intervention		
General statements- about climate change.	Agree	Neutral	Disagree	Agree	Neutral	Disagree

Weather in the past 30 years has changed.	12.00	84.00	4.00	98.00	1.67	0.33
Climate change is a serious problem faced by people at present.	3.00	81.00	16.00	49.33	46.00	4.67
Climate change will be more of a problem in future.	3.00	87.00	10.00	94.00	6.00	0.00
If the present rate of coal and oil use continues, climate change will continue to occur at a fast rate.	9.00	79.00	12.00	84.00	6.00	10.00

Causes of climate change

Before the intervention, since most of the women did not know about climate change, they were neutral to the causes of climate change. After the communication intervention more than 86% women disagreed that climate change was due to God's will and that high consumption of electricity and deforestation have nothing to do with climate change. A large majority (84%) of the women agreed that the primary cause of climate change is burning of fuels such as petrol/ diesel and oil (Table 8).

Table 8: Attitude of women to causes of climate change pre and post intervention

Statements of Attitudinal Scale	**Pre Intervention**			**Post Intervention**		
Causes of Climate change	Agree	Neutral	Disagree	Agree	Neutral	Disagree
Change in climate is God's will.	8.00	82.00	10.00	8.00	6.00	86.00
The primary human activity that causes climate change is the burning of fossil fuels such as coal and oil.	4.00	86.00	10.00	84.00	14.00	2.00
High consumption of electricity has nothing to do with climate change.	10.00	80.00	10.00	24.00	0.00	76.00
Cutting of forests has no relationship with climate change.	4.00	88.00	8.00	12.00	2.00	86.00

Impacts of climate change

Even before the intervention, 78-82% women agreed that frequency of rainfall at present had changed as compared to earlier times and drought and floods occurred more frequently at present. More than 90% women agreed that poorer quality and quantity of water would affect their health adversely. However, majority of the women were neutral to climate change impacting the quality of lives of their children and grand children in future. After the communication intervention, a larger majority of women (94-98%) felt that frequency of rainfall, drought and floods has changed at present as compared to earlier times and agreed that climate change will have a negative impact on the quality of life of future generations. In addition 85-100% women (as compared to 50% women before intervention) felt that climate change will impact them negatively as it will enhance their work burdens of water collection, purification and storage (Table 9).

Table 9: Attitude of women to Impacts of climate change pre and post intervention

Statements for Attitudinal Scale	Pre Intervention			Post Intervention		
Impacts of climate change	Agree	Neutral	Disagree	Agree	Neutral	Disagree
Frequency of rain has changed now as compared to that 50 years back.	82.00	18.00	0.00	94.00	4.00	2.00
One hears more about droughts and floods at present as compared to earlier.	78.00	22.00	0.00	98.00	2.00	0.00
Climate change will reduce the quality of life of our children & grandchildren in the *future.*	3.00	81.00	16.00	94.00	6.00	0.00
Climate change and women						
Climate change will more adversely affect women.	9.00	81.00	10.00	90.00	10.00	0.00
In future women will be more burdened by water collection.	50.00	50.00	0.00	84.00	12.00	4.00

4.3.3.4. Intent to behaviour change:

Mitigation strategies:

Even before the communication intervention, a large majority of the women and their families were already practicing several mitigation strategies suggested to them in the present study such as minimizing the use of electricity by switching off electrical equipment when not in use, use of CFLs, colouring walls with light colours, using public transport and the use of CNG vehicles. This was because of very low levels of income of families and very poor availability of natural as well as other economic resources to families which strictly called for minimizing their use. These families used cycles or public transport to travel long distances and walked to the nearby destinations. They could not afford to buy or hire petrol/diesel driven private vehicles.

After the communication intervention, the other respondents (who were small in number and were practicing the above mitigation strategies to some extent) said they would use these mitigation strategies in future. In terms of change in potential behaviour, 28% women said they would like to try using solar equipment (as compared to none before), 12% women who were non users of CFLs wanted to switch over to them and another 14% women thought they would like to try the use of CFLs. The constraint felt by most women in the use of CFLs was their high cost. As many as 26% women said they would like to adopt better waste disposal techniques in the future while 24% women said they would use less plastic bags in future.

Water linked adaptation strategies

A large number of families (56-100%) found certain adaptation strategies to be very easy and were practicing them to some extent even before the communication intervention. These were judicious use of water, use of covered and clean utensils for water storage, taking the help of other family members in water collection for the household. Most families reported that they occasionally used plastic pipes, cycles and/or carts for water accession and transport. Even before the intervention, almost 60% women were members of some women's group, which collected money from every member on a monthly basis and provided lump sum money to a

member by rotation. The women said they used this money for meeting personal expenses (clothes, jewelry, and gifts). Some women said they could think of utilizing the money for purchase of water management related equipment, which could improve the quality of their day-to-day life. After the intervention, more women (24%) as compared to (4%) earlier felt that they would like to install a water tank in their house to provide relief to them as well as use cycles/ carts to bring water at least to some extent. For adopting these strategies the women said they could not decide on their own and would have to request/motivate the male members of the family. A large majority (88%) also said they would install taps in water containers already possessed by them. With regard to purification/disinfection of water, even after the communication intervention, more than two-third women still said they would not like to invest in the purchase of water filter and would also not use boiling as a method of water purification. They preferred the use of solar disinfection technique and chlorine tablets for water purification/ disinfection since these did not involve much cost. .

Change in Awareness, Knowledge, Attitude and Behaviour of women to climate change

A paired samples t-test was conducted to assess the change in awareness, knowledge, attitude and behavioural intent of the urban poor women with respect to various aspects of climate change before and after the communication intervention. The results showed that there was a significant difference in the awareness scores of the women before the intervention (M=0.32, SD=0.648) and after the communication intervention (M=2, SD= 0.0); t (149)=31.734, p<.001, suggesting that the communication intervention had a statistically significant impact on the awareness of women about climate change.

Overall, the AKAB scores before the intervention were (M=163.91, SD=10.56) which, after the communication intervention changed to (M=193.02, SD=12.80; t (149)=20.21, p<.001). Hence, it can be concluded that the communication intervention had a very significant impact on the overall, awareness, knowledge, attitude and behavioural intent (AKAB) of the urban poor women to climate change (Table 10).

Table: 10: Change in AKAB after the communication intervention

Variable	Pre Test Mean	Post Test Mean	Mean Difference	t score	Sig. (2-tailed)*
Awareness	0.32	2	1.68	31.734	0.001
Knowledge	27.42	44.78	17.36	31.467	0.001
Attitude	76.68	85.36	7.6735	17.041	0.001
Behaviour	59.49	60.88	1.3866	1.323	0.188
AKAB	163.91	193.02	29.11	20.21	0.001

* 95% level of significance

A holistic overview of the results of AKAB change after the communication intervention reveal that there was a 36.5% change in the overall mean scores of awareness, knowledge, attitude and behaviour of the respondents to climate change and related aspects. A breakup of the scores indicates the maximum change occurred in the average score of awareness component (74.66%) followed by the knowledge level of women (59.66%). The percent change in the attitude of

women towards various issues pertaining to climate change was much lower, (13.4%) followed by change in their behavioural intent towards climate change adaptation and mitigation strategies (4.1%). It is important to note that despite a significant gain in the awareness and knowledge components, there was a limited change in the attitude and intent to behavior change of the women (Figure 5).

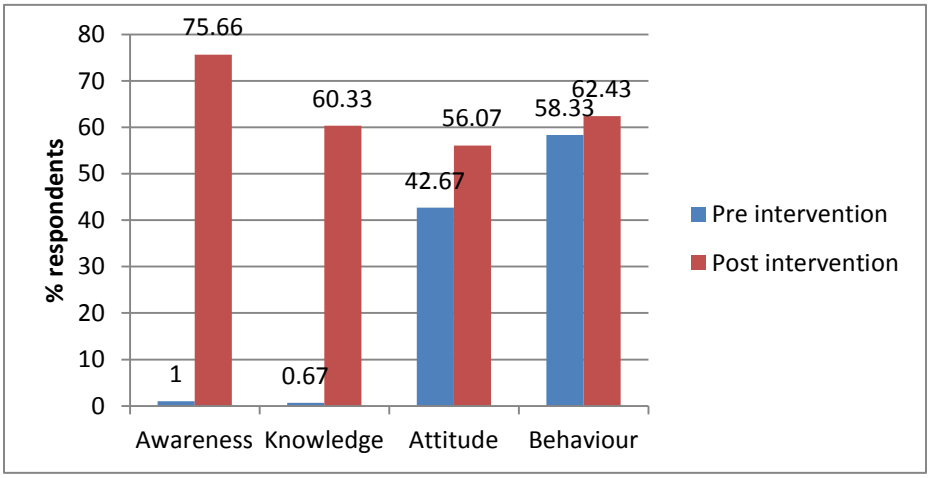

Figure 5: Change in AKAB scores after the communication intervention

Conclusion

The feedback indicated that the communication intervention was very interactive and participatory. It was appreciated by a large majority of women and contributed towards enhanced awareness, knowledge and understanding of climate change related issues. Moreover, the pace of disseminating information was adjusted to suit their needs such as, while using flip charts and flash cards, the facilitator was providing the commentary and could adapt to the audience, unlike the films or documentaries which proceeded at a set pace.

The present exercise has shown that use of Development Communication enabled approach with integrated media, such as films, flip charts, flash cards, puppet shows, skits, demonstrations etc. can be instrumental in enhancing adaptive capacities of poor urban women to climate change and can be suitably used to reduce their vulnerability to climate change. Knowledge and information are essential for people to successfully respond to the opportunities and challenges of social, economic and technological changes. But to be useful, knowledge and information must be effectively planned and delivered to the intended audience. A synergy is essential between climate change specialists, trainers and people at grass root level, media planners and producers for developing meaningful media which can not only raise awareness and understanding but also motivate people to take action and cope with climatic stresses and extremes.

References

Adger, W.N., Hughes, T.P., Folke, C., Carpenter, S.R. & Rockström. J. (2005). Social Ecological Resilience to Coastal Disasters. Science, 309, 1036-1039.

Arnell, N.W., (2004). Climate change and global water resources: SRES emissions and socio economic scenarios. Global Environment Change, 14, 31-52.

Asian Development Bank. (2001). Water for All: The Water Policy of the Asian Development Bank. Retrieved from http://www.adb.org/documents/policies/water (Accessed on February 16, 2013).

BBC World Service. (2007). Climate Change: Global Poll. Retrieved from: http://news.bbc.co.uk/2/shared/bsp/hi/pdfs/25_09_07climatepoll.pdf (Accessed on March 4, 2010).

IPCC, (2001): Impacts, Adaptation & Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. J. J. McCarthy, O. F. Canziani, N. A. Leary, D. J. Dokken and K. S. White (eds). Cambridge, Cambridge University Press, 1,000 pp.

IPCC, (2007a): Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor and H. L. Miller (eds). Cambridge, Cambridge University Press, 996 pp.

IPCC, (2007b): Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 976pp.

IPCC, (2008): Climate Change and Water. Technical Paper VI. Contribution of Working Group II. B. Bates, Zbigniew W. Kundzewicz, S. Wu and J. Palutikof (eds). Geneva, IPCC Secretariat, 210 pp.

MOSPI (2007). Compendium of Environment Statistics India, 2007. Ministry of Statistics & Programme Implementation, Government of India.

UNDP (2006). Human Development Report. Beyond Scarcity: Power, poverty and the global water crisis. United Nations Development Programme. New York: Macmillan.

UNDP. (2007-08). Human development report 2007: Fighting climate change: Human solidarity in a divided world. United Nations Development Programme. New York: Macmillan.

UNDP. (2011). Managing natural resources for human development, Developing the non-oil economy to achieve the MDGs. Timor-Leste Human Development Report 2011. United Nations Development Programme.

Venkateswaran S. (1995). Environment, Development and the Gender Gap. New Delhi: Sage.

WEDO (2008). Gender, Climate Change and Human Security lessons from Bangladesh, Ghana and Senegal (ELIAMEP).

WEDO. (2012). Gender, Climate Change and Human Security lessons from Bangladesh, Ghana and Senegal (ELIAMEP).

WHO/UNICEF (2004). Joint Monitoring Programme for Water Supply and Sanitation; Meeting drinking water and sanitation target: a mid-term assessment of progress. UNICEF: New York and WHO: Geneva.

WHO/UNICEF. (2008). Joint Monitoring Programme for Water supply and Sanitation. Progress on Drinking Water and Sanitation: Special Focus on Sanitation. UNICEF: New York and WHO: Geneva.

WHO/UNICEF (2010). Joint Monitoring Programme Report.Progress on sanitation and Drinking water for Water supply and Sanitation. UNICEF: New York and WHO: Geneva.

Kedarnath Disaster: Natural or Man-Made?

28

Kumar Nilmani**
Ranu Chauhan **

Abstract:

The magnitude of death, destruction and tragedy at the Himalayas of Uttarakhand and precisely in Kedarnath is a disaster to be waiting, created by man over a long period of time and trend is increasing in recent past years. Catastrophe caused by nature is immeasurable in scale and consequences. There is a tremendous loss of life and heavy damage to property. Climate condition in Himalayas varies from sub-tropical to heavy snow-clad mountain ranges and peaks. Monsoon rain is extremely intense, whic h leads to slop failure, landslide, flash flood and debris flow. The calamity of the Uttarakhand Himalaya has wreaked havoc in the entire landscape, settlements, pilgrimages and tourists, specifically those which are situated on the path of the river valley. Thousands and thousands of people are dead and many more are still missing. There is no agency, which have so far came up even with rough data to the estimated no. of people die and people who are missing. Environmentalist believe that this disaster is not natural, but man made, human activities in these regions have altered the environment which only exacerbates the problem, and nature is not solely responsible for it. Uttarakhand Himalayas region witnesses a huge demography alteration not only in terms of more human settlements, but in form of deforestations and road expansions too, which leads to the overall climate change of the region. Massive deforestation makes it extremely vulnerable to flash floods and the existing forest is not adequate to hold the water stream coming down heavily from the slope. The rapid urbanisation and mass movements of pilgrims in these places has completely changed the carrying capacity of these Mountain hills. A destination which is able to hold 10,000 to 15,000 people at a time is flooded with lakhs of pilgrims and tourists. To accommodate them necessary infrastructure has been created at one of the most vulnerable places, which directly jeopardise the lives of these peoples. Himalaya being the youngest mountain range is not only enduring to major tectonic shift, but also exposed to recurrent climate change. It compels the policy maker to analyse how a natural hazard become a disaster with numerous loss of valuable life and unprecedented destruction of property. A hazard cannot always be a disaster, unless it has not been happening in a habitat area. The most of the calamity that has been happened is because of the growing number of settlements on both sides of the flow of river path and Kedarnath pilgrimage is an iconic example of this.

Keywords: *Kedarnath, Disaster, Himalaya, Pilgrims, Vulnerable, Natural, Deforestation*

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1. Introduction

Kedarnath is situated at the altitude of 3,583 meters in the Rudraprayag district of Uttarakhand, which lies in Garhwal Himalaya. The Chorabari and the companion glacier are more than a kilometer away from Kedarnath temple. Chorabari glacier is originating point of river Mandikini, which travels 85 km southwest to meet Alaknanda at Rudraprayag. Further, Alaknanda joins the Bhagirathi River at Devprayag and form the mighty Ganga River. The stream emanates from companion glacier joins the Mandakini River upstream of Kedarnath. Kedarnath is located in downstream outwash landscape of Chorabari and its companion glacier within the Mandakini River. People have encroached the area where the glacial fluvial deposit has been dumped. After the encroachment the region is not able to hold the discharge of the river.

Fig. 1

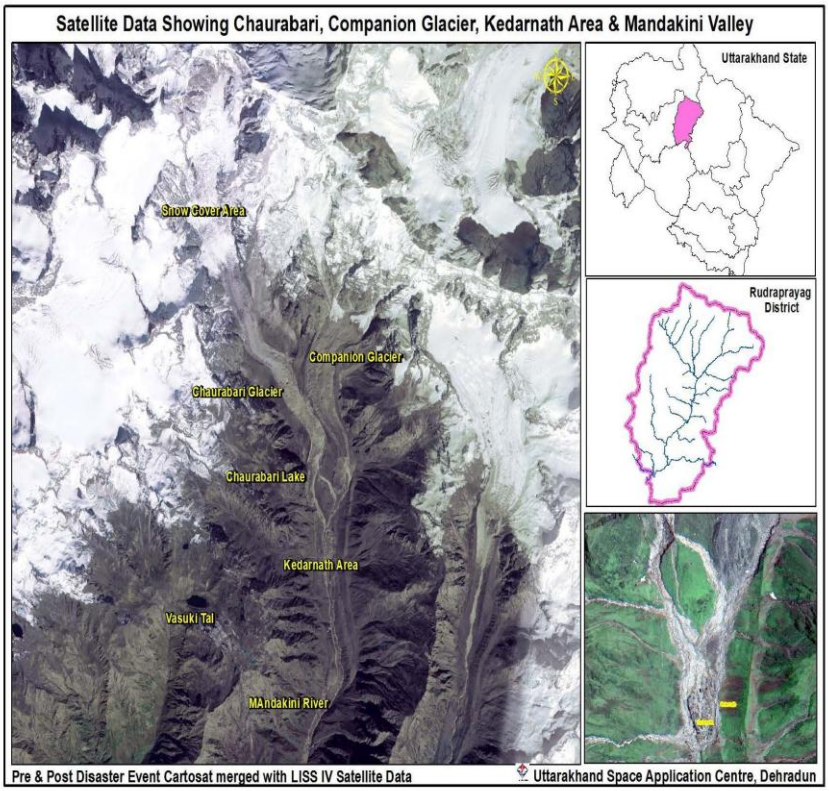
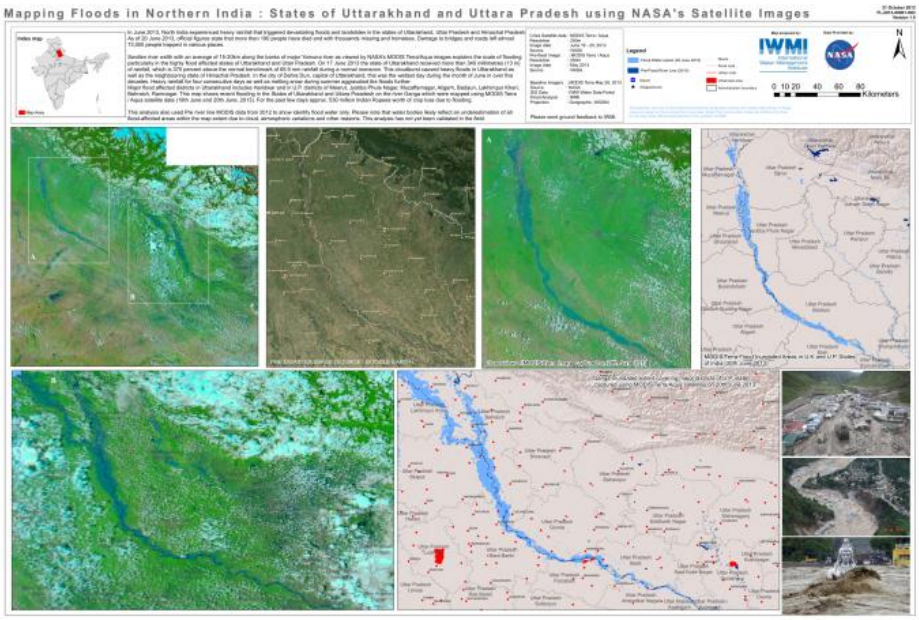


Fig. 2

Uttarakhand witness early arrival of the monsoon this year. Monsoon reaches this Himalayan state almost two weeks in advance of schedule. Rivers in this Himalayan region have already been flown heavy during this month, as glaciers melt because of the temperature. Early arrival of the monsoon and incessant rain leads to further melting of ice as ice , as when water falls on the ice it melts faster. Monsoon rain in this month is again more than usual. These factors, coupled with some other factor leads to overflow of rivers and more water is accumulated in glaciers whose outbursts lead to disaster at unprecedented scale.

Movement of Monsoon wind: Analysis of rainfall data of the past five years demonstrates that rainfall has increased in the districts of Uttarakhand, although not in regular manner but with arbitration. It does not show a precursor to disaster, but a pressing need of preparedness of disaster management, which doesn't exist in the state so far.

Fig. 3



Source: NASA

Temporary Lake

A sudden flow of water from Chorabari and companion glacier without any warning cause havoc and disaster at centuries old Kedarnath temple and its adjacent area. According to Anil Kulkarni[1] a renowned glaciologist and distinguished visiting scientist from IISc., told "Down to Earth" that due to innocent rain a temporary lake has formed. The lake exists for a short duration. The lake burst a there is a breach in the boundary that forms the lake. Basically, there are three main reasons for Kedarnath disaster. First, there is heavy rain (120mm in in 24 hours before the flash of June 16). On 17 June 2013 the state of Uttarakhand received more than 340 millimeters of rainfall, which is 375 % above the normal benchmark of 65.9 mm rainfall during a normal monsoon. Second, rain on the glacier, and third overflow of glacier which has already been melted much as the early arrival of monsoon. Snow and ice melt with much higher rates when they came in contact with rainwater. An increased rain on the glacier above the Kedarnath temple melts the ice. When all these things happened, this caused a fresh flood with the heavy downstream of water, and third channel is formed because of this in the path of Kedarnath temple and washed everything along its way.

[1]Dr. Kulkarni developed a new method to identify glacial terminus using satellite data. This was used to estimate retreat of about 1868 Himalayan glaciers. This investigation provided, for the first time, information about fragmentation of glaciers, loss in glacial area and about the dramatic impact of climate change on Himalayan cryosphere. Dr. Kulkarni developed a model to estimate glacier mass balance by monitoring snow line on the glaciers. This has provided, for the first time mass balance of large number Himalayan glaciers, which was otherwise available for few glaciers only.

Table 1: Rainfall

HYDROMET DIVISION

INDIA METEOROLOGICAL DEPARTMENT

DISTRICT RAINFALL (MM.) FOR LAST FIVE YEARS

District : RUDRAPRAYAG

Note : (1) The District Rainfall(mm.)(R/F) shown below are the arithmatic averages of Rainfall of Stations under the District.
(2) % Dep. are the Departures of rainfall from the long period averages of rainfall for the District.
(3) Blank Spaces show non-availability of Data.

YEAR	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.
2008							148.9	-30	295.5	-50	351.2	-44	205.0	-15	4.0	-91	6.0	-47	0.6	-98				
2009							17.8	-92	204.1	-65	171.7	-73	109.1	-55	36.6	-20	11.8	4	0.0	-100				
2010	20.0	-73	26.5	-64	3.2	-96	7.2	-87	47.5	-48	166.6	-21	577.2	-1	488.3	-22	448.8	86	12.1	-74	1.2	-89	25.0	-12
2011	32.5	-57	107.8	47	7.1	-92	12.7	-77	90.6	-4	369.6	70	437.3	-24	465.4	-27	112.1	-53	27.5	-48	0.0	-100	0.0	-100
2012	69.0	-9	9.3	-87	17.1	-80	34.0	-38	13.4	-86	95.4	-56	306.5	-47	504.6	-21	175.5	-26	3.6	-93	4.2	-69	29.4	-3

1.1 Geology of Himalaya

The Himalaya is one of the youngest mountain systems in the world. It is still growing, shifting towards the north, and many rivers which emanates from its continuously deepening the river valley that increase the instability of landscape and making it vulnerable place to reside. Himalaya the youngest mountain range in the world is also depicted as the abode of snow. The higher altitudes of Himalaya are also known as “the great Himalayan ranges” are snow clad whole of the year and the source of the origin of the major rivers of India, Pakistan, Bhutan, Bangladesh and China. Himalaya is bestowed with nature’s beauty, magnificent alpine meadows, terraced agriculture field, human settlements on mid altitude, waterfalls, river valleys and all of the above, the symbol Hindu Faith. Many Hindu pilgrimage sites are located on the hills and terrains of the Himalaya and symbol of Hindu faith, sanctity, and belief. Himalaya being the youngest mountain is also known for its geologically unstable, seismically sensitive, geographically remote, and ecologically fragile nature. These features can be evident from frequent landslide. Events which caused because of extreme weather like rains and cloudbursts is also a recurring phenomenon here. Himalayan climate varies from subtropical to cold frigid, this variation in weather making it more vulnerable to disasters. Himalaya forms one of the world most complex mountain systems in the world, being vigorous in nature, it houses many flora and fauna, and recognised as a significant biodiversity reserve. Being a source of many lakes, glaciers, and rivers, impact of climate on Himalayan range is enormous as billions of people live in the downstream of the river originates from it, so any significant change in the Himalayan climate there is respective change and impact on the lives of people residing near its banks of flow path of the stream. Fourth assessment report of the IPCC (Intergovernmental panel on

climate change) mentioned that there will be no diminishing in the floods in the Himalayan region, but the incidence and intensity will grow in future.

2. Methodology

An extensive literature review is conducted and information is gathered about the youngest mountain range Himalaya and its fragile nature and vulnerability. Most of the research paper of all the reputed online journals on the previous Uttarakhand disaster and Himalayan fragility has been studied extensively. Content on all the published news, analysis, article of all the newspaper, magazine, and other materials. Detailed analysis of the opinion of experts in the field on environment and disaster management to understand the different aspect of the problem and its genesis.

A detailed compilation of disaster history of the Uttarakhand region has been commenced after that, so that fair understanding of the land vulnerability and disaster typology can be comprehended. It helps in incorporating these elements in planning, development and framing sustainable development protocol to minimize the human impact on nature. Uttarakhand region and Garhwal Himalaya, specifically Kedarnath further evaluated in terms of Eco and Geo features and its sensitivity can be tried to establish so that further prevent/minimize the risk and swift relief and response can be initiated.

3. Climate Disaster in Himalayan Region.

Flash flood and debris flow are happening frequently in the Himalayan region by virtue of its structure. It accounts for approx... 70 percent of economic losses and 50 percent of human loss of life. Such kind of geological and climatic disaster has a very severe impact on the livelihood of the natives residing in those places. Not only the frequency of hazard is increasing with time, but its impact and intensity is also growing.

On 16th of June night and morning of 17th June 2013, the day when devastation took place, wreaked the entire land of Uttarakhand. Heavy rain in Monsoon is not a new phenomenon for the Himalayan range, but it was more than unusual. Cloudburst, landslide, debris flows are common characteristics of Garhwal Himalaya. Human settlements are lies either in the sides of the bank of the river or on fragile landscape. Himalayan climate has changed so much, because of the rising anthropogenic activities, high population growth and large scale deforestation. It reduces the water holding capacity of the land as tress act as a shield in case of the heavy downpour stream. Kedarnath because of its famous Hindu temple of Lord Kedar is open for pilgrimage in this season and are flooded with pilgrimage and tourist throughout the season. Kedarnath is situated 14km from Gaurikund, an urban area on the bank of River Mandikani.

Fig. 4

Source: NASA image created by Jesse Allen, using data provided courtesy of NASA/GSFC/METI/ERSDAC/JAROS, and U.S./Japan ASTER Science Team. Caption by Michon Scott.

Every year, almost an average 10 lakh pilgrims visit the holy temple of Kedarnath. On the disastrous night almost 10, 0000 pilgrims are on the way to Kedarnath and Badrinath. Cloudburst, debris flow, glacial lake outburst that starts with the bursting of Basuka Lake and Chorabrai which start sudden flash floods wipe out everything came in its way. It devastated the whole Kedarnath town, Rambada, Gaurikund, Sonprayag, Kalimath, Kund, Bhiri, Chandrapauri, Augustya Muni, Tilwada, Rudraprayag, a part of Srinagar Garhwal, which are located in the path of Stream of Alaknanda River, Devprayag and some areas of Rishikesh and Haridwar. Roads are badly damaged and somewhere it is completely washed away because of the heavy flow ofthe stream. Peoples are stranded as connectivity is completely brakes away. Heavy rescues and relief operation has started by army and air force in the history of Uttarakhand.

4. Reason.

Colossal devastation and tragedy at Uttarakhand Himalaya, particularly at Kedarnath compelled the policy maker to modify or rewrite the definition of natural hazard and disaster. Not every natural hazard is a disaster if it is happened in un-inhabited area, but because of the increasing anthropogenic activity and more and more human settlements across these areas, now every natural hazard has enough chance to become a disaster and wreak havoc on precious human life and property. A disaster destroys landscape, agriculture, residential settlement and take lives. It has been found that most of the death and destruction has been happened in the place which is on the side of the river path of the stream. Most of the human settlements destroys because of the high flow stream, and flood in the river. Landslide occurs which also destroy the settlements. The fundamental question is how to avoid the tragedy or minimise its impact on human life and property.

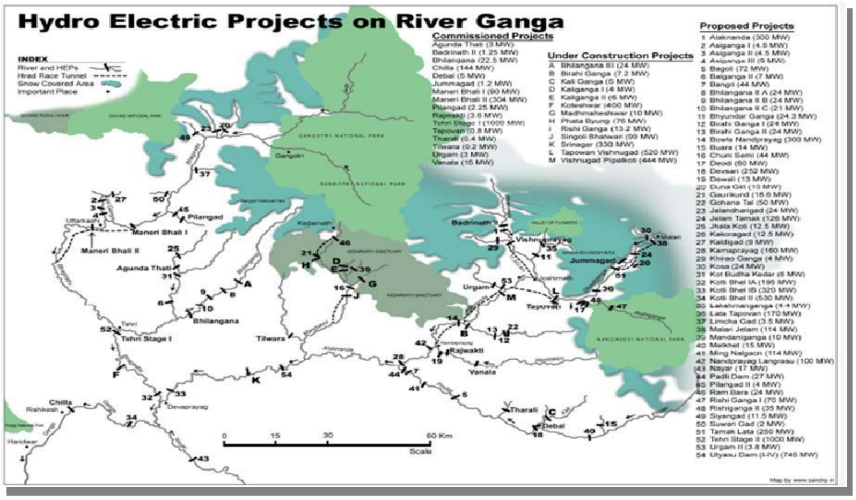
4.1 Man-made reasons of Uttarakhand Disaster (Specifically, in Kedarnath).

A) Creation of road, destabilising of mountains: Unprecedented scale of disaster is not only because of nature's fury, but the human element is equally responsible for it. Himalaya, which is known for its fragile nature and poor landscape stability, construction of roads and other necessary infrastructure to accommodate tourist multiply the no. of deaths and making this disaster one of the worst in the history of Uttarakhand. Char Dham Yamunotri, Gangotri, Kedarnath and Badrinath is famous for its religious tourism, most of the causalities are higher because pilgrims and tourist are exceptionally large as compared to the carrying capacity of the destination.

According to data compiled by Uttarakhand state transport, in 2005-06 83,000 vehicles were registered in the state, but in 2012-13 it rises to 180, 000. Smaller vehicles like car, jeep and SUV who has the capacity to penetrate deeper into destination, has been increased sharply. In 2005-06 there were 4,000 vehicles registered of this kind, but increases 10 fold to 40, 000 in 2012-13. Now, it has been a well-established fact that the growth of the tourism industry is directly related to increasing no. of landslides in typology like Himalayan terrain.

B) Increasing Threat from Dams: Ganga,which originates from Uttarakhand is a key source of power generation in the state. More than 70 projects are going and still many more

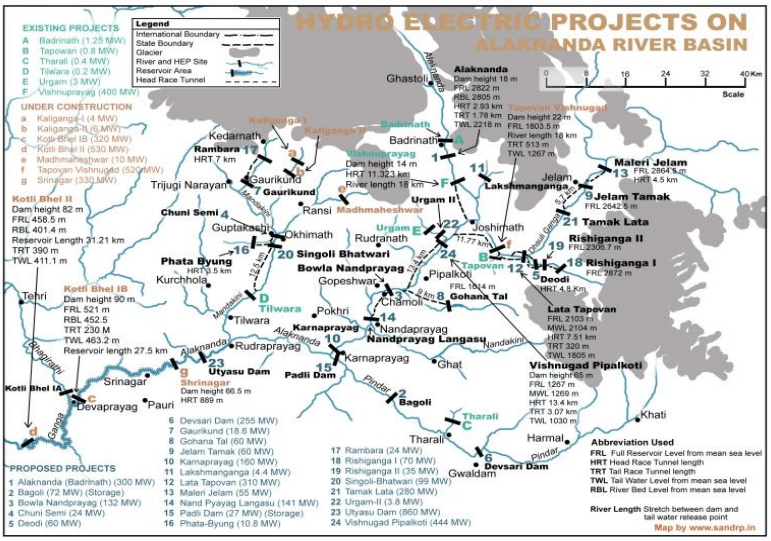
Fig. 5



Source: South Asia Network on Dams, Rivers and People

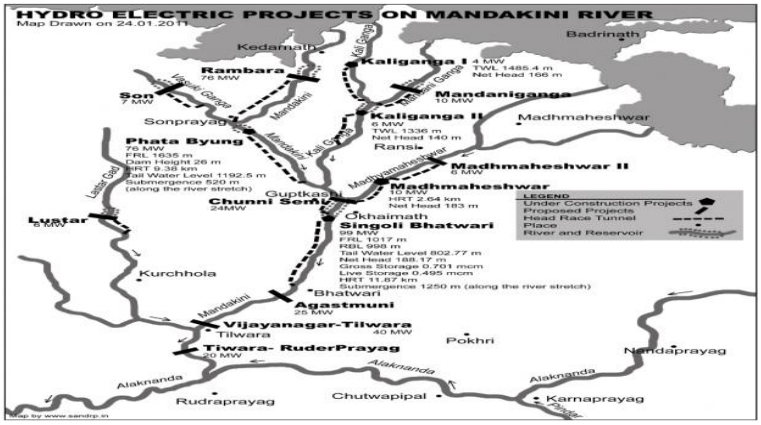
will come up in the future. Ganga and its tributaries are worst affected by increasing no. dams in this river basin. Almost 80% of the Bhagirathi and 65% of Alaknanda is affected because of this. Projects the state has planned to generate 9,000 MW of electricity, these projects are worst affecting is the Ganga and its tributaries. These projects have changed the entire landscape of Uttarakhand and make it more vulnerable for frequent landslide and disaster.

Fig.6



Source: South Asia Network on Dams, Rivers and People (August 2008)

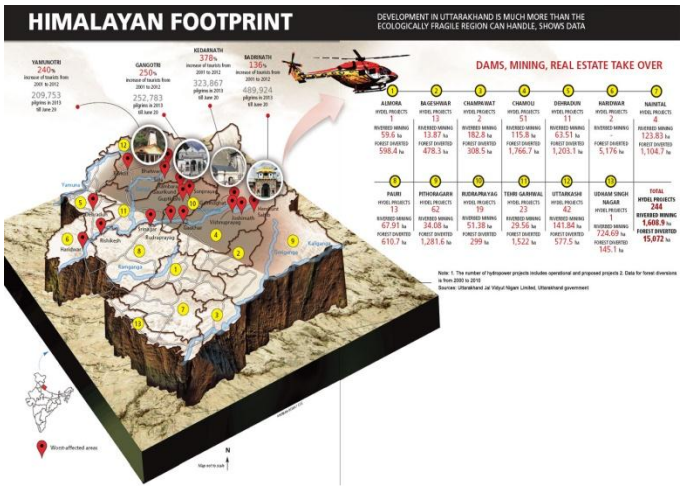
Fig. 7



Source: South Asia Network on Dams, Rivers and People

C) Unplanned Development: Heavy machines are used to move every day to create necessary infrastructure and widening of roads or making new one. These heavy machines travelled through kaccha roads weakened the mountain and making it more prone to landslide.

Fig. 8



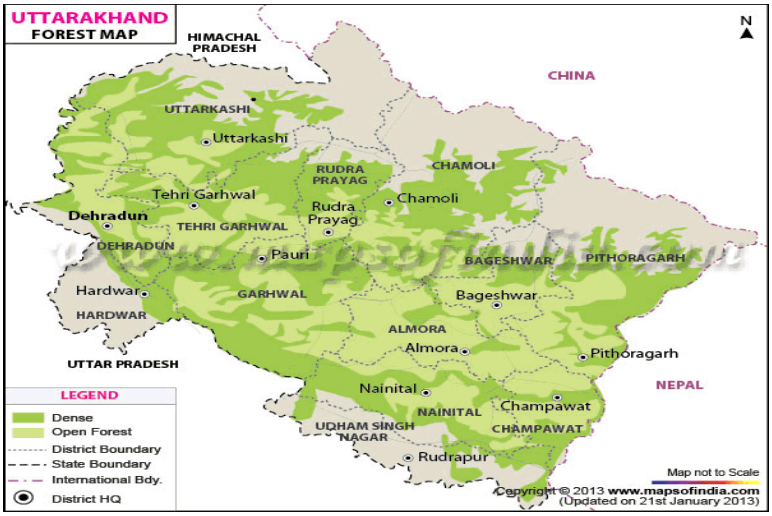
Source: Down to Earth

Mountains are cut to give way to new roads without proper assessment of landslide and debris flow. Contractors who are employed for the job is from outside without any expertise and knowledge about mountain behaviour, which make these mountains more vulnerable and making the projects infeasible. Sometime Landslide continues for four years and making the contractors bankrupt as they wasted all the resource, money and time on clearing the debris. Environmental engineer and Ganga Crusader G. D. Agarwal[2], says that construction along the Ganga cost much more if assessment of damage of the environment is taken into consideration. People have completely damaged the ecology of the mountains, and these unplanned developments are results into more frequent landslide in the hills.

D) Deforestation: Deforestation intensifies flood in mountainous regions and Uttarakhand disaster is an iconic example of this. Most of the forest areas area that is diverted for hydroelectric projects, roads, and the transmission line are in four districts of Chamoli, Uttarkashi, Rudraprayag and Pithoragarh, which is severely damaged by flash floods. Hydel projects lead to submerged thousands of hectares of forest land which have consequences in the form of flood disaster etc. As per reports from the Ministry of Environment and Forests (MoEF), 44,868 ha of forest land is diverted for non-forest uses in Uttarakhand since 1980.

[2]Dr. G. D. Agrawal alias Swami Gyan Swaroop Sanand(born 20 July 1932) is the doyen of environmental engineers in India. After a long career, he continues to teach and inspire students as an Honorary Professor of Environmental Sciences at the Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, in Chitrakoot, Madhya Pradesh. He is notable for his successful fast in 2009 to stop the damming of the Bhagirathi River.

Fig. 9



This large scale deforestation has intensified the flood problem in the state of Uttarakhand. Environmentalist claim that impact of flood in Kedar valley is less as compared to places like Valley of flowers, Nanda Devi Biosphere reserve and regions around Joshi math where several villages completely washed away by landslide and cloudburst, but oak trees in the Kedar valley because of its great soil-binding capacity and water retention power mitigate the disaster.

5. Result and Discussion

Tourism in the state has increased manifold in recent years. According to the data mentioned by down to earth[3] tourism has increased 168 percent (213 percent, according to the Uttarakhand tourism department) over the past 12 years. The Char Dham Yatra of holy shrines of Hindu pilgrimage all are above the altitude of 3,000 metres in The Garhwal Himalayan range of Uttarakhand In a particular month 1.3 million people visit the four shrines of Kedarnath, Badrinath, Yamunotri and Gangotri. Such kind of tourism generate huge revenue, but at the same time press immense burden which are not at all equipped to deal with large influx of people. According to PHDCCI[4], tourism contributes approx. 27% in state revenue and in terms of absolute size it is approximately 26,500 crore. On June 16, when torrential rain and glacier outburst strike the Kedarnath approximately 34,000 people are there in the town. All the places of nearby area where the disaster struck people are always more than the carrying capacity of the

[3] In May 1992, the Society for Environmental Communications started India's only science and environment fortnightly, Down To Earth (DTE).Over the years the magazine has informed and inspired people about environmental threats facing India and the world -- a dimension underplayed in mainstream media.Circulation figures are not a true indicator of the wide reach of the magazine: DTE has become a reading habit in 400 out of about 500 districts of the country -- more than any other Indian newspaper or magazine

[4] PHD Chamber of Commerce and Industry, established in 1905, is a proactive and dynamic multi-State apex organisation working at the grass-root level and with strong national and international linkages.
The Chamber acts as a catalyst in the promotion of industry, trade and entrepreneurship. PHD Chamber, through its research-based policy advocacy role, positively impacts the economic growth and development of the nation.

destination, as there is no mechanism in the place which can assess the destination capacity, at the same time there is no regulation in place which can implement the rules and regulation by which large no. of people can be saved. It exposes the weakness of Uttarakhand tourism, which in unsustainable in Himalayan terrain. The Uttarakhand tourism policy aims at several issues like creating world class infrastructure, development on the basis of public private partnership, explore new destinations and making it tourist attractive. But nothing has been happened at ground level.

Table. 2

Place-wise Number of Domestic Tourists Arrivals in Uttarakhand (2008 to 2010)			
Tourists Place	**2008**	**2009**	**2010**
Dehradun	1422578	1123715	1401942
Rishikesh	551495	581869	1093164
Mussoorie	1086411	1096698	1098870
Pauri	85447	90960	97516
Srinagar	202486	247974	219103
Kotdwar (Incl. Swargashram, Chilla etc)	310324	310402	321438
District Rudraprayag (Excl, Kedarnath)	592368	416775	404527
Kedarnath	468982	402633	400243
Gopeshwar (N. Prayag, K. Prayag, Thrali etc)	389978	401838	381722
Joshimath (Incl. Ghangria and Govind Ghat)	1279659	1350280	1609216
Badrinath	1075372	798063	921250
Auli	24902	40732	40290
Hemkund Sahib	400410	332451	308888
Valley of Flower	11551	1419	4155
District Tehri	1067869	871827	898505
Uttarkashi (Incl. Harsil Gagnani etc)	656851	680764	593290
Gangotri	326081	379673	310255
Yamunotri	327421	322001	309452
District Haridwar	11356250	12049450	18837125
Nainital	615469	749556	786705
Kathgodam	69480	112698	150423
Corbett National Park	186933	191866	181000
District Udham Singh Nagar	86890	95579	100457
Almora	93615	97492	95947
Ranikhet	80105	88506	83211
Kausani Bageshwar	77184	78987	70523
District Pithoragarh	164225	183484	189474
District Champawat	53834	56522	63443
Uttarakhand	**23064170**	**23154214**	**30972134**

Source: Department of Tourism, Govt. of Uttarakhand.

Almost 80% of the tourist in Uttarakhand came for some sort of religious tourism. The road traffic is an overflow of vehicles as everyone in rush to complete the journey as soon as possible, without any strict supervisory body, Vehicles are rampant on the road in this season which resulted in many road related incidences. Tour operators also try to complete this Yatra in a

hurry to make more money, which leads to exhaustion of driver and ultimately converted into a road accident.

Despite the continuous growth of legal and illegal hotels along riverside there is a huge shortage of room for tourists in Uttarakhand. Tourist growth is consistent with the hilly state, but the accommodation facility failed to catch that pace. A working paper of Indian Council of Research on International Economic Relations[5] published a report in 2008 about the economy of the state in 2006 which find a grave shortage of accommodation facility in Uttarakhand. The survey conducted for the purpose of the paper on development strategy for the hill districts of Uttarakhand mentioned that annually the state has only 8.4 tourist rent houses per million, 102.5 hotels and guest houses per million tourists, and 337 beds available for every million tourists.

This huge shortage of accommodation facility catered by illegal structures, without any assessment of risk and geographical consideration. Some of them are constructed just on the right of riverbank, which exposes the tourists towards very high risk. According to estimates of Uttarakhand hotel and restaurant association, almost 100 hotels are washed away completely which are right on the bank of river path.

Tourism is promoted without any proper mechanism of risk assessment and mitigation. Ministry of tourism is promoting "777 days of the Incredible Indian Himalaya"[6] without considering the ill effect of the growing number of tourists because of this. Ministry seems more concerned in promoting the destination rather than making the tourism safe and sustainable for the tourists.

6. Conclusion and Recommendation.

After 13 years of statehood Uttarakhand shed it conventional way of development and growth. The government single minded focus on creation of monetary wealth, it shows sheer neglect and disrespect of mountains, forests and its rivers. The government blindly pushes the road, dam, bridge, tunnel, and many more other infrastructure without taking into consideration the fragile ecosystem of its mountainous terrain. It creates an infrastructure in most fragile and vulnerable place of The Himalayan region.

In the process the green mountains become deforested, mountains are blasted for making tunnels which make the region very fragile, roads are constructed and widened, Hydropower projects are sanctioned and started without keeping in consideration the heavy price of it on the ecology of

[5]Established in August 1981, ICRIER is an autonomous, policy-oriented, not-for-profit, economic policy think tank. ICRIER's main focus is to enhance the knowledge content of policy making by undertaking analytical research that is targeted at informing India's policy makers and also at improving the interface with the global economy. ICRIER's office is located in the institutional complex of India Habitat Centre, New Delhi.
http://www.icrier.org/pdf/Working_Paper_217.pdf

[6] In a historic moment in Indian Tourism, the Government of India, Ministry of Tourism launched the 777 Incredible India Himalaya campaign on 27th September 2013, also the World Tourism Day. With 73% of the entire Himalayan range lying in India; it will celebrate this with the awareness that travellers have more to experience across the 6 Indian Himalayan states.

the region. Hotel and other infrastructure encroached the river banks and its flow path. All this makes this region a catastrophe to be waiting which happened on 16th and 17th of June which will have far reaching consequences in many more years to come.

There should be an immediate ban on the construction on the riverside, private and commercial both. The Construction quality of houses is also posing a big question mark on its sustainability in mountainous regions. Concrete construction should be avoided and woods are used as much as can be used. There should be a proper mechanism to tackle these natural disasters. Civil society and government should work in close collaboration. Good scientific and precise information is needed based on reliable data so that accurate forecasting can be done. There should be a regular analysis of climate change and mountain specifications so that actual condition and trend can be analysed and its behaviour can be predicted. Minimising the risk from such kind of disaster is fundamental for poverty alleviation and sustainable development.

A strict tourism regulation is needed, as there is no any warning mechanism related to disaster or other natural calamities related incidences. People are always unaware about it. Only Amarnath Yatra and Manasarovar Lake issue warning notices to pilgrimage from time to time. The Amarnath shrine act includes marking of points which are dangerous and prone to landslide, avalanches or any such kind of related incidences. On the same line an act should come into place in the whole mountain region and specifically for The Himalayan region, which are more prone to landslide, debris flows, flash flood and glacier outburst. Amarnath Kind of act need to be replicate in all the hilly areas and mountainous region across India, so that casualties can be avoided or minimised. Development should be done not only to increase the GSDP growth rate of the state, but growth should be on the basis of natural law and scientific facts. There should be a clear demarcation of peril zone and people are discouraged to dwell in these areas and construction should be completely banned in this zone. Appropriate planning and arrangement should be made to keep people out of the hazard zone. A hazard zone map should be prepared so that people have an idea where they are and how much vulnerable they are at risk. Development should be sustainable not recklessly, so that resources should be available for future generations.

References:

1. *The untold story from Uttarakhand, June 25, 2013, Updated: June 26, 2013 00:31 IST RAVI CHOPRA.*
http://www.thehindu.com/opinion/lead/the-untold-story-from-uttarakhand/article4847166.ece
2. Why Kedarnath happened, Frontline, THE NATION, Published: July 10, 2013 12:30 IST Updated: July 24, 2013 17:53 IST
http://www.frontline.in/the-nation/why-kedarnath-happened/article4894867.ece?css=print
3. Climate Change, Uttarakhand, and the World Bank's Message, Economic and Politic Weekly, Vol-XLIX No. 1, January 04, 2014, M Balasubramanian and P J Dilip Kumar.
http://www.epw.in/notes/climate-change-uttarakhand-and-world-banks-message.html?ip_login_no_cache=2f70e70fed41d6c81607b11a62cfea0a

4. Chauhan, Chetan (2012): "Green Minister's No to New Hydel Projects on Ganga", Hindustan Times, 8 August.
5. Singh, Jyotsna (2013): "Check Global Warming to Prevent Uttarakhand-like Disasters: World Bank", Down To Earth, available at http://www.downtoearth.org.in/content/check-global-warming-prevent-uttar....
6. Trivedi, Anupam (2012): "More Than 200 Villages in Uttarakhand Face Threat, 85 Need Immediate Relocation", Hindustan Times, 6 August.
7. Trivedi, Anupam and Deep Joshi (2012): "Uttarakhand Bans Riverside Settlements", Hindustan Times, 7 August.
8. Man-made reasons for Uttarakhand disaster, Author(s): Jyotsna Singh, Soma Basu Issue Date: 2013-6-18, http://www.downtoearth.org.in/content/man-made-reasons-uttarakhand-disaster
9. Extreme Weather Related Disasters: A Case Study of Two Flash floods Hit Areas of Badrinath and Kedarnath Valleys, Uttarakhand Himalaya, India Vishwambhar Prasad Sati Journal of Earth Science and Engineering 3 (2013) 562-568 01/2013; 3:562-568.
9. VISIBLE EARTH, NASA http://visibleearth.nasa.gov/view.php?id=8564
10.Catastrophe was waiting to happen! Environmentalists deny Home Minister's claim, say Uttarakhand tragedy at hand is man-made: http://indiatoday.intoday.in/story/uttarakhand-floods-environmentalists-blame-rapid-urbanisation-pilgrim-movement-india-today/1/284843.html
11. Disaster relief emergency fund (DREF) India: Monsoon Flash Floods, International Federation of Red Cross and Red Crescent's societies, DREF operation n° MDRIN012 GLIDE n° FL-2013-000070-IND Operation update n° 03 12 August 2013
http://www.ifrc.org/docs/Appeals/13/MDRIN012drefOU3.pdf
12. Uttarakhand Tourism Development Master Plan, 2007 – 2022, Government of India, Government of Uttarakhand, United Nations Development Programme, World Tourism Organization.http://uttarakhandtourism.gov.in/files/17th%20sept/3.pdf
13. Floods in Uttarakhand: A New Relief Deal,JULY 2013
EXPERIENCE LEARNING SERIES 60, ALL INDIA DISASTER MITIGATION INSTITUTE (AIDMI) & DISASTER MANAGEMENT COMMUNITY OF UN SOLUTION EXCHANGE (INDIA)
13. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Core Writing Team, Pachauri, R.K. and Reisinger, A. (Eds.) IPCC, Geneva, Switzerland. pp 104, http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf
14.Causes of Kedarnath Tragedy and Human Responsibilities – Dhruv Sen Singh, Centre of Advanced Study in Geology, University of Lucknow, Lucknow-226007 (Email: dhruvsensingh@rediffmail.com)

Problems of Sustainaible Devlopment and Industrial Development in India

29

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Inroduction

Sustainable development means attaining a balance between environmental protection and human economic development and between the present and future needs. It means equity in development and sectoral actions across space and time. It requires an integration of economic, social and environmental approaches towards development. Sustainable development refers to attaining social equity and environmental protection. This paper aims at discussing some of the important issues relating to sustainable form that would lead to sustainable development with special references to India. The paper is based on available literature and secondary data. The paper is divided in two parts. The first part deals with the concept of sustainable development and its implications. First section of this part of the paper explains the concept of sustainable development and problem of sustainable development. This is followed by the second section of this part with a discussion of the Industrial development.

An ultimate objective is that industrial expansion should be sustainable and should ensure sustainable livelihood for the people of India. Sustainability is hampered by the economy's high import propensity level. Domestic producers do not only compete against cheap imports of final goods, but production is inherently dependent on imported intermediate a reduction of imports in all stages of production. However the SIDP seemingly confuses self-sustainability with self-sufficiency. In an increasingly globalized economy, self-sufficiency is not essential for sustainable industrial development. In fact international trade theory suggests that specialization is an integral part of sustainable industrial development. Although the SIDP suggests a balance between imports and exports, most of its recommendations focus on the ultimate reduction of imports. What is relevant though is that the trade balance needs to be improved either by a reduction in imports or by increased export earnings. Again international experience show that export production has the potential to provide more sustainability in the development process. With higher levels of exports, the balance of payment constraint could be reduced significantly.

Goals of Sustainable Development:

The ideal world-and the most prevalent idea of the future that one can think of-must consist, essentially, of social inclusion for all, constant economic growth and a clean and secure environment. For this, we must move beyond economic wealth as *the* indicator and vehicle of the progress of humanity. Most importantly, sustainable development goals should:

- priorities a more secure world;
- lift people out of poverty and eradicate poverty altogether;
- protect the planet's natural resources;
- ensure equal opportunity for everyone and sufficient jobs (having a fair trade operation in

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- place can greatly support this);
- provide clean water and sufficient food;
- provide quality healthcare and education for all;
- ensure access to energy; and
- Empower women and girls and secure their equal social status.

Government and organizations must priorities these issues, tailor them according to social demand and start emphasizing a united approach to executing environment and development agendas.

The top issues that currently concern humanity and development are:

- **The effects of climate change**;
- **Pollution from fossil fuels.** A transformation of our culture of energy consumption shows us a path towards "People" Smart Energy, leading to an energy industry revolution;
- **Sufficient human rights for all human beings.** This includes workers rights, ensuring maximum forty working hours per week and keeping this in consideration with regards to laborers in developing nations;
- **Water for all.** One billion people globally do not have access to adequate drinking water. We must develop a new understanding of how to wisely use available water and curb the development of water-borne diseases;
- **Proper access to electricity.** One in five people currently lack access to electricity. Demand for electricity will increase significantly. Three billion people still use wood, charcoal, coal or animal waste as a cooking tool. Providing them with electricity will reduce a significant amount of toxic and carbon emissions. It will also help reduce the two million deaths per year which occur due to the toxicity of these materials. Technology transfers, as well as significant support and implementation by the government and other organizations, can help in the adoption of renewable energies; and overfishing.Sustainable fishing is an important issue as around 200 million people's livelihoods depend on fishing industry. This industry requires an urgent shift to sustainable fishing methods so that resources do not deplete as overfishing may result in the extinction of many species.

Industrial Development Policy:

Industrial Policy in the traditional sense was reactive, bureaucratic and demand side based.The introduction of new policy measures required little institutional change except for regulatory capacity. This was because such policy changes mainly involved price interventions through taxes, import tariffs or subsidies. The targets (companies) of the policies would approach the regulators for assistance to be provided. In many cases, such policies were introduced on the basis of lobbying of the target market. The whole policy process was reactive from lobbying to design and application of the policy instruments. Modern industrial policy requires pro-active intervention and changes for the implementation thereof. Firstly, modern industrial policy is characterized by pro-active analysis on the basis of which a policy could be defined. Secondly,

its implementation requires all institutions to collectively buy in to the policy and to change their behavior to reflect the new policy intentions. Thirdly, the policy requires continuous monitoring of the operating environment and the business environment in order to address policy bottlenecks. The profound difference is that modern industrial policy should address competitiveness and policy interventions should also focus on the supply side. It should highlight three core areas:

-The operating/enabling environment

-Government's capacity to co-ordinate and facilitate the policy development process and its implementation.

Sectoral/Micro competitiveness:

India's Sustainable Industrial Development Policy (SIDP) addresses these core areas. The main thrust of the SIDP is to ensure a suitable enabling environment, facilitate private sector development through, inter alia, the privatization of state assets, deepening and widening of industrial capacity and the development of specific sector capabilities. Some four years after its adoption as a national industrial policy, the SIDP is yet to have major impact on India's industrialization. One of the objectives of this study on India's sustainable industrial development and competitiveness is to analyze constraints on the full implementation of the SIDP within the framework of achieving sustainable and competitive development. India is rich in agriculture and mineral resources. Although substantial portions of such resources are exported in their crude or semi-processed forms, tremendous efforts have been made to process these resources, many of which are industrial raw materials. The structure of industry is basically oriented to the production of consumer goods. However, some items of consumer durables, non-durables or intermediate goods are also produced. Agro-industries play a significant role in the industrialization of the country. There is scope for forward backward integration of industries and industry in relation to other sectors, in particular, the agro-industry linkage. However, due to a number of constraints, which are highlighted elsewhere in this study, the industrial sector has not been able to contribute substantially towards food self-sufficiency, employment creation and poverty alleviation.

The Sustainable Industrial Development Policy:

The main purpose of the SIDP is to set out a path for the sustainable development of Indian industry in the medium term with a focus on the following objectives:

- Human development – creating employment, poverty alleviation, providing basic needs and sustainable livelihood.
- Sustained economic growth - promoting capital and intermediate goods production.
- Economic transformation and integration in the domestic economy - agrarian to industrialized; forward establishing forward - backward linkages.

-External balances - import substitution and export promotion

-Equitable development - rural and urban; SMME's vs. large-scale enterprises.

-Sustainable environmental conservation.

- Development of economic agents - entrepreneurship; advancement of informal sector operators

The SIDP views industrial development in a holistic and systemic way. It accepts that the constraints, competitive issues and opportunities are complex, inclusive of different disciplines and requires the participation of various institutions, stakeholders and sectors. In its approach, the SIDP embraces the principles of a market economy and suggests that industry would only prosper in the hands of the private sector. In this regard, the Government should phase out its direct involvement in industry and become more involved in the creation of an enabling environment.

SIDP suggested Policy Actions:

The establishment of the above-mentioned production capacities would depend on the appropriateness of other policy instruments and policy issues which are outside the domain of the Ministry of Industry and Trade. The SIDP therefore recommends that policy instruments and policy issues, which could impact on industrial development and competence, should be reviewed. The responsible institutions should work closely together to create the right policy environment for industrial growth and sustainable development. The following are examples of policies that should support the goals and objectives of the SIDP and the institutions that should work closely together in defining such policies. Policy coordination among the different stakeholders is a prerequisite for success. Three government departments are seen as key to the successful implementation of the SIDP: Ministry of Industry and Trade, Ministry of Finance and the Planning Commission. The Ministry of Industry and Trade should be capable of reviewing its implementation and make recommendations for policy adjustments. The Ministry of Finance and the Planning Commission should be jointly responsible for macro-economic policy, which should provide the framework for the development agenda and sectoral policies. Given that policy development is an interactive process involving key stakeholders in the public and private sectors, the SIDP envisages the establishment of a public private consultative mechanism. This partnership between the Government and the private sector also augurs well for industrial governance.

SIDP and sustainable industrial development:

The SIDP highlights the following:

-Transformation from a public sector driven industrial development to private sector led industrial development and increased market orientation.

-Production of capital and intermediate goods to complement the current production of consumer goods.

- A move towards competitive advantage or industrial competition.
- Reducing dependency on imports and gradually work towards self-sustainability.
- Creating an enabling environment for private sector development and minimizing direct government interference
- Moving away from central planning and single-minded approach to a holistic and systemic approach.

Strategy for Sustainable Development in India:

India presented its perspective on sustainable development before the World Summit for Sustainable Development (WSSD) in 2002 as detailed study "Empowering People for Sustainable Development" (EPSD). It was brought out by the Ministry of Environment and Forests. The Indian Government did not feel the need for a separate specific strategy for sustainable development. The Five Year Plans (see below) provide medium-term strategies for overall development. However, after the WSSD, the Indian government initiated a process of preparing and implementing a national strategy for sustainable development by 2005.

EPSD introduces the essential framework for sustainable development in India: democratic continuity, devolution of power, independent judiciary, and civilian control of the armed forces, independent media, transparency and people's participation. It follows multidimensional, sectoral and cross-sectoral approaches.

EPSD – four main Objectives

- Combating poverty
- Empowering people
- Using core competence in science and technology
- Setting environmental standards: Conservation of Natural Resources, Improving Core Sectors of Economy

The multidimensionality in the EPSD is described in the chapters "Combating poverty", "Putting people first", "Harnessing scientific and technological prowess" and "Setting standards, institutions and legislations". Cross-sectoral elements are included in the chapter "Conservation of natural resources" (water, agriculture, forest & biodiversity, marine resources, water resources). The penultimate chapter "Promoting sustainable development" shows a slightly sectoral approach. The sectoral orientation in EPSD focuses on the identified core sectors as energy, industry and transport, because they are essential for the future growth of the Indian economy and were responsible for much of the pollution of air and water in the past. The "Unfinished agenda" refers to the unsatisfactory progress in sustainable development globally, the North-South contract (financial transfer and environment technology transfer to developing countries) and the remaining national challenge in achieving sustainable development. The government's commitment to sustainable development is reflected in specific and monitor able targets for a few key indicators of human development and conservation of natural resources that became part of the Tenth Five Year Plan (FYP). The EPSD includes first of all descriptions of India's conditions and resumes the developments of the past. There are also some measurable medium-term targets. But the planning itself has to be put into more concrete terms within FYP. Right now the Eleventh Five Year Plan is in force.

National Five Years Planning:

Planning is an important steering instrument of India's democracy. It is based on an iterative process involving interaction between the centre, the state and the local bodies. Multiple stakeholders participate in the planning process. Working groups and task forces are established to prepare plans and reports for various sectors. They are responsible for substantial participation of civil society. Sustainability concerns have become a vital element in the planning process.

"The Ninth Five-Year Plan (1997-2002) explicitly recognized the synergy between environment, health and development and identified as one of its core objectives the need for ensuring environmental sustainability of the development process through social mobilization and participation of people at all levels." The Planning Commission of India (PCI) is responsible for making the Five Year Plans. The PCI works under the overall guidance of the National Development Council (NDC), the highest decision-making authority in the country on development matters. In a preparatory meeting, the NDC directed the Planning Commission to prepare the Tenth Five Year Plan with a target growth rate of 8 per cent per annum along with significant improvements in social and environmental indicators. Thus, principles for sustainable development were integrated into the acting of the administration and into the Tenth FYP. The PCI consults with the Central Ministries and the State Governments while formulating FYPs and Annual Plans for short-term development goals and also oversees their implementation. The Commission also functions as an advisory planning body at the highest level. The short-term development goals (plans) are implemented through a decentralized and broad-based administration. A uniform pattern exists of devolution of responsibility between the centre and the states on one hand and the states and local bodies on the other. There is a mid-term appraisal within the FYP. As already mentioned, in addition to India's 8 % growth target, further targets were set up to reflect the importance of the sustainable dimensions in development planning; the Tenth Plan identifies specific and monitor able targets for a few key indicators of human development.

Targets for Sustainable Development:

- Reduction of poverty ratio by 5 percentage points by 2007 and by 15 percentage points by 2012
- All children in school by 2003; all children to complete 5 Years in school by 2007
- Reduction in gender gaps in literacy and wage rates by at least 50 % by 2007
- Reduction in population growth between 2001 and 2011 to 16.2 %
- Increase in literacy rate to 75 % by 2007
- Reduction of Infant Mortality Rate (IMR) to 45 per 1000 live births by 2007 and to 28 by 2012
- Reduction of Maternal Mortality Rate (MMR) to 2 per 1000 live births by 2007 and to 1 by 2012
- Increase in forest cover to 25 % by 2007 and 33 % by 2012
- All villages to have sustained access to potable drinking water by 2007
- Cleaning of major polluted rivers by 2007 and other notified stretches by 2012 Source:

Implementation Aspects and Specific Initiatives:

Principles of sustainable development passed the first bottleneck by being accepted in the Eleventh FYP. New approaches and instruments like measurable national indicators improved the planning towards sustainable development even further. More time has to pass, before conclusions can be drawn. A lot will depend on the performance on the State level and the progress in capacity building from there down to the municipal level, where objectives and plans have to be translated into practical action. The same applies to the citizens' participation and the

influence that the new sustainable thinking will have on their lives. Poverty and inter-regional and inter-class conflicts remain a major challenge.

Concerning capacity building in the young generation, India set up a National Green Corps (NGC) program several years ago. The program aims to provide opportunities for children to understand the environment and environmental problems through school eco-clubs. The MoEF launched NGC with the main objective of creating environmental awareness through people's participation especially among school children. During the Tenth Plan it is expected that about 50,000 schools will participate in NGC related activities. In addition, 3,000 eco-clubs have been set up in schools with the Ministry's assistance.

The concept of sustainable development was cast into a law, the Biological Diversity Act, for the first time in 2002. According to the act, the central government shall integrate the conservation, promotion and sustainable use of biological diversity into relevant sectoral or cross-sectoral plans, programmes and policies. "Sustainable use" is defined as the use of components of biological diversity in such manner and at such rate that does not lead to the long-term decline of the biological diversity thereby maintaining its potential to meet the needs and aspirations of present and futuregenerations. Further national strategies, plans, programmers are to be developed to increase awareness with respect to biodiversity.

Joint Forest Management is a new style of governance. Similarly, in the case of environmental clearance all major projects have to go through the process of a public hearing. Both, the government and the local communities participate in managing the forest resources.

India has an ambitious development program that reflects the importance of sustainable growth of the economy. But many projects and further steps will be successful only if financial support is given and international co-operation and transfer of knowledge strengthen. And of course there has to be an effective national monitoring. The Planning Division (assistance to the Planning Commission) participated in a seminar on Sustainable Development Indicators organized by TERI, as can be read in the last annual report 2002-2003 by the Planning Commission. Thus, there might be further improvement in the monitoring of sustainable development. Empowering people to participate substantially is one of the main objectives of the FYP. Special attention was paid to this objective in the "Programmatic Activities" of the FYP under the paragraph "Improving governance". It was chosen as an example in this study because of the special importance it is given in India's society in general. The real translation into practice will be seen in the next few years.

Improving governance - Important Components of Civil Services Reforms:

Civil Service Reforms must be aimed at improving transparency, accountability, honesty, efficiency and sensitivity in public administration at all levels. See some important components of Civil Service Reforms:

- The processes and the outcomes of policies, entitlements and procedures must be made transparent, widely shared and well displayed.

- It is believed and as such should be followed, that less discretion would lead to a more equitable and less corrupt system.
- Prevalent institutional arrangements will have to be reviewed and changes made so that those vested with authority are also made accountable.
- The present system of rewards and punishments in public life, which makes corruption a high return-low-risk activity, needs to be changed.
- It is necessary to review the situation, and identify departments and functions within departments that were once essential, but are now redundant and would need to be done away with.
- The induction of professionals/specialists into the administrative system, on contractual appointments should be examined and suitable policy changes made in the entry policy.
- Pre-service and demand driven in-service capacity building for all cadres and ranks should be made a regular feature.
- Contributory Pension System for the new employees must be seriously considered.
- Alternative ways of carrying out a job/activity must be examined and assigned to Government only if considered essential.
- Stability of tenure is essential and should be ensured for any constructive and sustainable work Source.

In the Eleventh FYP, much attention was also given to an integrated approach to improve the agricultural sector in order to protect natural resources and combat poverty at the same time. This is quite a sustainable approach that has to be implemented in the next few years,

Conclusion:

Sustainable development is a vision and a way of thinking and acting so that we can secure the resources and environment for our future generation. It will not be brought about by policies only it must be taken up by society at large as a principle guiding the many choices each citizen makes every day, as well as the big political and economic decisions that affect many. It is clear that environmental degradation tends to impose the largest costs on those generations that are yet to be born. Future generations are disadvantaged with regards to present generations because they can inherit an impoverished quality of life, share a condition of structural weakness in having no voice and representation among the present generation and so their interests are often neglected in present decisions and planning while its very much needful that we think about our generation. We can only improve sustainable development when it will put an emphasis on involving citizens and stakeholders. Ultimately, the vision will become reality only if everybody contributes to a world where economic freedom, social justice and environmental protection go hand in hand, making our own and future generations better off than now.

References

Helmut Weidner, Martin Jänicke (2002): Capacity Building an National Environmental Policy – A comparative Study of 17 Countries, Environmental Capacity-Building: India's Democratic Politics and Environmental Management, Page 239-259, Berlin Heidelberg 2002.

Central Intelligence Agency (CIA) (18. December 2003 - latest update): World Fact Book – South Korea, Available: http://www.odci.gov/cia/publications/factbook/geos/in.html (Accessed: 2004, February 24).

Cruz, R.V., H. Harasawa, M. Lal, S. Wu, Y.Anokhin, B. Punsalmaa, Y. Honda, M. Jafari, C. Li and N. Hu Ninh (2007): Asia. Climate Change, 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to The Fourth Assessment Report the Intergovernmental Panel on Climate Change, M.L.Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson Eds, Cambridge University Press, Cambridge, U.K. 469-506.
Dempsey, N. and M. Jenks (2005). Future forms for city living? In Future Forms and Design for Sustainable Cities, M. Jenks And N. Dempsey eds. Elsevier, Oxford, U.K.

Govt. of India, Ministry of Environment and Forests, White Paper on Pollution in Delhi with an Action Plan. http://envfor.nic.in/

Govt. of India, Planning Commission (2008). Eleventh Five Year Plan, 2007-2012 vol. III. Oxford, India.

Hindustan Times, (2008). Death of the lakes. In Hindustan Times, August 5, New Delhi, Metro Edition.

Jenks, M. & N. Dempsey, (2005). The language and meaning of density In Future Forms and Design for Sustainable Cities, M. Jenks And N. Dempsey eds. Elsevier, Oxford, U.K.

Kenworthy J.and F.B. Laube (1999). An International Sourcebook of Automobile Dependence in Cities 1960-1990, University Press of Colorado, Boulder.

Kundu A. and S. Thakur (2006). Access to drinking water in urban India: An Analysis of emerging spatial pattern in the context of new system of governance In Managing Water Resources: Policies, Institutions and Technologies, V. Ratna Reddy and S. Mahendra Dev eds. Oxford, New Delhi.

International Cooperation Division in the Ministry of Environment and Forest (ICEF) (2002): India-Canada Environment Facility – Status Report, Available: http://www.envfor.nic.in/divisions/ic/ic/html (Accessed: 2004, February 24).

OECD, Global Forum on sustainable Development: Emission Trading (2003a): Concerted Action on tradable Emissions Permits Country Forum, Implementing Kyoto-Type Flexibility Mechanisms for India: Problems and Prospects by Shreekant Gupta, Available: http://www.oecd.org/dataoecd/11/59/2957638.pdf (Accessed: 2004, February 28).

Planning Commission, Government of India (PCI) (2002): Tenth Five Year Plan, Available: http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html (Accessed: 2004, February 29).

Planning Commission, Government of India (PCI) (2002a): Annual Report, 2002- 2003, Available: http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html ((Accessed: 2004, February 29).

Planning Commission, Government of India (PCI) (2002b): Tenth Five Year Plan, Chapter 8, Policy Imperatives and Programmatic Initiatives, 2002-2003, Available: http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html (Accessed: 2004, February 29). .

Centre of Environment Education, India: http://www.ceeindia.org, (Accessed: 2004, February 29).

CIA – The world Fact Book:

http://www.odci.gov/cia/publications/factbook/appendix/appendix-b.html, (Accessed: 2004, February 10).

Columbia University, Center for International Earth Science Information Network: Envis – ELDIS – The Gateway for Development Information: http://www.eldis.org/, (Accessed: 2004, February 10).

Environmental Information System, India: http://www.envis.nic.in/, (Accessed: 2004, February 12).

Ministry of Environment and Forests, India: http://www.envfor.nic.in, (Accessed: 2004, February 12).

Planning Commission, Government of India (PCI), Assessed 2004 March 30th: http://planningcommission.nic.in, (Accessed: 2004, February 28).

Sustainable Development Networking Programme: http://sdnp.delhi.nic.in/, (Accessed: 2004, February 12).

The Energy and Resources Institute (TERI): http://www.teriin.org/, (Accessed: 2004, February 20).

TERI – The Energy and Resources Institute: http://www.teriin.org, (Accessed: 2004, February 12).

The Federal Foreign Office of Germany: http://www.auswaertiges-amt.de, (Accessed: 2004, February 10).

UN Commission on Sustainable Development: http://www.johannesburgsummit.org/, (Accessed: 2004, February 12).

United Nations Development Programme: http://www.undp.org/, (Accessed: 2004, February 10).

World Bank Group: http://www.worldbank.org.in (Accessed: 2004 June 12).

Human Right to Development in Consonance with an Approach to Sustainable Development: Environmental Perspective

30 Vishal Guleria

I. Introduction

The march of human civilization is always accompanied by the process of development. As the progress of human civilization is a continuous process, so is the case of the process of development. Therefore, the process of development has been in progress since the inception of human civilization, however, the thrust and course of development have changed over a period of time depending upon time and space. Apart from being a continuous process, the development has always had an intimate relationship with its surroundings, which is known as environment. Environment has two vital components: first is physical and second is social. The history is the witness that the process of development has done a huge damage to the physical environment because it has resulted into the environmental pollution. It has not only led to massive deforestation but also polluted the air and water bodies all around. Further, the process of development has over exploited the natural resources, which did not only belong to the present generation but to the future generations as well. It means that the process of development has not remained compatible with the natural surroundings.[7] Every individual and all peoples have the Human Right to Development, and to other fundamental human rights linked to and dependent upon realization of the Human Right to Development. Development is a comprehensive process involving sustainable improvement of the economic, social and political well-being of all individuals and peoples. Development aims for the realization of all human rights -- civil, cultural, economic, political, and social -- and for the greatest possible freedom and dignity of every human being. The Human Right of every woman, man, youth and child to Development includes the following universal, indivisible, interconnected and interdependent human rights: "The right to development is an inalienable human right by virtue of which every human person and all peoples are entitled to participate in, contribute to, and enjoy economic, social, cultural and political development, in which all human rights and fundamental freedoms can be fully realized. The human right to development implies the full realization of the right of peoples to self-determination. The human person is the central subject of development and should be the active participant and beneficiary of the right to development. States have the duty to formulate national development policies that aim at the constant improvement of the well-being of the entire population. States have the duty to take steps to formulate international development policies with a view to facilitating the full realization of the right to development. States should take steps to eliminate obstacles to development resulting from failure to observe civil and political rights, as well as economic, social and cultural rights. All states should promote

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[7] Pushpinder Kaur, *Environmental Protection in India: Judicial Activism and Beyond*, available at www.AIRwebworld.com

international peace and should do their utmost to achieve disarmament [and] to ensure that resources released by disarmament are used for development. States shall ensure equality of opportunity for all in their access to basic resources, education, health services, food, housing, employment and the fair distribution of income...
." --*Declaration on the Right to Development*, Articles 1, 2, 4, 6, 7, and 8
"Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature. In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it. All States and all people shall cooperate in the essential task of eradicating poverty as an indispensable requirement for sustainable development...."
--*Rio Declaration*, Principles 1, 4, and 5
"The objective of enabling all people to achieve sustainable livelihoods should address issues of development, sustainable resource management and poverty eradication simultaneously. The objectives are: To implement policies that promote adequate levels of funding [for] human development, including income generation, increased local control of resources. To develop for all poverty-stricken areas integrated strategies and programmes of sound and sustainable management of the environment, resource mobilization, poverty eradication and alleviation, employment and income generation. To create a focus in national development on investment in human capital, with special policies directed at rural areas, the urban poor, women and children. Governments should support a community-driven approach to sustainability, which would include. Empowering women through full participation in decision-making, giving communities a large measure of participation in the sustainable management and protection of the local natural resources...."
The notion of sustainable development is quite commonplace today in the parlance of discussion of developmental issues in the disciplines of Economics and other social and environmental sciences.Sustainable development is essentially a policy and strategy for continued economic and social development without detriment to the environment and natural resources on the quality of which continued activity and further development depend. Therefore, while thinking of the development measures the need of the present and the ability of the future generations to meet its own needs and requirements have to be kept in view.[8]The World Commission onEnvironment and Development definedsustainable development as a concept ofintertemporal resource use based on anethical theory of inter-generational equity.To be more specific, the concept requiredthe present generation to so use thenatural, manmade and human capital resourcesthat they leave behind enough ofthese for the future generation to be ableto attain at least the same level of socialwell-being as enjoyed by themselves.[9]

Sustainable development is essentially a policy and strategy for continued economic and social development without detriment to the environment and natural resources on the quality of

[8] H.N Tiwari, *Environmental law*, p.1, (1999, 2nd ed.)
[9] Ramprashad Sengupta, Human Well Being and Sustainable Development, *Economic and Political Weekly*, p. 4289, Oct. 2002

which continued activity and further development depend. Therefore, while thinking of the development measures the need of the present and the ability of the future to meet its own needs and requirements have to be kept in view. While thinking of the present, the future should not be forgotten. The balance between environmental protection and developmental activities could only be maintained by strictly following the principles of sustainable development.

Industry is central to economics of the modern societies and indispensable motor of growth. It is essential to developing countries, to widen their development base and meet the growing needs. Industry extracts material from natural resources base and inserts both products and pollution into the human environment. The relationship between man and his environment isundergoing profound changes in the wake of modernscientific and technological developments. In India, from time to time various laws have been enacted for the protection ofenvironment, flora and fauna, and Indian Constitution is the first constitution in the world which contains specific provisions for the protection and improvement of environment.[10] In India, in view of the various constitutional provisions and other statutory provisions contained in various laws relating to environment protection, the Supreme Court has held that the essential feature of "sustainable development" such as the "Precautionary Principle" and the "Polluter Pays Principle" are part of Environmental law of the Country.[11]

a) Concept of Environmental Protection

It is rather difficult to define what environment really means. It is an expression of very wide amplitude as it takes into account all those factors which directly or indirectly have bearing upon the natural surroundings of human beings.[12]The environment has been defined as that outer physical and biological system in which man and other organisms live as a whole. This entire system is a complicated one as it has many interacting components. These components of the environment generally include its rocks, minerals, soils and waters, its lands and potential vegetation, its animal life and potential for animal husbandry and its climate. There is a close and complicated interaction amongst these various components which tend to produce a kind of equilibrium in the scheme of nature, which is generally termed as 'ecological balance'.[13]Changes in the ecological system occur continuously through natural process and man's activities but the system has to a certain extent a remarkable tendency to rebalance itself. This system taken as a whole is useful to man. Perhaps it is due to this usefulness that for fulfilling his physical requirements, man is totally dependent on environment. Thus there is a close relationship between man and the environment. Therefore, when we talk about the environmental protection in the present day context, we essentially have to conceptualise the term 'environment' relatively. This would give us a functional concept of environment protection- a concept which enables us to meet the numerous and divergent societal needs without still creating the problem of any serious imbalance in the scheme of nature. If understood in this context, the question of

[10]P.S. Jaswal, Nishta Jaswal, *Environmental Law*, p.40., (2nd ed.2005)
[11]*Vellore Citizens' Welfare Forum v. Union of India*, (1996) 5 SCC 647
[12]*Supra* note 3 at 2
[13] Kailash Thakur, *Environmental Protection Law and Policy in India*, p.1, (2007.1st ed.)

reallocation of priorities among various needs and choosing among diverse means for meeting them.[14]

Environmental protection and improvement were explicitly incorporated into the Constitution by the Constitution (Forty- Second Amendment) Act of 1976. Article 48A was added to the Directive Principles of State Policy. It declares: 'The State shall endeavour to protect and improve the environment and to safeguard the forest and wildlife of the country.' Article 51A (g) in a new chapter entitled 'Fundamental Duties' imposes a similar responsibility on every citizen 'to protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creature. Together, the provisions highlight the national consensus on the importance of environmental protection and improvement and lay the foundation for a jurisprudence of environmental protection.[15]

II. Fundamental Rights

Principle 1 of the Stockholm Declaration finds reflection in Article 14[16], 19[17] and 21[18]of the Constitution of India dealing with the right to equality, freedom of expression and right to life and personal liberty respectively. All these rights are secured to the people of India under the Constitution of India particularly in Part III dealing with Fundamental Rights.[19] The Supreme Court of India has contributedsignificantly especially during the 80's in broadening the contents and contours of some of these basic rights. Rights in context of environmental protection are:

A. The Right to a Wholesome Environment

The Interpretation given by the Supreme Court in ManekaGandhi's case has added new dimensions to the concept ofpersonal liberty of an individual. It laid down that a lawaffecting life and liberty of a person has to stand the scrutinyof Articles 14 and 19 of the Constitution. In other words, if a law is enacted by a legislature which touches upon the life andliberty of a person and curtails it, then it is a mandatory requirement that the procedure established by it for curtailing the liberty of a person must be reasonable, fair and just. It is this interpretation of Article 21 which the court has extended further so as to include the right to a wholesome environment. In other words, environmental pollution which spoils the atmosphere and thereby affects the life and health of the person has been regarded as amounting to violation of Article 21 of the Constitution.[20]

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[14]S.C. Tripathi, *Environmental Law*, p.11 (2008, 3rd ed.)

[15]Shyam Divan, Armin Rosen, *Environmental Law and Policy in India*, p. 45.(2nd ed.,2006)

[16]Article14 states: 'The State shall not deny to any person equality before the law or the equal protection of the laws within the territory of India Prohibition of discrimination on grounds of religion, race, caste, sex or place of birth.'

[17]Article 19. states: "1) All citizens shall have the right: (a) to freedom of speech and expression;(b) to assemble peaceably and without arms;(c) to form associations or unions;(d) to move freely throughout the territory of India;(e) to reside and settle in any part of the territory of India; and (f) omitted(g) to practise any profession, or to carry on any occupation, trade or business."

[18]Article 21 states: "Protection of life and personal liberty No person shall be deprived of his life or personal liberty except according to procedure established by law."

[19]*Supra* note 4 at 51

[20]Kailash Thakur, *Environment Protection Law and Policy In India*, p. 204 (1st ed, 2005)

In Dehradun Quarry's case[21]the Supreme Courtentertained complaints from the rural litigation and entitlement Kendra, Dehradun, alleging that the operations of lime stone quarries in the Mussoorie- Dehradun region resulted in degradation of the environment affecting the fragile ecosystems in the area. In this case the Supreme Court moving under Article 32 ordered the closure of some of these quarries on the ground that these were upsetting the ecological balance though the judgment did not make a reference to Article 21 but involving of jurisdiction by the court under Article 32 presupposed the violation of right to life guaranteed under Article 21.

B.Right to Livelihood

The judicial grammar of interpretation has further broadened the scope and ambit of Article 21 and now "right to life" includes the "right to livelihood". The right to livelihood as a part of right to life under Article 21 was recognized by the Supreme Court in Olga Tellis vs. Bombay Municipal Corporation.[22]In this case, the petitioners, a journalist and two pavement dwellers challenged the governmental scheme by which the pavement dwellers were being removed from the Bombay pavements. The main arguments advanced on behalfof the petitioners was that evicting a pavement dweller or slum dweller from his habitat amounts to depriving him of his right to livelihood, which is comprehended in the right guaranteed by Article 21 of the Constitution as deprivation of their livelihood would tantamount to deprivation of their life andhence unconstitutional. It was further argued that no person can be deprived of his life except according to the procedure established by law which has to be "just, fair and reasonable".The petitioner also contended that the State is under an obligation to provide citizens the necessities of life and, inappropriate cases; the courts have the power to issue orders directing the state by affirmative action, to promote and protect the right to life. Social commitment is the quintessence of our Constitution which defines the conditions under which liberty has to be enjoyed and justice has to administered.Therefore, directive principles, which are fundamental in the governance of the country, must serve as a beacon light to the interpretation of the constitutional provisions.

The Court held-If the right to livelihood is not treated as a part of the constitutional right to life, the easiest way of depriving a person of his right to life would be to deprive him of his means of livelihood to the point of abrogation. Such deprivations would not only denude the life of its effective content and meaningfulness but it would make life impossible to live.The Court further held: The State may not by affirmative action, be compelled to provide adequate means of livelihood or work to the citizens. But, any person, who is deprived of his right to livelihood except according to just and fair procedure established by law, can challenge the deprivation as offending the right to life conferred by Article 21. Thus, from the decision of the Supreme Court it is evident that development is not antithetical to environment. However, thoughtless development may cause avoidable harm to theenvironment as well as it can deprive the people of their right to livelihood.[13]

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[21]*Rural Litigation and Entitlement Kendra vs. State of U.P.,* AIR 1988 SC 2187.

[22]*Olga Tellis v. Bombay Municipal Corporation*, AIR 1986 SC 180 at 189- 190.

C.Right to Equality

Article 14 of the Constitution which states that "The Stateshall not deny to any person equality before the law or theequal protection of the laws within the territory of India,"guarantees the right to equality. This Article is the principleinstrument to strike at the arbitrariness of an action should itinvolve a negation of the right to equality. The right toequality as enshrined in Article 14 of the Constitution may beinfringed by government decisions which may have impact onthe environment, particularly in cases, where permissions arearbitrarily granted, for instance, for construction, that are incontradistinction of development regulations or for miningwithout adequate appreciation of environmentally damagingconsequences. Environmentally conscious groups haveresorted to take legal proceedings under Article 14 tochallenge the Constitutional validity of the arbitrary officialsanctions in such matters. Thus, we find that Article 14 can beused as a potent weapon against governmental decisionsthreatening the environment.[23]

The Indian Constitution isperhaps one of the rare Constitutions of the world whichreflects the Human Rights approach to environment protectionthrough various constitutional mandates. In India the concernfor environment protection has not only been raised to thestatus of fundamental law of the land, but it is also weddedwith the human right of every individual to live in pollutionfree environment with full human dignity. The Constitution ofIndia obligates the "State" as well as "citizens" to "protect"and "improve" the environment.[24] The Permanent Peoples' Tribunal regards the "anti-humanitariannot as an unavoidable part of the exiting industrial system, butrather a pervasive and organized violation of the mostfundamental rights of humanity. For, most among them arethe right to life, health, expression and access to justice.

III. Conclusion

The growth of environmental law in India has been largely influenced and accelerated by PIL. It has generated tremendous awakening amongst people about environmental protection, has ushered in the evolution of innovative judicial techniques to arrest environmental degradation and has transformed the jurisprudence of public law review. The technique of PIL serves to provide an effective remedy to enforce group rights and interest as the traditional judicial system is not equipped to tackle such problems. The socio economic demands of a changing society, groaning under the strains of rapid industrial development adversely impacting the natural riches, warrant a different kind of jurisprudence-dynamic, vibrant and resilient to address people's problems. PIL is one such tool to help the poor, under-privileged, downtrodden and exploited millions. It is essentially a co-operative or collaborative effort on the part of the petitioner, the state or public authority and the court to secure observance of the Constitutional or legal Rights, benefits and privileges conferred upon the vulnerable sections of the community and to provide social justice to them. Therefore, a citizen has a right to have recourse to Article-32 of the Constitution for removal of factors causing detriment or impairment to the quality of life.Another guiding principle has been that of adopting a model of sustainable development. The

[23]A.K. Tiwari, *Environmental Laws in India*, New Delhi, p. 25.(2nd ed. 2009)

[24]Available at http://books.google.co.in/books

consistent position adopted by the courts as enunciated in one of its judgments has been that there can neither be development at the cost of the environment or environment at the cost of development. The foregoing discussion has amply bought out the role played by the higher Judiciary in India to come to the fore whenever senseless development has caused damage to the environment. The Apex Court has in such cases not only endeavored to stop the damage but by its progressive judgements also tried its best to undo the harm that has been caused to the environment and has also in the process meted out severe penalties to the perpetrators of such environmental degradation which not only did justice in those cases but also acted as a deterrent to other people. It is sincerely hoped that the trend would continue in the future also and our Judiciary would never be found lagging whenever it comes to the protection of our environment and the cause of sustainable development.

Tourism and Environment: A Case Study on Mall Rad, Shimla

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Abstract

Nature is a beautiful gift of god, many people travel from one place to another to experience, explore and enjoy the feeling of being linked to nature. Every aspect have positive and negative sides, so do nature based tourism. Positive side is that it provides revenue, development (in terms of infrastructure, standard of living, transportation) to the destination residents and the government. Negative impacts of tourism activities have been traced on the destinations in terms of exploitation of natural resources, lost of natural charm and attractiveness disturbing the carrying capacity of the destination. Himachal Pradesh is one of the potential states of India which is blessed with the immense natural charm, sky touching snow capped mountains, picturesque locations, mesmerizing enigma which attracts everyone to visit himachal at least once in a life. Due to over exposure of the destination to tourism, areas of himachal have started losing its charm and beauty.

The basis of the study was to find out up to which extent tourism has affected the natural environment and the carrying capacity of the area of mall road, Shimla, and to analyze that up to which extent the initiatives of the government, to protect the natural environment and to ensure sustainable development have proved successful.

For this research study, data is collected by primary data collection method by using questionnaires and personal meeting. Data is collected by directly visiting mall road and the surrounding areas which is the best place to get the respondents. The response for the research study is taken from the tourists, local people and government officials, which helped to meet the objectives of the study.Study on 50 respondents has revealed that though overflow of tourism have negative impacts on the natural beauty and the overall environment of the mall road, Shimla but it has also improved the standard of living of local people. The initiatives taken by the government to improve the situation of mall road are satisfactory but it requires more budgets for the better initiatives and sustainable development of the destination.

Mall road consist of every aspect that a perfect destination should carry. It is developing every year but for the sustainable development it requires more efforts and inputs by the government. Tourist traffic should be managed professionally and local people living and lifestyle should not be affected by the negative footprints of tourism.

Keywords: *Tourism and environment, Carrying capacity, sustainable development.*

Introduction:

Tourism is travel for recreational, leisure, or business purposes. The World Tourism Organization defines tourists as people "traveling to and staying in places outside their usual environment for not more than

one consecutive year for leisure, business and other purposes". Tourism has become a popular global leisure activity. Tourism is almost wholly dependent on the environment. Natural resources (beaches, seas, mountains, lakes, rivers etc) and man-made resources (historic cities, heritage buildings and sites, monuments etc) constitute the primary source of tourism. Any degradation of the primary sources is likely to lead to a decline of tourism.

Environment is a primary source of tourism. Both tourism and environment has a very complex and interdependent relationship. Tourism has both positive and negative impact on environment. Positive impact includes development of the destination, employment generation, revenue generation, connection of the destination with world.

Himachal Pradesh provides the tourists an opportunity to come close to the beautiful and snow covered hill station situated in the lap of Himalaya. It is located in the north India spread over the 21,495 sq meters. With the Himachal tourism, tourist can explore the most enchanting hill stations of India. Beauty of the state can be imagined by its amazing snow covered mountains, deep valleys, flowing rivers, wide crystal clear lakes and the beautiful dense green deodar forest. Tourism in Himachal is for all kinds of tourists for honeymooners, family, group and adventure lovers such as trekking, skiing, ice skating, paragliding, etc. If you are looking for a place that is full fledge tourist destination then tourism in himachal Pradesh, north India is at the top on the list for tourists.

As the Summer Capital of the British in India, Shimla was the country's focus for the better part of every year and now, is the state capital of Himachal Pradesh. Today, it has well developed facilities, easy accessibility and numerous attractions making it one of India's most popular hill resorts. Situated in the lower ranges of the Himalayan Mountains, it is surrounded by pine deodar, oak and rhododendron forests. Towards the north lie the snow-covered high-ranges, while the valleys breathe whispering streams and swaying fields. Within the town are host of splendid colonial edifices, quaint cottages and charming walks. Shimla offers a variety of shopping, sport and entertainment activities.

Mall Road is the main street in Shimla, the capital city of Himachal Pradesh, India. Constructed during British colonial rule, the Mall road is located a level below the ridge. The offices of Municipal Corporation, fire service, and police headquarters are located here. Automobiles, except emergency vehicles are not allowed on this road. For this reason, the locals and tourists are often found strolling on this road in the evenings.

Mall road has a number of showrooms, department stores, shops, restaurants and cafes. A Himachal emporium that offers handicraft products of Himachal Pradesh like locally designed woolen cloths, branded cloths, pottery items, and jewelry is also located here. There are at least three books shops including one that sells old books.

Objectives of the study:

a. To study the effect of overflow of tourist on the environment as well as carrying capacity of mall road and the surrounding areas.

b. To study the role of government bodies in the development and improvement of the environment of the place.

Research Methodology:

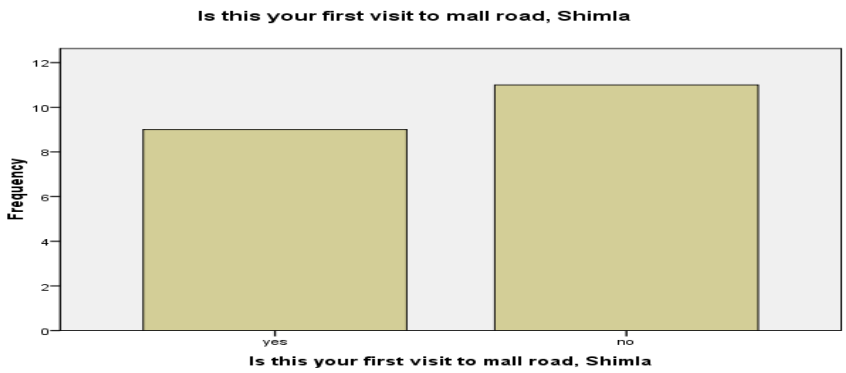
To carry out this research Primary and Secondary data sources has been used. Primary data required for this study is collected from the tourist, local people, government and non-government bodies of Shimla in the form of personal interviews and questionnaires and secondary data required for this study will be collected from different authentic sources like internet, books, published journals, articles and newspapers.

Research findings and analysis:

Response from Tourists:

Is this your first visit to mall road, Shimla

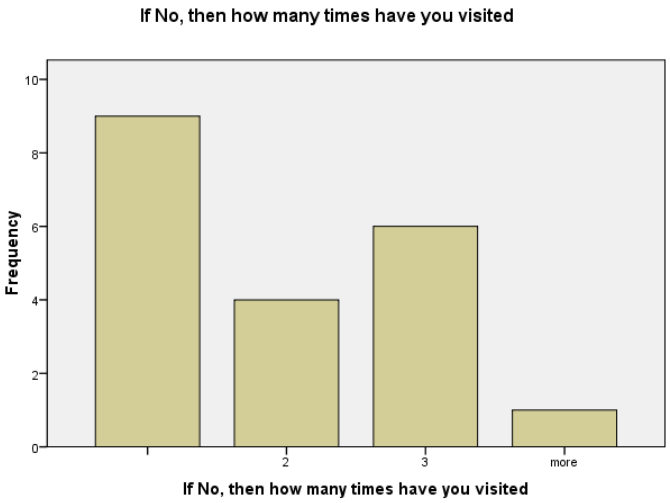
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	9	45.0	45.0	45.0
	No	11	55.0	55.0	100.0
	Total	20	100.0	100.0	



As per the analysis of this question out of 20 respondents 9 said that they are visiting mall road first time and 11 are the repeated visitors.

If No, then how many times have you visited?

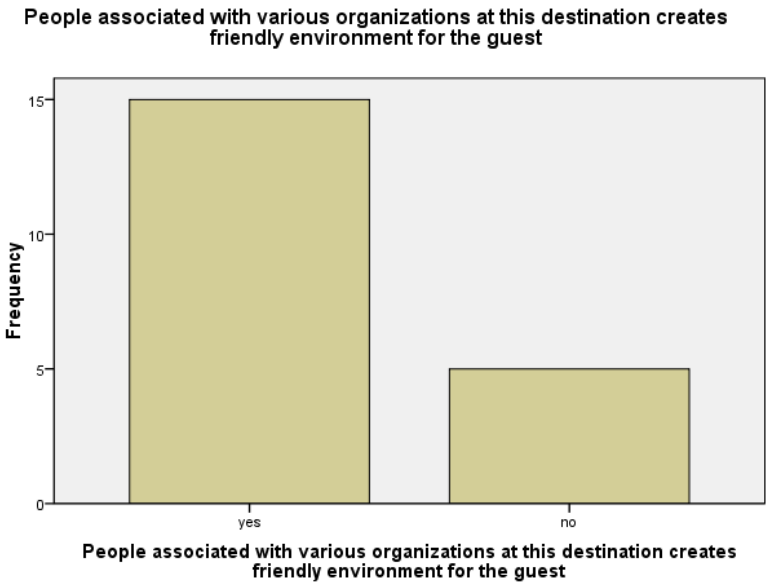
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		9	45.0	45.0	45.0
	2	4	20.0	20.0	65.0
	3	6	30.0	30.0	95.0
	more	1	5.0	5.0	100.0
	Total	20	100.0	100.0	



As per the analysis of this question out of 9 respondents have previously visited the destination once, 4 have visited twice, 6 respondents have visited thrice and 1 of the respondent is the repeated.

People associated with various organizations at this destination creates friendly environment for the guest

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	15	75.0	75.0	75.0
	no	5	25.0	25.0	100.0
	Total	20	100.0	100.0	



As per the analysis of this question 75% respondents agree with the statement that People associated with various organizations at this destination creates friendly environment for the guest and 25 % were not agree with the statement.

Mall road, Shimla has a unique image in terms of natural beauty

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly agree	4	20.0	20.0	20.0
	Agree	12	60.0	60.0	80.0
	Neutral	4	20.0	20.0	100.0
	Total	20	100.0	100.0	

As per the analysis of this question 20% respondents have submitted their strong agreement to the statement Mall road, Shimla has a unique image in terms of natural beauty, 60 % have agreed with the statement and 10% have the neutral opinion.

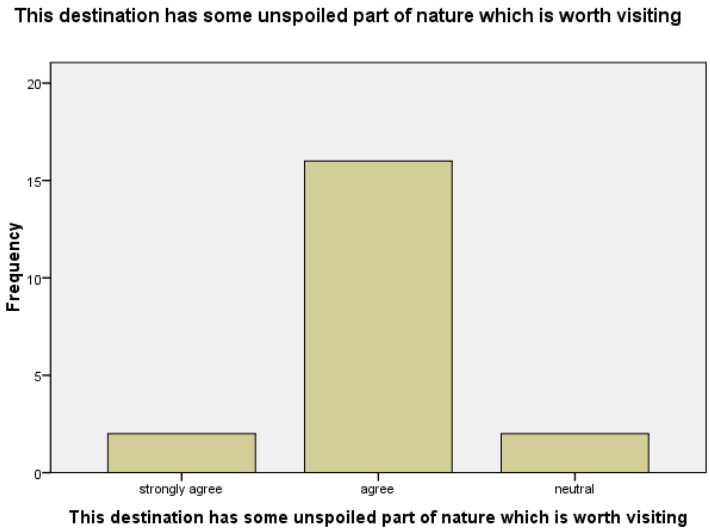
The destination has lost its charm and beauty due to excess visit of tourist

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly agree	8	40.0	40.0	40.0
	agree	8	40.0	40.0	80.0
	neutral	4	20.0	20.0	100.0
	Total	20	100.0	100.0	

As per the analysis of this question 40% respondents strongly agree and 40% just agree and 20 % have neutral opinion on the statement that the destination has lost its charm and beauty due to excess visit of tourist.

This destination has some unspoiled part of nature which is worth visiting

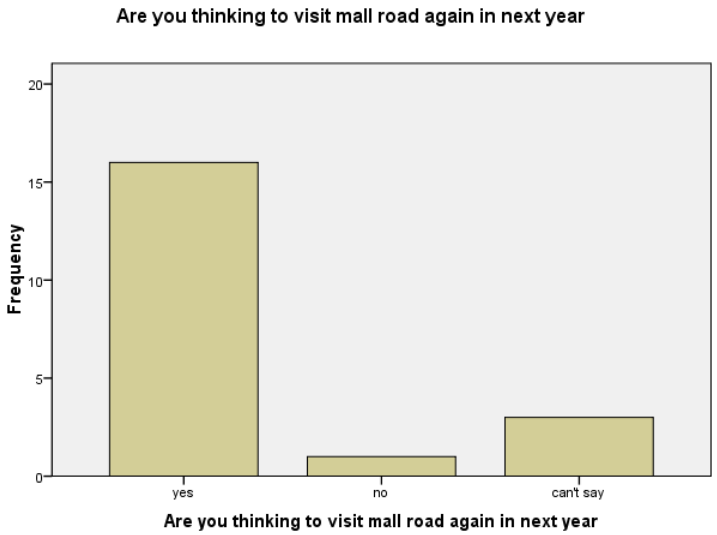
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly agree	2	10.0	10.0	10.0
	agree	16	80.0	80.0	90.0
	neutral	2	10.0	10.0	100.0
	Total	20	100.0	100.0	



As per the analysis of this question 10% respondents strongly agree and 80% just agree and 10 % have neutral opinion on the statement that this destination has some unspoiled part of nature which is worth visiting.

Are you thinking to visit mall road again in next year

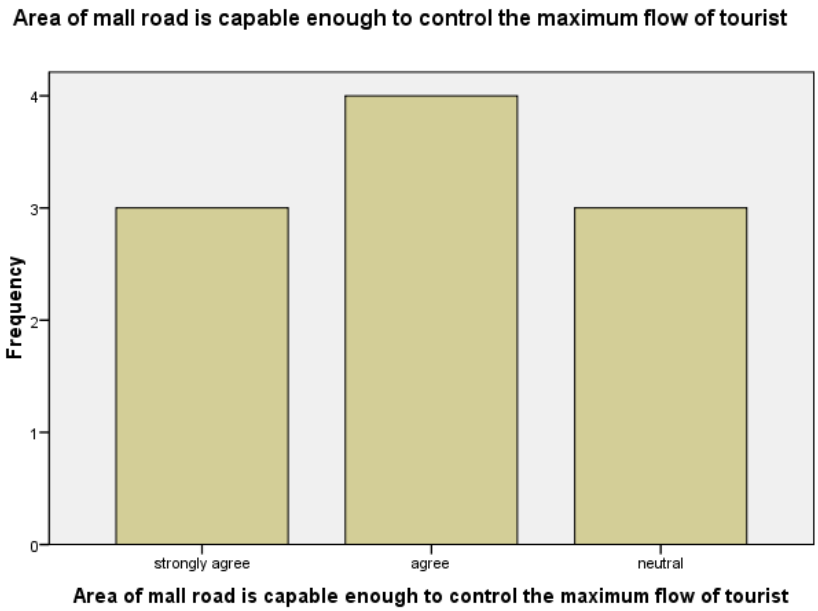
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	16	80.0	80.0	80.0
	no	1	5.0	5.0	85.0
	can't say	3	15.0	15.0	100.0
	Total	20	100.0	100.0	



As per the analysis of this question 80% of the respondents are planning to visit mall road, Shimla next year again whereas 5 % are not planning and 5% can't say at the moment that weather they will visit next year or not.

Area of mall road is capable enough to control the maximum flow of tourist

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	strongly agree	3	30.0	30.0	30.0
	agree	4	40.0	40.0	70.0
	neutral	3	30.0	30.0	100.0
	Total	10	100.0	100.0	



As per the analysis of this question 30% respondents strongly agree and 40% just agree and 30 % have neutral opinion on the statement that Area of mall road is capable enough to control the maximum flow of tourist.

Excess inflow of tourist has destroyed the maximum scenic beauty and natural environment of mall road

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	7	70.0	70.0	70.0
	Neutral	3	30.0	30.0	100.0
	Total	10	100.0	100.0	

As per the analysis of this question 70% respondents strongly agree and 30% just on the statement that Excess inflow of tourist has destroyed the maximum scenic beauty and natural environment of mall road.

Summery and recommendation:

Research finding shows that:

- Overflow of tourism has marked negative footprints on the mall road and the surrounding areas.
- Tourists have positive perceptions for the destination but they expect more improvement and development in terms of facilities and hygiene.
- Initiatives by the government are satisfactory but more inputs are needed in terms of the sustainable development of the destination.
- Excess inflow of the tourist has affected the living standard and lifestyle of the local people.
- Carrying capacity of mall road is disturbed up to some extent.

Suggested Recommendations:

- Government should take strict steps to stop the over exploitation of the natural resources.
- Government should fix a certain rules and regulations for tourists and local people to save the natural beauty of the destination.
- Plastic bags should be banned in the mall road and surrounding areas.
- Control on the over construction of the infrastructure is required and it should be up to certain limit.
- It is should be insured that living style and standard local people should not be negatively affected by tourism.
- Flow of tourist should be controlled according to the carring capacity of the Mall road, Shimla.

Bibliography:

- THEOBALD, W. F.(2005). Global Tourism.
  Retrieved:
  http://books.google.co.in/books?hl=en&lr=&id=X_gqz7u9iboC&oi=fnd&pg=PA78&dq=tourism+and+positive+environmental+impacts&ots=e4hsYmzdLy&sig=Af7DBMQ_TbUJ8bnTyJkCDxDSaTM#v=onepage&q=tourism%20and%20positive%20environmental%20impacts&f=false
- AZAM, M. (2011). Green Tourism in the Context of Climate change towards Sustainable Economic Development in the South Asian Region. *Journal of Environmental Management and Tourism. vol. II, issue 1, pages 6-15*
- PILLANIA, R. K. (2012). Future of Green Management and Sustainability in India. *Journal of Environmental Management and Tourism. vol. III, issue 1, pages 18-25*
- RADULESCU, C. V. (2011). Tourism and Environment – Towards a European Tourism Policy. *Journal of Knowledge Management, Economics and Information Technology.* Issue 5
- UTANG, P.B. & ADIE, L. A. (2011). Environmental Change and the Challenges of Tourism Patronage in the Obudu Ranch Resort Nigeria. *Journal of Environmental Management and Tourism. Vol. II, Pages: 61-71*
- VIJ, M. & VIJ, A. (2012). Tourism And Carbon Foot Prints In United Arab Emirates – Challenges And Solutions. *Journal of Environmental Management and Tourism. vol. III, Pages: 41-54*
- ZAMBRANO, A. M. A., BROADBENT, E. N. & DURHAM, W. H. (2010). Social and environmental effects of ecotourism in the Osa Peninsula of Costa Rica: the Lapa Rios case. *Journal of Ecotourism. Vol. 9, No. 1, page 62 –83*
- "Shimla, Mall Road quick infoshot @ surfindia.com". Surf India. Retrieved 2007-05-29
- http://en.wikipedia.org/wiki/Tourism.
- http://hptdc.nic.in/cir0103.htm
- http://www.himachaltourism.in/

Migration and Sustainable Development in Uttrakhand Himalaya

32

Dr. Rukma Rawat

Abstract

In Uttarakhand Himalaya a majority of the population have been found living in hill spurs and river valleys, had their self sufficient and self sustaining economy. These communities produced almost everything of their need except salt, spices and gur, which was also made available to them by indigenous bhotiya tribe either from plains or from Tibet. However growth of population, marginalization of land holdings, denudation of forests, quarrying of land for construction of roads and various development projects, climate change increasing landslides, decreasing productivity of land etc, resulted in food scarcity resulted in large scale migration of young males of active working age group. These migrants have have either joined armed forces or migrated to towns for eking bread for themselves as well as for their dependents living behind in the villages. This way approximately 70% of males of working age group were absent from villages leaving agriculture economy to be attended by females. Gradually the migration streams from the region were ever widening so much so that the new trend of family migration has been started. Now one can notice the scores of broken houses and barren fields in the hill areas. The desertion of hill villages as well as economy is alarming. Hence sustainable development is the need of the hour and this may also play a vital role in arresting the rate of migration from the hills. Present paper is an attempt in this direction.

Introduction:

During 19th Century Communities living in U.P. Hills (Now Uttarakhand) were self sufficient to large extant. Their economy was also self sustaining and the majority of the population have found living in hill spurs and river valleys. But the rapid growth of population during 20th century, expansion of agriculture land, marginalization of land holdings, denudation of forest, quarrying of land for construction of roads and various projects related to development, climate change, increasing land slides, decreasing productivity of land etc, resulted in migration of young males in search of employment to feed themselves as well as their families. Actually these migrating young males were of productive age group hence in their absence forced females of the region to carry on agricultural work. The percent of young working age group migrants was approximately 70 percent. This high rate of migration now takes an alarming situation because now family migration also started leaving behind scores of broken houses and barren fields. The development schemes of the region remained paper success and practically fail to arrest the rate of migration. Now a new concept named sustainable development has come into existence with greater emphasis to human aspect and environment. In this context development program should incorporate environment friendly development with

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human dimension to retain and control the migration streams.

Migration is a universal phenomenon. It has been present in all stages of human history and for this reason some scholars have considered it as instinctive in men as in animals, birds and fishes etc. However the process and forms of migration among human beings have been changing over years. Early migration tended to be the movement of tribes, families and still more of individuals seeking economic settlement and transient work in other lands. In the present context we may broadly classify migration into international and intra-national, which also have sub-forms such as urban to urban, urban to rural, rural to rural and rural to urban. Whereas rural to urban migration become most conspicuous under the twin processes of industrialization and urbanization.

The rate of migration from hill districts of Uttarakhand is alarming. Rawat (1993) reports that rural communities of the hill districts produced food grains only for four to six months in a year and for the rest people have to depend upon imported grains from the plains. Consequently the young males of working age group had no option other than to migrate to urban plains to eke bread of their own and their dependents living behind in the villages. Approximately 67 percent of the males have been found absent from the villages. They have either joined armed forces or migrated to urban plains in search of gainful employment (Rawat, 1993), Madhav Ashish (1979) reports that the volume of male migration from hill areas was to such an extent that if the wives of these migrants accompany their migrant husbands, the hill would become practically empty.

So far as the concept of sustainable development is concerned, it is found that the concept puts an emphasis on the change in order to improve ecological, economic and social conditions for all people at all times and all places, (Singh 2002). In fact the concept of sustainable development emphasis human aspect more. Actually the concept of development have been changing over years. Initially development referred only economic aspect of social change. Later on the concept of all round development came into existence. Now a days development refers inclusive growth side by side the concept of sustainable development is also gaining momentum.

The Brundtland Report perceived development “which meets the needs of the present without compromising the ability of future generations to meet their own needs.” The idea of sustainable development originated earlier in the world conservation strategy launched by the International Union for the Conservation of Nature and Natural Resources (IUCN), the United Nations Environment Programme (UNEP) and the World Wide Fund (WWF). Sustainable development is the multi-disciplinary subject and every discipline can prepare a strategy to use the environment in a wise and sustainable manner for current and future generations.

The objectives of this paper are; one , to find out the age at which majority of young male migrated. Two, to examine the causes of migration. Three, type of migration? Four, why migration streams are unabated?Five ,how can migration be arrested? And finally what kind of sustainable development is required to arrest the phenomenon of large scale migration.

Uttarakhand State has total 13 districts, out of these 13 districts 10 are hill districts. According to census 2011 the total population of the state is ..101.17 lakhs. out of which 50% of

the population live in hill districts. The total land area of state is 53,566 sq.km and 93 percent of the total land is mountainous and 64 percent of the total land is covered by the forest, 90 percent of the population depends upon agriculture. In fact agriculture is the main stay as the people, however only 23:06 percent of total land is under cultivation. The population density comes 4.77 persons per hectare of the cropped land which is rugged, un-irrigated and insufficient to support the population. Hence area is a net importer of substantial amount of food grains .Approximately 75 percent of the subsistence requirement is imported from the plains. In fact irrespective of various other causes the agriculture economy was unable to sustain the growing population as a result young males forced to migrate from the region.

In order to meet out above objectives a descriptive research with structural functional approach was carried forward. The study was conducted in Pauri Garhwal where rate of rural urban migration is far greater than the rural society of plains. The sample of 78 respondents from five villages was taken and these respondents were interviewed for this study.

Age of the migrant plays a very crucial role in the process of migration, as majority of them migrate when they were young. Table one gives us the age wise distribution of these migrants.

Table – 1 Distribution of the respondents by their age at the time they migrated from the valley

Age	F	Percentage
10 year and below	01	1.28
11 – 14 years	11	14.10
15 – 19 years	43	55.13
20 – 24 years	19	24.36
25 years and above	04	5.13
Total	**78**	**100.00**

Data show that most of the respondents (53.13%) migrated from the villages at the age group of 15 – 19 years. In the age group of 20 – 24, 24.36 percent of the respondents migrated where as in the age group of 11 – 14 years 14.10 percent of the respondents migrated. Further the data shows that when the respondents migrated at the age of 15 – 19 years they had schooling upto tenth or twelfth class. And these rural urban migrants generally migrate either to urban centres or joined army service.

Migration from rural areas have been explained in terms of so many factors, which include economic, demographic, socio-cultural and psychological, political and institutional and various other factors. The rural urban migration of labour force is caused by the expansion, as well as better economic opportunities in urban areas. This phenomenon has been exaplained in terms of push-pull theory. The “push” theory often used to explain the causes of rural –urban migration .Further rural poverty, low productivity, underemployment, low income levels of consumption may push people out to the cities and towns where her are better economic opportunities. Adverse economic condition in the greatest single cause of migration to cities

cited in sample report of nine Indian cities; Baroda, Hubli, Hyderabad, Secunderabad, Jamshedpur, Kanpur, Poona, Gorakhpur, Lucknow and Surat, conducted at the assistance of the Research Programme committee of the planning commission. The I.L.O. studies have also came to the conclusion that the main push factors causing the workers to leave agriculture as it has the lower level of income. "Pull" factors refer to the factor which encourage migration to an area which has employment and other economic opportunities, various facilities and amenities etc. The advanced economy coupled with better economic opportunities of urban area pull rural surplus labour. Migration from the countryside to cities bears close functional relation to the process of industrialization, technological advancement and other cultural changes which characterise the evolution of modern society in almost all parts of the world.

In case of rural urban migration from hill areas to plains the "Push" and "Pull" theory does not explain the process fully. The "Push" factor related to the community of origin. Whereas the "Pull" factors related to the community of destination. Rawat (1983) reports that it is largely the community structure which determines the nature and extent of migration. It may be of immense interest to examine the above controversy in more detail. White (1980) has tried to solve this controversy in terms of two philosophies, objective and cognitive. By objective philosophy he means the cultural and physical characteristics of the environment, whereas by cognitive philosophy he means relationship of objective as well as imaginary factors of the environment of the community of destination with one's self actualization need. Impinging environment at the place of origin is the "Push" factor without any problem but the need for self actualization or cognition of the relationship between self actualization and community structural factors is not fully explained by "Pull" factor. Hence "Push" "Pull" theory has been questioned by number of scholars such as Lambert (1963), Sovani (1966), Ashish Bose (1970) and others. Further few scholars like Peterson (1966) has considered migration as a sui-generic process i.e. prior migration causes further migration.

Rawat (1984) reports that community structure may provide a better explanation of this question and also solve the controversy of "Push" "Pull" factors. He says that due to the processes of industrialization, urbanization the rate of migration from rural to urban areas increased. The village community characterised by its distinctiveness, smallness, homogeneity and self pervading, self sufficient society has been divided into two halves i.e. the migrants and non-migrants. The members of these two halves maintain closer linkages with one another through their visits, remittances, economic and social assistances etc. Thus the migration of the rural population to urban areas splits to community into two halves in a demographic sense i.e. the members of the same family reside in rural as well as in urban area in separate households and yet maintain strong social ties with each other. This type of community structure is termed by him as community fluidity which denotes the process in which members of a community though structurally related with one another through intimate relations, do not live together within a given geographical boundary but live in a number of communities. According to him communities structural factors are major causes of rural urban migration.

Apart from economic "Push" and "Pull" and community structural factors scholars have found a number of other contributing factors for the immigration of people from one area to another, which includes education, socio-economic class structure, caste, family and other individual factors. It is found that education, travel and contact with other men are stated to have been responsible for their migration.

The causes of migration of people from rural society of Garhwal Himalaya are explainable in terms of its ecological factors and community structure. Ecological factors explain terraced and rain fed cultivation, continuous, erosion of land by heavy rain and floods, lack of irrigation facilities, small size of landholdings, rudimentary methods of cultivation, lack of agricultural innovations are some of the reasons for low land yield and poverty of the peasants of this region. Community structure of this region can be explained in terms of community extension. While majority of the males from the have migrated to various urban towns in search as gainful employment, women along with the children, old parents live behind in the villages. The community comprises of the migrant and the non migrant population and maintain intimate strong structural relationship with each other half through visits, remittances and communication through letters and mobile homes.

When the respondents were asked about the causes of their migration from the village majority of them stressed upon the distressing agriculture economy of the region, which yeilds a little and hardly meet their subsistance requirements for four to six months in a year. Consequently a majority of males have left the villages with a desire to seek supplementary employment. Table 2 explains the reasons for migration of our respondents.

Table – 2 Distribution of the respondents by their causes of migration.

Causes	Frequencies	Percentage
Poverty and Family Debt	49	62.82
Attraction of City Life	08	10.26
Non-Availability of Employment	10	12.82
Education	07	8.97
Unpleasant Climate at Home	04	5.13
Total	**78**	**100**

Data show that majority (62.19%) of migrants from sample villages reported poverty and family debt as the main cause of their migration. Non availability of employment has been reported by 12.82 percent followed by 10.26 percent of the migrants reported city attraction as the cause of their migration whole other 8.97 percent migrated for education, 5.13 percent of them reported unpleasant climate of the village as the cause of their migration. In rural Garhwal below subsistence cultivation in the wide spread phenomenon so young energetic population has no other option than to migrate to cities and towns for gainful employment and percentage of those migrated for other reasons were negligible.

To know the type of migration, respondents were asked to tell their choice of destination as shown in the table - 3.

Table – 3 Distribution of the respondents according to their choice of destination.

Choice of Destination	Frequencies	Percentage
Rural to Rural	02	2.56
Rural to Urban	76	97.44
Total	**78**	**100**

Data indicate that a majority (97.44 percent) of the respondents migrate to urban areas, while a negligible percentage of them migrated to rural areas. In fact in rural Garhwal there are almost little avenues of rural employment and lack of industrial development,lack of educational facilities did not attract rural to rural migrants consequently a good majority have not option other than to migrate to urban areas for making living. So far as the unabated migration stream is concerned causes of migration already, elaborated show the continuous migration of young males from the region. The study conducted in rural society of Garhwal shows 40 percent of the total and 67 percent of the male population of the district has migrated as against the all India figure of 15 percent of the total and 26.40 percent as the male population, (Rawat 1993).

Viewing the geographical, ecological and social situation of the area the question arises that what type of development was being introduced in the region which could not arrest the ever widening migration streams. Actually in the development schemes human aspect and environmental aspects were neglected. So now we are hopeful that the inclusion of new concept of sustainable development would initiate some changes are this direction.

Sustainable development shows interest not only on human causes and impacts on environment but also recognizes local and regional differences as critical for human dimensions. Most of the social science disciplines place a strong emphasis on the integrated involvement of human dimension which takes care of environmental protection as a component of sustainable development consistent with poverty eradication. So, the human dimension has to be incorporated into planning with an emphasis on sustainable development which covers culture scientific approaches, socio-economic traditions, lifestyles and consumption patterns.

In conclusion we may say that arresting of migration from the region is only possible through initiation of development schemes compatible with the available regional natural resources and their scientific exploitation, eco friendly infrastructure development along with various facilities specially health and education. The Himalayan hill region is rich in biodiversity and forest resources but neither has been properly explored nor the process of sustainable development has been put to use. So far as the agriculture development is concerned consolidation of land is most important factor, along with it there is a strong need to motivate farmers to change traditional cropping pattern. Further the development schemes should be compatible with available labour power in the region. Majority of the development programmes are male oriented, while labour power rests in the hands of women. Hence there is a need of women oriented development schemes first, Industrial development and employment generation may also help in this direction.

References

Ashish, M. 1979. Agriculture economy of Kumaon hills : threat to ecological disaster. Economic and Political weekly, Vol XIV No. 25.

Census of India, 2002., Vol. XV. Uttar Pradesh Part – II – A General Population tables.

Raturi, H.K. 1980. Garhwal Ka Ithihas (Hindi) Tehri, Bhagirathi Prakashan.

Rawat, P.S. 1993. Migration and Structural Change in Garhwal Himalaya : Sarita Book House, Delhi.

Singh. R.B. (ed). 2002. Human Dimensions of Sustainable Development : Rawat Publications, Jaipur.

Sridhar, Kala S.,Reddy,Venugopal A. and Srinath,Pavan . "Is it Push or Pull ? Recent Evidence from Migration in India."2010www.pacindia.org.google.retrived2.10PM on dated01-03-2014.

Sustainable Economic Development withPrevention of Natural Resources

33

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Vivaswan Singh**

Abstract

Business leaders generally assume that economic growth is essential to future prosperity. Environmental leaders sometimes assume that economic growth is the enemy. But economic growth is measured in rupees, and a growth in transactions does not necessarily mean a growth in environmental impact.Economic activity, both production and consumption, relates to the environment in two fundamental ways -- we draw resources (both renewable and non-renewable) from the environment to produce goods and services, and we emit wastes into the environment in the process of both producing and consuming. What will happen to our industrial civilization if the supply of natural resources is constantly diminished relative to demand? The answer is obvious. Our prosperity will be threatened. And the solution is obvious. We must strive to obtain more goods and services from our finite supply of non-renewable resources.

Growth in GNP has become the seminal indicator of the health of our economy. In the national accounting system driven by GNP; we fail to calculate net income. Our forests shrink, but we do not subtract the shrinking asset value from gross income to see if we are realizing net income. Our topsoil is lost, but we do not subtract its value from the value of agricultural products. And so on, and so on, as we gradually impoverish ourselves without even counting the costs.

We can see that even at today's prices and under today's accounting systems and economic yardsticks, much that is needed in the way of conservation of natural resources and protection of the environment will enhance the efficiency, productivity and competitiveness of our economy. At the same time, we can see that today's prices, accounting systems and economic yardsticks are badly flawed, and that removing subsidies and developing better accounting systems and yardsticks would contribute enormously to both economic prosperity and environmental protection. The key to our future is investment, and this investment must mean reduced consumption.

Economic Activity;

Both production and consumption, relates to the environment in two fundamental ways -- we draw resources (both renewable and non-renewable) from the environment to produce goods and services, and we emit wastes into the environment in the process of both producing and consuming.

Too often we think and act as if we were not part of nature. Rather than thinking of ourselves as nested in nature and dependent upon it, we think of ourselves as sitting on top of it, managing it. We think there are the human world and the natural world, and we forget that we are ourselves, with all our technology, part of nature.

So what is the reality? What will happen to our industrial civilization if the supply of natural

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resources is constantly diminished relative to demand? The answer is obvious. Our prosperity will be threatened. And the solution is obvious. We must strive to obtain more goods and services from our finite supply of non-renewable resources, and we must protect -- from both extraction and waste impacts -- the natural productivity of our forests, fisheries, agricultural and range land, and other renewable resources.

Yardsticks of Prosperity;

Our continued prosperity depends on protecting both extractive potential and waste absorption capacity. In thinking about how environmental protection expenditures relate to future prosperity, we must first consider the yardsticks we use to measure how we are doing in economic terms. Growth in gross national product has become the seminal indicator of the health of our economy. But how good a yardstick of our present or future prosperity is it?

Gross sales of goods and services as a measure leave something to be desired. If an economic activity produces directly one million rupees in product but also results in one million rupees of costs in health impacts and destruction of essential assets, common sense might lead you to think nothing has been gained. But health services and asset replacement are part of the gross national product, and using GNP as a measure, the loss becomes a gain. To the one million rupees in product is added one million rupees in health services and asset replacement, yielding two million in GNP. Something is clearly wrong with this picture.

Lots of things which enhance our quality of life do not contribute to our GNP. For example, if we were to take extremely good care of our constructed assets -- our homes, buildings, vehicles, industrial equipment and so on -- we would spend less on their replacement. This would reduce our GNP, but can anyone reasonably suggest that it would reduce our wealth. GNP measures transactions, not net worth.

Beyond this, could anyone really suggest that human well being is adequately measured by net worth? If we maximize net worth, but poison our bodies in the process, would anyone really suggest that we would be better off?

Our forests, fisheries, agricultural and range lands, mineral resources, fossil fuel resources, slow to recharge aquifers, and other natural resources are being consumed. Yet in the national accounting system driven by GNP, we fail to calculate net income. Our forests shrink, but we do not subtract the shrinking asset value from gross income to see if we are realizing net income. Our topsoil is lost, but we do not subtract its value from the value of agricultural products. And so on, and so on, as we gradually impoverish ourselves without even counting the costs.

We can see that even at today's prices and under today's accounting systems and economic yardsticks, much that is needed in the way of conservation of natural resources and protection of the environment will enhance the efficiency, productivity and competitiveness of our economy. At the same time, we can see that today's prices, accounting systems and economic yardsticks are badly flawed, and that removing subsidies and developing better accounting systems and yardsticks would contribute enormously to both economic prosperity and environmental protection.

So what does this mean for economic growth? Business leaders generally assume that economic growth is essential to future prosperity. Environmental leaders sometimes assume that economic growth is the enemy. But economic growth is measured in rupees, and a growth in transactions does not necessarily mean a growth in environmental impact.

Rupees saved by natural resource efficiency will be spent on something. To the extent that that something is less resource intensive and pollutant generating that the expenditures replaced, the environmental impacts of the economy will decline.

Removal of massive subsidies to material consumption will not end economic growth but redirect it. As we meet our basic material needs -- for food, shelter, transport, clothing, etc. -- we naturally tend to shift in our wants. We don't generally want more and more, but we generally want better -- better tasting food, more attractive, safer and more durable structures and goods, more access to entertainment, culture and information, more leisure to enjoy our lives, and so on. To the extent that material consumption is priced at its true cost, we will make more efficient use of it and shift our economic demands to less resource intensive and polluting products and services.

Imagine this future. Per capita income has doubled. The share of income spent on material goods has halved. The resource inputs and pollutant outputs of producing materials goods has halved. In this future, our prosperity has doubled but our environmental burden on the Earth has fallen dramatically.

Suggestions for Inclusive Development;

The key to our future is investment, and this investment must mean reduced consumption. Reducing and eventually ending subsidies to consumption will help generate the investment capital, and if we invest properly, the process will build on itself.

We need to invest in non-renewable resource efficiency, natural renewable resource protection and restoration, renewable energy, recycling, restoration of the safety and educational systems of our cities, mass transit and energy efficient vehicle technology, affordable and environmentally benign housing, industrial R&D, family planning, child development, and more. An investment program can be crafted which would at one and the same time yield growing prosperity and shrinking environmental destruction.

First, from a global perspective. There is no realistic possibility of increasing per capita incomes and preventing the destruction of the global environment without halting population growth and at the same time promoting massive economic development and economic growth. The real question is the nature and direction of that growth and development. Investment must be directed to those technologies which can improve living standards without destroying the natural resource base. Population stabilization probably depends more than anything else on increasing economic security in the developing world. At the center of this is improving health care and economic opportunity for women. This requires economic growth -- the right kind of economic growth.

Protecting the living and productive natural systems in these countries -- their forests, fisheries, agricultural lands, etc. -- depends in turn on halting the slide into desperate poverty. A starving

population will strip every twig and blade of grass to survive. We face the prospect of utterly destroying much of the natural world in developing countries unless a successful economic program is created.

Next, from a national perspective. First, we must invest in the rest of the world as well as in ourselves. Today there is a net flow of capital from the poor to the rich in the world. Much is said these days in the political process about reducing foreign aide. Granting that massive change is needed in how and for what that aide is given, we cannot survive as an island of prosperity in a declining world. Our long-term future depends on helping to promote and capitalize global development. At the same time, we must focus on increasing our competitiveness in the economy of the developed world. The investment program described above will do this, and will do it without destroying our nation's environment and natural resource base in the process.
Increasing resource efficiency will lower the cost of our products in the world market. Investing in cities, children, and education will improve the quality of our workforce. And investing in technology development will give us the tools we need.

Next, from a community perspective. Urban sprawl and unbalanced land use imposes immense costs on communities, both in economic and quality of life terms. We need compact, balanced, affordable, transit served, clean, healthful and safe communities. None of this can be achieved with sprawl.

Sprawl and unbalanced land use increases costs -- for infrastructure, utilities, housing, schools, transportation, public safety and community services, and more. And sprawl escalates the environmental impacts of a community.

From the perspective of businesses and corporations, unbalanced land use at low densities drives the increasing cost of doing business locally. Labor costs go up to attract and retain employees in spite of high housing costs and unpleasant commutes. Tax burdens go up to pay for the infrastructure and service facility and personnel increases necessitated by sprawl. Utility costs go up as utilities must expand their distribution grids and production capacities. Facility costs go up with escalating land costs. Shipping and work based trip costs go up as congestion gets worse. Sprawl and imbalanced land use burdens the economy at the same time it produces air pollution, greenhouse gases, acid rain, water pollution, energy and water waste, and more.

A program for better planning, environmental protection, and ending consumption subsidies would clearly help some businesses and hurt others. This should not distract from the reality that as a whole such a program would help business. And this reality should not blind us to the fact that -- given today's business capital investments, land holdings, market position, product mix, etc. -- some businesses will oppose the program outlined above because of impacts on their particular short-term interests.

The other side of the coin is that environmental protection offers many business opportunities. That is particularly true here in the Silicon Valley. Information processing technology, biotechnology, and high technology in general will play a central role in improving

both natural resource efficiency and pollution reduction. And the market for our technologies will be helped as consumers shift their demand away from material and energy intensive goods and services and demand more goods and services in the areas of information, culture, entertainment, education and so on.

Change is much in vogue in this political year. And indeed we need change. But to get the right kind of change we will need a massive educational effort. Our contradictory feelings about government taxing and spending -- we want the taxing to go down but the spending on our needs to go up -- are a reflection of the fact that a large part of government spending represents support for middle class consumption. Entitlements programs transfer funds not nearly so much from the rich to the poor as from the future to the present. Our taxing and spending policies subsidize middle class consumption.

We will not change these things easily. We will not get the government out of the business of picking our pockets unless we are equally willing to get it out of the business of shoving money in. But most of all, we will not think clearly or rationally about public policy unless we stop this foolish business of pitting the economy against the environment and fess up to the fact that we want both prosperity and a sustainable planet. It is time we started to work together to craft an agenda that will produce both.

References

Bhattacharyya, S., and Hodler, R., 2010. "Natural resources, democracy and corruption," European Economic Review, Elsevier, vol. 54(4).

Gylfason, T., 2001. "Nature, Power, and Growth," Scottish Journal of Political Economy, Scottish Economic Society, vol. 48(5).

Gylfason, T. and Zoega, G. 2003. Inequality and economic growth: Do natural resources matter? In: Eicher and Turnovsky (eds). Inequality and growth: Theory and policy implications. MIT Press.

Suslova, E. and Volchkova, N., 2007. "Human Capital, Industrial Growth and Resource Curse," Working Papers WP13_2007_11, Laboratory for Macroeconomic Analysis, HSE.

Stijns, J.-P., 2006. "Natural resource abundance and human capital accumulation," World Development, Elsevier, vol. 34(6).

Out Migration In Uttarakhand: Its Socio-Economic & Cultural Consequences

34

Ashok Ku. Sahani

Abstract

" The United Nations recommended in its fifth Asian and Pacific population conference to promote research on the inter-relationship between Migration, development and Poverty reduction as well as to build national capacity for relevant data collection, analysis and research." The 27th new state of Indian subcontinent, Uttarakhand, Migration is a burning issue in since long. Formation of new State does not became fruitful for checking Migration. The problem is so serious that many villages became deserted with many land resources and houses became barren. The state comprising of thirteen district with a population of 84, 79,562 and male female ratio of 1000:964 (2001) situated in the Central Himalayan Zone. Because of its geographical location which lies approximately within 300-7000 amsl is the basic hindrance of backwardness in term of basic infrastructure. The topography of the states is characterized by deep valleys, high peaks and wide verities of vegetation. The temperature ranges from 16° c to 40°c, but it drops below freezing points in many parts of high Mountains areas of the region during winter. In 2011 census the total population reached to 120crore in the country, but within the ten hill districts in the state the population merely 48 lacs 42 thousands only which is less than the three plains districts (Dehradun, Haridwar & Udamsinghnagar) in the state, which stand 52 lacs 73 thousands. The people became minority in their own state. Two hill Districts, Almora & Pauri in the top list of Migration. In 2001 census, the hills districts represent total 53% to the State population which is reduced to 47% in 2011 census and if it continued in this rate than all the villages within hill districts became deserted by 2021. The state's economy is agrarian cum pastoral type of economy. A large proportion of the State around 78% lives in rural areas, (Mehta, 2004). They contribute the backbone of agricultural economy in the state, but difficult geographical terrain, dependent only on rain, inadequate development of basic social infrastructural facilities, difficult public services and institutional support are some of the basic factors in slow face development of the State and leads to out Migration.

Key words- Migration, Uttarakhand, topography, Valley, Elevation, Terrace, Socio-economy, Almora, Pauri.

Introduction

It has been universally known fact that the non-availability of gainful employment opportunities in the state, significantly a larger segment of labor force migrated out side the region seeking employment in different sectors so as to maintain theirs families at home in their local. The situation is that over 55% of the house holds in the region are only dependent on the money received from the migrant members; because of the income earned from agricultural and other sources is much below the level of their requirements,(Pandey et al 2002). So the State's economy is otherwise known as ***"Money order economy***". Out Migrations of labor forces from the State, lost a larger proportion of well educated and active human resources. Though majority

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of the Migrants still own land in the village and they are unwilling to forgo this ownership of land as the land is regarded as "status symbol" and at the same time it is the last economic resort to fall back upon. But because of terrace land and non availability of irrigation facilities, the crop is full dependant on rain water and out come is much lower than the expectation. Besides the above the following are the some major causes of out migration in the state.

a. Differential attract for Migration

Basic amenities like hospital, education, electricity etc. lacking in rural set-up, because of the villages located in different altitude.

b. Inter Regional Balance

By exporting labor force and importing of consumer goods and capital from developed regions.

c. Caste Barrier

The migrant finds an access to an open wider occupational choice. The caste disability restrict this in native place, therefore migration is favoured by enthusiastic young man.

d. To Improve Social Status

Migration is often resorted for social reason when an out caste wants to climb to the higher ladder of recognition and honor by changing caste or keeping dubious names in a different place.

e. Educational Upliftment

Educational achievement promotes migration for occupation and pull factors of migration.

f. Decline or shortage of Natural Resources

Decline or shortage of natural resources for which one had got free of cost during past and now to pay for it, decreased demand for a particular product or more over the land resources, where the family depend wholly.

Objective

1. To asses the impact of out-migration on natural resources and ecology.
2. To understand the linkages between social infrastructure and resource scarcity with migration.
3. To analyze economic characteristics of migration for possible development of entrepreneurship.
4. To evaluate implications of migration on economic and socio-cultural issues like gender.

Methodology

To Know the trend of out- migration the study untaken in four villages of Almora district among the migrated families by using standard questionnaires, Schedules and PRA methods. Case study and interviews were made among the migrated families. The selection of village was made by purposive sample and survey was conducted in 100 households among the migrated families in the Bhasiyachina Block of the Almora district of the State. Data were collected to cover the following points.

a. Trends and motivation for Migration.

b. Level of livings.

c. Employment and earning.
d. Reasons characteristics and benefits of Migration.
e. Comparison of migrants with their natives.
f. Socio-economic and cultural changes due to migration.

Out come

A survey was made in four villages namely Dallakote, Sangyadi, Shella and Dhaulla in Bhasiyachhina block of Almora district in Uttarakhand during April-2008. It was observed that these villages are prone to Out-Migration because of its geographical and social infrastructure. The village Dallakote was total 35house hold with population of 178 from which 13 families & 12house head have been migrated. The migrated families left the villages not because of economic difficulties, but because of social upliftment like better education, services, better health etc.They were economically sound and the village social Infrastructure lacking behind according to their requirement. The village Dallakote is located in a place which is 7 kms from the main road and bus stop.

Only a serpentine footpath lying to the village in different elevation by which one can go only by foot. Because of transport difficulties the other problems automatically arises. There is severe Scarcity of water in this village for any use. Drinking water the village ladies brought from a faraway place which is called ***Naulla*** and it is located approximately 150/200 mts lower elevations to the village level. There is a small spring flowing here which could be used for water storage by making a check dam or embankments. This water could be used for multipurpose by the villagers. But as there is no planning so far by any govt/institution for the flowing water useable, the villager facing with severe water scarcity.

The other village Sangyadi with 27 household with population of 157 soul mainly agriculturist, small artisan and daily labor. The village's geographical location is also with houses in different elevations. The village having the electric and water connection by the state government, but it is very much disturbing and irregular. The maximum families of the village are economically backward and 21 person from the village left village and out migrated for in search of job. They left their wives with small children and old parents and go faraway place for searching better economy so that they can able to feed their families. Some small artisan making iron instrument for agriculture and house hold use, but it was not properly marketwise and the artisan do not get proper value of his labor. So they loss interest for this artistic work and do not wish to carry forward for future generation. The women staying alone without husband attend all work of the house from caring children, old parents to other all house hold activities. Lack of transport facilities to the village make people poorer as they unable to go far labor to near by town in daily basis by which they can return by evening. The small children going to Nagarkhan for study by passing 4 kms Jungle route and which is in high elevation to their village location. There is no primary school which is the fundamental right of every citizen.

The next village Dhaulla located 1kms distance but around 150-200 mts below to the level of Nagarkhan. The situation of the village is same like other two villages. No basic social facilities for healthy living. Total 17 nos able body male members from the total 22 households,

out of village to Delhi, Chandigarh, Jaipur etc for search of job. The women taken all responsible at home from attending the kitchen to agriculture field. They bring water from a far away place below 150 mts lower elevation. The small children going to school, by climbing the hilly terrain to Nagarkhan. The other village Shella which is situated on the way to village Dallakote is also lack of basic amenities for a health life. Out of 16 families 11 person and 3 families were out migration form this village. There is a primary school and one teacher is appointed here who is not coming regularly because she comes from a far place. In morning she reached late and in after noon she left early as she has to catch the bus which is 6kms from the school. The student comes to school and if the teacher comes they study for some time and if the teacher does not come they played for some time and take mid day meal served by the helper and go back to home. Since male members were absent in the village and ladies do not have time to meet the teacher, the education of their children going like this.

Conclusion:

To summaries of the study it is seen that Nagarkhan is the head quarter and centre point for all these four villages, which having a school up to secondary level, a dispensary and ¾ shops. The dispensary having no doctors or nourishing staff, a peon is coming from a distance place and opens the dispensary for some time. Very occasionally some health staff comes to dispensary and maintained forge records. Because of lack of basic facilities no Government staff wishes to stay there for permanently. Those who are staying in the villages either by compellation or no other option but to follow tradition. The following are some the factor responsible for out-migration in these four villages which are observed during study.

1. Talent, Training & education
2. Non-availability of work
3. Work available by interval only.
4. Inadequate Income.
5. Attraction for city life.
6. Family tension.
7. Others

Though out-migration brings good remittance for better livelihood in terms of better food, good clothes and housing etc, but it has severe negative impact on natural resources. For ex, because of male migrant, what ever agriculture land he having in village it became barren and infertile gradually. The migrants person after having good amount of money prefer to built *Pucca* houses in the village, which is causing harm to the natural habitat. The migrants member adopt new consumerism ideas like changing traditional food habit, purchase television, tape records etc, which cause environmental degradation on the village habitat. Because of male members absent at the house the family members' feels social insecurity and the house lady became over burden of social responsibilities. Because of over loads and busyness she unable to maintain good health which leads to sickness and growing older in early age. The unmarried young migrant comes with new ideas and thoughts like dowry, high status brides which is alien

to hill culture and broken social tradition. Many good and traditional houses were broken or damage, many kitchen garden destroyed because whole family migration which is very much economic loss to the state.

Policies recommendation

1. There should be concrete plan/policy in respect to location development of infrastructure, particularly Road, School and Hospital.
2. There should be policy/plan for unused abandon resources which can be reusable by the villager's befit.
3.Strategy/policy recommendation for develop entrepreneurship so that one can get earning at their own habitat.
4. There should be policy by which the returned Migrants follow the rule and work for environment management and degradation.

Reference:

1. *Census Handbook 2001, Registrar General of Census operation, New Delhi.*

2. *Kollamair, Michael in International day of Mountain Day 2009. (ICIMODE), KATHMANDU, NEPAL.*

3. *Mehta, G.S, (2004): Development of Uttarakhand issue and perspectives, APH publishing corporation, New Delhi-02.*

4. *Pandey, D.C and H.C Joshi, (2002): Migration in Rural Kumaun, "Man, Culture and Society in the Kumaun Himalayas" edt by Dr. C.M Agrawal, Shree Almora Book Depot, Almora-263643.*

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Disaster Management in Uttarakhand

35

Dr. Vijay Singh Negi

Abstract

Uttarakhand the 27th state of India was carved out of the Himalayas and adjoining districts of UP on 9th November 2000. If has not only been hub of temple tourism but has also been of historical relevance to both Hindus and Buddhists. On June 16,2013 the sacred place, where it is said 'Gods Dwell' turned a tragic picture of devastation, after torrential rains in the eastern Himalayas breached a glacier, flooded mountain rivers and triggered scores of landslides.

Disaster management is the discipline of dealing with and avoiding about natural and manmade disaster. It involve preparedness,response,and recovery in order to lessen the impact of disaster and the scenario of Uttrakhand disaster is a common thing. There is natural and manmade both kind of disasters happens in Uttrakhand. In this study I want to share the disaster management of Uttrakhand ,further we'll study about the steps had taken by the Uttrakhand Government and how they did overcome with this disaster and statements of the eyewitness of recent Uttrakhand disaster in 2013 .The Uttrakhand disaster management authority (UDMA),constituted in 2007and the national disaster response force (NDRF) is established in 2009 in Delhi. It is a disaster response agency under national disaster management authority (NDMA) created by the ministry of home affair, Govt.Of India and specialized response to natural and manmade disaster functioning at state and central level.It consist of 8 battalion of Indian armed forces including two each of BSF,CRPF,CISF,ITBP.In this study we'll find out that how the disaster management authority of Uttrakhand is functioning on the management process.

Introduction :-Disaster in simple words is a natural or manmade (Or Technological) hazard resulting in an event of substantial extent causing significant physical damage, loss of life, or drastic change to the environment. A disaster can be extensively defined as any tragic event stemming from events such as earthquakes. Floods, Catastrophic accidents, fires, or explosions. It is phenomenon that can cause damage to life & property the economic social & cultural life of people.

Recent perspectives in anthropological study define a disaster as a process/event involving the mixing together of two or more thing of a potentially destructive agents from natural & technological equipment & a population in a socially & technologically manufactured condition of vulnerability and the scenario of uttrakhand there are every kind of disaster (Natural can be seen frequent flash floods. Landslides , cloud bursts. Golf & heavy intensity of rainfall have not only claimed lives in uttrakhand but also effect livelihood lives stock farm & heavy economic losses. This is high probability of increase is the frequency & intensity of climate related natural hazards due to climate change & hence increase in potential threat at due to climate change related natural disasters. In the absence of community level awareness, which make them more vulnerable to those changed scenario of natural disasters also due to the lack of regional or local level studies which could be used to formulate batter policy decisions for mitigation. Adaption and risk reduction. The present study gives a direction to promote climate

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change issue as a local issue with global concerns.

Disaster :-Context on kedarnath valley [16th Jun 2013] :-A detail study of the geomorphology & geology of the source region of such disaster will go a long way to understand & solute this problem. The words affected area of this tragedy was 18 km distance from kedarnath to sonprayag. On 16th& 17th June 2013, together with heavy rain, lake burst, heavy avalanches and temporary damming & bursting district caused flooding in the kedarnath of Rudarparyag district (Uttrakhand). These are reports of loss of large number of human lives & damage to the property & livestock.

In june 2013 a multiday cloudburst centered on the north Indian state of Uttarakhand eased divasting attain floods & landslides in the country's worst natural disaster since the 2004 tsunami. Through some parts in India experienced the flood some region Tibet also experienced heavy rainfall over 95% of the causalities occurred in uttrakhand.

As of 16th July 2013 according to figures provided by the uttarakhand govt. More then 5,700 people were "presumed dead". This total included 934 local residents.

Destruction of bridges and roads left about 100.000 pilgrims and tourists trapped in the valleys leading to there of the four Hindu chota char Dram pilgrimage site. The Indian air force, the Indian army and paramilitary troops evacuated more than 110,000 people from the flood ravaged area.

Origin :-from 14 to17 June 2013, the Indian state of Uttarakhand & ad joining area receive heavy rainfall which was about 375% more than the benchmark rainfall during a normal monsoon. This caused the melting of chorabari Glacier at the height of 3800 meter's & eruption of the mandakini river which led to heavy flood near Gobindghat, kedar dame Redraprayag distrect (Uttarakhand). Himanchal Pradesh & western Nepal & acute rainfall in other nearby regions of Dehli, Haryana & some parts of Tibet.

The upper Himalayan Territories of Himanchal Pradesh & Uttarakhand are full of forests & snow covered mountains & thus remain relatively inaccessible. They are Home to several major & historic Hindu & Sikh pilgrimage sites besides several Tourist sports & tracking trails. Heavy rainfall for four consecutive days as well as melting snow aggravated the floods. Warning by the Indian Meteorological Dept. predicating heavy rains were not given wide publicity beforehand, causing thousands of people to be caught unaware resulting in huge loss of life and property. In the city of Dehradun, capital of Uttarakhand. This was the wettest June day for over five decades.

Consequences :-Landslides, due to the floods, damage several house & structures, kiilling those who were trapped. The heavy rains resulting in large flash floods & Massive landslides. Entire village & settlements such as gaurikund & the market town of Ram Bada a transition point to kedarnath, have been obliterated, while the market town of son prayag suffered heavy damage & loss of lives. Pilgrimage centers in the region, including Gangotri, Yamunotri, Kedranath Badrinath. The hallowed Hindu Chardham (Four Sites) pilgrimage centers are visited by thousands of devotees, especially after the month of may onwards. Over 70,000 people were stuck in various regions because of damaged or blocked roads. People in other important locations like the valley of flowers, Roopkund & the sikh pilgrimage center Hemkund were stranded for then 3 day's national Highway 58, an important artery connecting the region were also washed away near Jyotirmath & in many other places.

Because summers have more number of tourists the number of people impacted is substantial for more than three days, strand pilgrims & tourist were without rations or survived on little food. The roads were seriously damaged at more than 450 places, resulting in huge

traffic James & the floods caused many cars & other vehicles to be washed away. On 18th June, more than 12,000 pilgrims were stranded at badrinath the popular pilgrims center located on the banks of the Alaknanda river.

Rescuers at the Hindu pilgrimage town of Haridawar on the river Ganga recovers bodies of 40 victims washed down by the flooded rivers as of 21 June 2013. Bodies of people washed away in Uttarakhand were found in distant place like Bijnor Allalibad & Bulandshaher in Uttarpardesh searching for bodies in Kedar Valley continued for several month and even as late as September,2013, about 556 bodies were found out of which 166 bodies were found in highly decomposed state during fourth round of search operations.

Rescue Operations :-The army, Air force, Navy Indo-Tibetan Bordered police [ITBP],BSF, NDRF, PWD & local administrations worked togather for quick rescue operations, several thousand soldiers were deployed for the rescue mission. Activists of political & social organization are also involved in the rescue & management of relief centers. The national Highway & other Important roads were closed to regular traffic Helicopters were used to rescue people, but due to the rough terrain, Heavy fog & rainfall, maneuvering them was a challenge by 21 June 2013 the army had deployed 10,000 soldiers and 11 helicopters & the air force had deployed 43 aircraft incluveling 36 Helicopters from 17 to 30 June 2013, the IAF airlifted a total of 18,424 people-flying a total of 2,137 sorties & dropping/landing a total of 3,36,930 kg of relief material and equipment.

On 25 June One 3 IAF mil mill 17 rescue helicopters returning form kedarnath carrying 5 Air force officers, 9 of the NDRF, & 6 of the ITBP crashed on a mountainous slope near gaurikund killing on board. The deceased soldiers were given ceremonial guard of honour by home minister of India at a function organized by the uttarakhand state government.

Environmental Issue :-Unprecedented destruction by the rainfall witnessed in uttarakhand state was attributed by environmentalists, to unscientific developmental activities undertaken in recent decades contributing to high level of loss of property and lines road constructed in Haphazard style, new resorts & Hotal built on fragile river banks and more than 70 hydroelectric projects in the watersheds of the stat led to a “disaster waiting to happen” as termed by certain environmentalists. The environmental experts reported that the tunnels built and blasts undertaken for the 70 hydro electric project contributed to the ecological imbalance in the state with flow of river water restricted & the streamside development activity contributing to a higher number of landslides & more flooding.

Conclusion :- It will take years to roll back the physical, psychological, social, economic & ecological damage wrought by the terrible flood in Uttarakhand, which killed more by the 1000 people. The deeper causes of the epic tragedy were not natural, but manmade. They ensured that cloude bursts and heavy rainfall, which routinely occur in uttarakhand’s upper hills turned into a catastrophe.

The cause include official policies & governance failures aggressive promotion & runaway growth of tourism unchecked unplanned development of roads, hotels, shops mines & multi-strayed housing in ecologically fragile areas and above all the planned development of scores of environmentally hydroelvtricity dams.

True uttarakhand’s worst affected areas experienced heavy rainfall of 340-370 mill meters within 24 Hours on June 16-17 leading to flash floods but this was far from unprecedented uttarakhand has recently recorded single-day rainfall in excess has recently several time including 450 mm in 1995, & 900 mm in 1965 Cloudbursts floods & rapid swelling of rivers too aren’t uncommon.

No evacuation plan was drawn up for uttarakhand's vulnerable districts despite their recent history of disasters, including earthquakes & floods. As the comptroller & Auditor general pointed out this past April, the Uttarakhand Disaster Management authority formed in October 2007, has never met or formulated "rules", regulations policies or guidelines.

Source & References :-

1. *"Indian floods a man-made disaster, say environmentlist "*
   - CNN Retrieved 26 June 2013.
2. *"Uttarakhand floods : when all else failed, youth took charge"*
   - Hindustan Times, 26 Jun 2013, Retrieved 26 June 02013.
3. *"India to begin mass cremation of flood victims"*
   - Fox News, 24 June 2013, Retrained 24 June 2013.
4. *" Government cancels Kailash Mansarover Yatra Due to Uttarakhand Disaster : North News"*
   -India Today, 19th June 2013, Retrieved 19 June 2013.
5. *"Us Ambassador announces relief to flood victims in Uttarakhand" –*
   - The Economic Time 23 June 20130, Retrieved 24 June 2013.

Natural Resource Database Creation and Analysis in Prospect of Calamity in Kedarnath Valley of Uttarakhand State

36

Aaha Thapliyal[1], Sanjeev Kimothi[2], Anju Panwar[1]

Abstract

Uttarakhand is a hilly state and abounded with Central Himalayan region. Viewing the calamity over Kedarnath valley in Mandakini watershed region of Uttarakhand state, an attempt has been made to analysis natural resources in the prospect of rehabilitation plan. Thousands of lives and families were get effected by the calamity and it realized that now the early warning system should be the part of the integrated rural development information system. Precautionary measures are suggested by monitoring and interpretation of glaciers, glacial lakes and water discharge rate and etc. Similarly, land resources map was generated with the land use/land cover, slope maps and water resources development map was generated using slope and drainage maps. Watershed study was carried out by using space borne and field datasets in GIS environment for different decadal periods from 1962 to 2013. In the initial stage of project the natural resources of the watershed was monitored and estimated using LISS-III/IV, AWiFS and ETM/TM Satellite imagery. The study was carried out over the Mandakini river basin which extends from 30° 35'N to 30° 49'N latitude to 78° 59'E to 79° 22'E longitude. The basin has a total number of 40 glaciers occupying an area of 81.64 sqkm with the ice reserve of 5.9856 km^3. One the largest glacier of this watershed was receding on its lateral side and not on the snout position. Overall reduction in the basin glacier area was estimated 1.23 sqkm during the year 1990 to 2013 and increases the water discharge rate. Drainage pattern was generated using Cartosat-space borne sensor over the Chorabari sub watershed for year 2011 and during the period of disaster.The high discharge rate exposed hazard and existence of more glacial lakes over the region.

1.0 Review of literature

In the initial stage of project the natural resources of the watershed are monitored and studied using Remote Sensing Satellite data. This information further may be used in areas such as water resources, agriculture, resources monitoring, environment, ecology and forest mapping, land use and land cover mapping, etc. The information from these analyses can be archived in a central database with suitable storage and retrieval mechanisms. It is observed that glaciers are retreating and melting at a much faster rate than usual. Huge quantity of water may be accumulated in the glacier lakes. Due to monitoring pressure of water a lake with unstable bank may be exploded partially or entirely causing devastating floods which is called glacial lake outburst flood (GLOF).

The Chorabari glacier that played a role in the disaster in the month of June 2013.Using different sets of satellite data glaciers and lakes were monitored and estimated the available water storage over the region. Glacier volumes and the lakes size was estimated and then water channels were predicted. Total loss in the downstream was estimated. The derived information further may be

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used in areas such as water resources, agriculture, resources monitoring, environment, ecology and forest mapping, land use and land cover mapping, etc.

Himalayan glaciers are the major source of water as it lays over almost 6000 glaciers and occupied by an aerial extent of 20000 km^2. They can affect the supply of water to a large number of people in the Indian subcontinent. In the other side the variation of glaciers are uncontrolled and they can be the major risk prone zone for various types of calamities especially in the context of climate change scenario. This is almost half of the glacier-covered area in the region and it suggests that the glaciers are losing an average 0.4% area per year (Bolch et al., 2010, 2012; Yong et al., 2010; Bhambri et al., 2011; Kulkarni et al., 2011; Bahuguna,2007). Disaster occurred in Kedarnath valley in Alaknanda watershed of Uttarakhand vindicates the impact of climate change and it is a challenge to create the opportunity for adaptation of Climate change by policy makers. Most of these studies related to glacier retreat in Himalaya are attributed to climatic variations or global warming Bhutiyani 1999; Kulkarni et al. 2002a, 2005; Kulkarni 2007; Bhutiyani et al. 2008; Hasnain 2008. Disaster occurred in Kedarnath valley in Alaknanda watershed of Uttarakhand indicates the impact of climate change and it is a challenge to create the opportunity for adaptation of Climate change by policy makers (Asha Thapliyal, *et al.* 2013).

Glaciological studies carried out by various researchers in the Himalayas suggest that many of the glaciers are in a state of retreat due to climate forcing (IPCC report 2010). Recently it has been reported that antecedent rainfall together with bursting of Chorabari lake situated near snout of Chorabari glacier and snow melt in the area, has found one of the reason for activation of flash flood and debris flow (landslides) in the region, that have led to heavy damage to lives, properties, infrastructure and landscape in Kedarnath dham, Rambara, Gaurikund and downstream up to Rudraprayag and Srinagar (Dobhal *et al*, 2013).

2.0 Overview of Study Area and Dataset Used in study

The Mandakini, which is fifth order basin of Alaknanda catchment, is delimited in the north and west by Bhagirathi basin whereas the eastern boundary is shared with Mena nadi basin of Alaknanda catchment. Mandakini valley is an almost north-south trending elongated valley. The head of the valley in the north is bounded by five peaks viz. Bharat Khunta peak, Kedarnath peak, Mahalaya Parvat peak, Hanuman top peak and Brahma Gupha. The Mandakini valley is occupied by 24 glaciers and Chorabari is the largest glacier in this valley. The Mandakini River that originates from the Chorabari glacier flows towards south and joins Alaknanda River at Rudraprayag. Uttarakhand floods in Kedarnath lies between latitudes 30°442 503 N and 30°452 303 N, and longitudes 79°12 163 E and 79°52 203 E, from an altitude of approximately 6,000 m (20,000 ft) at the slopes of Kedarnath peak, to 3,800 m (12,500 ft).

The Kedarnath temple and town is located in the western extremity of the Central Himalaya in the Mandakini River valley which has a total catchment area of 112.23 km^2 (up to Mundkate Ganesh), out of which 25% area is covered by glaciers. Bhart Khunta (6578 m), Kedarnath (6940 m), Mahalaya peak (5970 m) and Hanuman top (5320 m) are few well known peaks in this area. Chorabari is a valley glacier which has two snouts, one in its left margin and other in the right margin. The right snout, which is presently the main supplier of water to the

Mandakini River, is situated at an altitude of 3865 masl and the left snout is at an altitude of 3835 m asl. Chorabari glacier is covered around 4.23 km^2, and length of the glacier is around 7 km approx., similarly Companion glacier covered around 3.59 km^2 and length of this glacier is around 5.79 Km^2.

Database creationwas generatedbyusingspace bornesensors and ground based datasets in GIS environment for different decadal periods from 1962 to 2013. In the initial stage of project the natural resources of the watershed was monitored and estimated using Cartosat, LISS-III/IV, AWiFS and ETM/TM Satellite imagery.For long term change monitoring, Survey of India (SOI) topographical maps of 1962 at 1:50 000 scale are used as reference maps.The satellite and pictorial view of study area is shown in fig.1 &2.

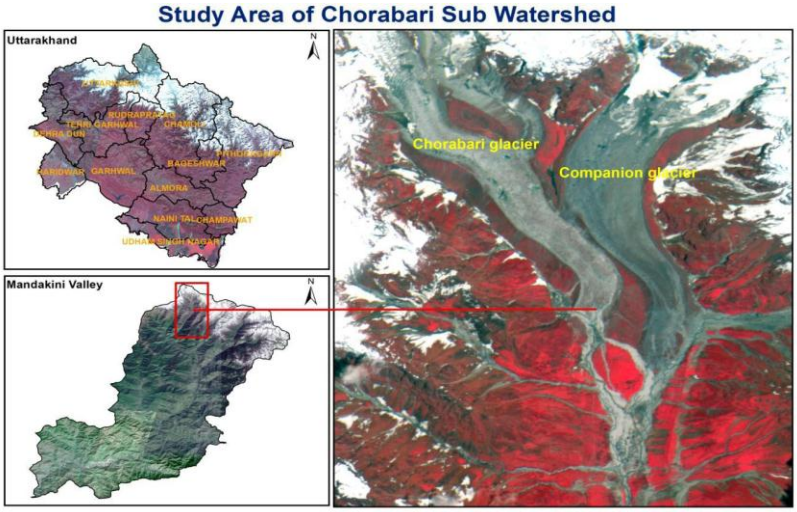

Fig 1: Satellite view of Study Area

Fig 2: Photographic view of Kedarnath temple and town before the disaster

3.0 Results and Discussion

3.1 Glacier Inventory

The glacier inventory map with details of the glacier features has been prepared by visual on screen interpretation using different multi temporal satellite data and ancillary data in GIS envirnment. The studied basin has a total number of 40 glaciers occupying an area of 81.64 sq km with the ice reserve of 5.9856 km^3. The reduction in the glacier area has been observed on the lateral side of chorabari glacier and not on the snout position. Overall reduction in the basin glacier area was observed 1.23 sq km during the year 1990 to 2013 which increases the water discharge. Drainage pattern and discharge of the mandakini river basin at Gaurikund was recorded 3.6m^3/s, 3.07m^3/sec and 94.3m^3/sec during the month of January, February and March 2013 respectively. The preexisting lakes BasukiTal and NandiKund were also found overflowed with an occupied area of 7.29ha and 6.24ha respectively. In Chorabari glacier retreat has also been estimated based on glacier extent mapped from multi-temporal satellite data available from 1976 to 2013 using different time frames. The glaciated area in the Mandakini River basin extends from 30º 35’ N to 30º 49’ N latitude to 78° 59’E to 79° 22’E longitude.

The basin has a total number of 40 glaciers occupying an area of 81.64 sq km with the ice reserve of 5.9856 km^3. The largest glacier recognized in this basin is Chorbari glacier which occupies 8.34 km^2 with the ice reserve of 0.7441 km^3. Four grid of SOI sheets & 17 grids of 3'x3' are mapped on 1: 10,000 K scale. Maximum numbers of lakes are mapped between the elevation of 4000 to 5000 m i.e. 45, in 53 N/2 and 53 N/6. Type of lakes observed in Mandakini river basin are Cirque, End moraine dammed lake, Valley and erosion lakes. The BasukiTal is the largest valley type lake with an area of 7.29 (ha) with the length 528 m. The other important lake is Nandi Kund with an area of 6.24 (ha) with the length of 417m. Based on multi temporal satellite imageries glacier morphological layer has been generated at 1: 10,000 K for year 2011 and 2013.

3.2 Glacier Retreat in Chorabari and Companion Glaciers

Monitoring of chorabari glacier was done using Multi temporal Satellite data from 1962-2013. The maximum changes in the glacier was noticed during 1962-1976 period. The overall reduction in the glacier area from 1990 to 2013 was also found very slow, which is only 1.23 km^2. Drainage pattern of watershed was generated using available space borne sensors Cartosat for the year 2011 and LISS-IV during the period of disaster in year 2013.The high discharge rate at Gurikund has exposed threaten and possibility of the generation of glacial lakes over the region. The high discharge rate exposed hazard and existence of more glacial lakes over the region. The preexisting lakes BasukiTal and NandiKund were also found overflowed with an occupied area of 7.29ha and 6.24ha respectively. Action plans for glacier, glacial lakes and water resources development may be interpreted from the database of existence of glacier, glacial lakes and water flow rate. Overflow of water in drainage pattern (fig 3) from the source of chorabari is the main cause of disaster in the Kedarnat ghati region. Similarly, land resources map is generated with the land use/land cover, slope maps and water resources development map is generated using slope and drainage maps.

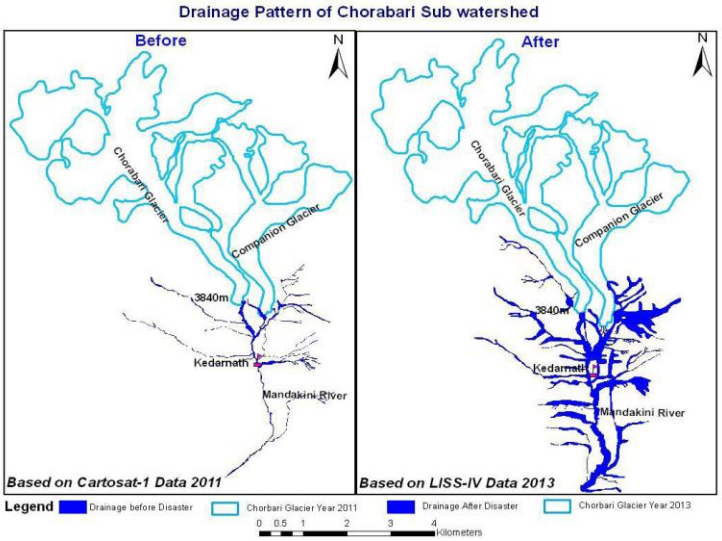

Fig3:Drainage pattern of Chorabari sub watershed before and after the calamity

3.3Loss of Biodiversity and settlement along both side of river

Intensity of disaster was mapped and areal extent of river was shown by high resolution satellite dataover the region. The biodiversity patches on both side was mapped and demarcated which are the clear evidences of the overflow of river. The total loss of vegetational biodiversity along the river was estimated using satellite data which shows that the river was over flooded due to heavy rainfall which causes great damage on the both sides of river.

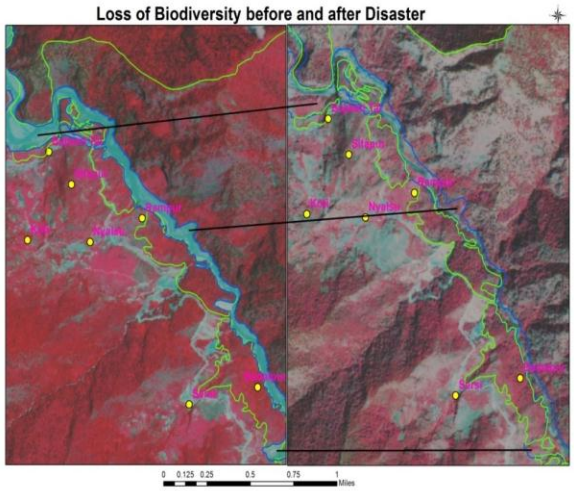

Fig 4: Biodiversity Status before and after the calamity

4.0 Conclusion

The reduction in the glacier area has been observed on the lateral side of chorabari glacier and not on the snout position. Overall reduction in the basin glacier area was observed 1.23sqkm during the year 1990 to 2013 which increases the water discharge and may be the reason of

damage during the calamity. Overflow of water in drainage pattern from the source of chorabari is the main cause of disaster in the Kedarnat ghati region. Glacier retreat, land resources, slope and drainage maps and water resources development map should use in action plan strategy. The biodiversity patches on both side was mapped and demarcated which are the clear evidences of the overflow of river. Action plans for glacier, glacial lakes and water resources development may be interpreted from the database of existence of glacier, glacial lakes and water flow rate. This study further intended to design and assimilate of natural database creation of glacial areas with collateral datasets to improve the warning system in various applications such as disaster monitoring, agriculture, irrigation, climate change. Each watershed should have the appropriate details which can be access to their district, and state along with other mandal in the district. The collective database will be further useful in integrated rural development information system and maybe highly applicable in various research areas such as water resources and natural resources monitoring.

References

1) Asha Thapliyal, Anju Panwar & M. M. Kimothi (2013) Snow Cover and Glacier Retreat in Chorabari Sub Water Shed Using Indian Multi Temporal Satellite Data and Topographic Map: USAC/SR/04/2013.

2) Bahuguna, I. M., Kulkarni, A. V., Nayak, S., Rathore, B. P., Negi, H. S., and Mathur, P.: Himalayan glacier retreat using IRS 1C PAN stereo data, Int. J. Remote Sens., 28, 437–442, 2007.

3) Bhambri, R., Bolch, T., Chaujar, R., and Kulshreshtra, A. C.: Glacier changes in the Garwal Himalaya, India, from 1968 to 2006 based on remote sensing, J. Glaciol., 57, 543–556, 2011.

*4) Bhutiyani M R 1999 Mass-balance studies on Siachen Glacier in the Nubra valley, Karakoram, Himalaya, India; J. Glaciol. 45(149**)** 112–118.*

*5) Bhutiyani M R, Kale V S and Pawar N J 2008: Changing stream flow patterns in the rivers of north western Himalaya: Implications of global warming in the 20th century; Curr. Sci. **95(5)** 618–626.*

6) Bolch, T., Yao, T., Kang, S., Buchroithner, M. F., Scherer, D., Maussion, F., Huintjes, E., and 15 Schneider, C.: A glacier inventory for the western Nyainqentanglha Range and the Nam Co Basin, Tibet, and glacier changes 1976–2009, The Cryosphere, 4, 419–433, doi:10.5194/tc-4-419-2010, 2010.

7) Bolch, T., Kulkarni, A., K¨a¨ab, A., Huggel, C., Paul, F., Cogley, G., Frey, H., Kargel, J. S., Fujita,K., Scheel, M., Stoffel, M., and Bajracharya, S.: The state and fate of Himalayan Glaciers, 20 Science, 336, 310–314, 2012.

8) D.P.Dobhal, Anil K. Gupta, Manish Mehta and D.D.Khandelwal. Kedarnath disaster: facts and plausible causes. Scientific Correspondence, Current Science, 2013, vol. 105, NO. 2, 25.

9) Deepak Srivastava, S. Swaroop, S.P. Shukla and B. P. Mukherjee. Report on Integrated Ice, Snow Avalanche and Quaternary Glaciological studies in Mandakini Valley around Kedarnath, District Chamoli, Uttar Pradesh (Field season 1991-92, 1992-93 and 1993-94).

10) Hasnain S I 2008 Impact of climate change on Himalayan glaciers and glacier lakes; Proc. Taal 2007, The 12th Lake conference, pp. 1088–1091.

11) Intergovernmental Panel on Climate Change, Statement on the melting of Himalayan glaciers Geneva, 20 January 2010.

12) Kulkarni A V, Mathur P, Rathore B P, Suja Alex, Thakur N K and Kumar M 2002a Effect of global warming on snow ablation pattern in the Himalayas; Curr. Sci. 83(2) 120–123.

13) Kulkarni A V, Rathore B P, Mahajan S and Mathur P 2005 Alarming retreat of Parbati glacier, Beas basin, Himachal Pradesh; Curr. Sci. 88(11)1844–1850.

14) Kulkarni A V, Philip G, Thakur V C, Sood R K, Randhawa S S and Chandra R 2007 Glacier inventory of the Satluj Basin using remote sensing technique; Him. Geol. 20(2)45–52.

15) Kulkarni, A. V., Rathore, B. P., Singh, S. K., and Bahuguna, I. M.: Understanding changes in Himalayan Cryosphere using remote sensing technique, Int. J. Remote Sens., 32, 601–615, 2011.

16) Swaroop, S., Oberoi, L. K., Srivasatava, D. and Gautam, C. K., Recent fluctuation in snout front of Dunagiri and Chaurabari glaciers, Dhauliganga and Mandakini–Alaknanda basins, Chamoli district, Uttar Pradesh. Geol. Surv. India, Spec. Publ., 2001, 53, 77–81.

17) Yong, N., Yili, Z., Linshan, L., and Jiping, Z.: Glacial change in the vicinity of Mt. Qomolangma (Everest), central high Himalayas since 1976, J. Geogr. Sci., 20, 667–686, 2010.

Emerging Challenges in Sustainable DevelopmentofHimalayan Region

37

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Abstract

Sustainable development (SD) is a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for generations to come. In Which Environment, Local people, Future play vital role. Sometimes it is called ELF. The environmental awareness is linked with our survival on the earth planet. The mountain of Uttrakhand is especially important from the point of view of environmental regeneration. The connectivity is essential but it should not against the nature. But the worst result of unplanned expansion of connectivity which gave rise to problems like landslide, erosion, loss of bio-diversity and earthquakes. So the need is to check reckless exploitation of the natural resources. This is only possible if we go for sustainable development like the development of eco-tourism, Heritage management, Floriculture, milk and Gomutra trade production of organic fertilizer, Herbal and medicinal production ,Adventurous tourism and Traditional crop cultivation. It requires a systematic and planned policy. Otherwise we will face the natural calamities like Kedarnath on 16-17 July 2013.Here in our paper we have discussed the various aspects of development and the process of running projects and there impact on the nature. Our paper will certainly raise questions regarding the sustainable development and demand of the appropriate policy of sustainable development

Key Words: Environment, resources, sustainable, tourism, calamit

Introduction

Himalayan region is situated in the north of Indian map and well known for it flora and fauna. The natural spot, conical mountain, Bugyal, snow covered hills, verity of culture etc make it really the inhabitant of God and Goddess. Moving towards sustainable development is not a matter of choice but necessity of Himalayan Region. The blind Physical chase of human after the Industrial revolution not only affect the natural resources but also responsible for the degradation of environment and the result is various kinds of calamities and disasters which we are facing every year. Our government is usually declares that they have connected the rural area but if go through the data of last five year, we find that the statement is true but here is a question , " Is that connectivity is useful during the time of need? Is it paying to us?" Certainly, it is not. The mountains of Uttarakhand are especially important from the point of view of environmental regeneration. Therefore, the need is to check the reckless exploitation of the natural resources and thus the sustainable development policy is the demand of time.

Objectives

- To find out the problems arising in the sustainable development of Himalayan region.
- To find out grass root solutions for sustainable development.

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Methodology

- In our research we used the primary observation of the works in progress in districts Dehradun and Pauri. We also used the secondary data and photographs of Newspapers/self photographed.

Scope of livelihood in Himalayan region

The environmental awareness is linked with our survival on the earth planet. Hence for the development of the region we need sustainable use of the resources. While we are observing the various development programmes of district Dehradun and Pauri Garhwal and going through the literature available, we find that to fulfill the purpose the following areas should be developed-

- Eco-tourism
- Heritage management
- Floriculture, milk and Gomutra trade
- Waste management and production of organic fertilizer
- Herbal and medicinal production and tourism
- Adventurous tourism and Traditional crop cultivation.

Few Examples of Observations

1. Unplanned Expansion:

The worst result of unplanned expansion of connectivity which gave rise to problems like landslide, erosion, loss of bio-diversity and earthquakes. The following are few examples-

Source:Dainik Jagran/self snaps

Unplanned Cutting of the Connectivity

2. **Wetland of Utarakhand :**

The wetlands which are sometimes described as "the Kidney of the landscape" are shrinking from the Shivalik range of the state. Actually these wetlands are the sources of pure drinking water called by the name 'Dhara','Noula'etc. in local languages. Hence the people of hills are continuously facing the

problem of water during summer. There are number of places where the 10-15 liter cane of water is sold in 100-120 rupees.


3. Burning forest

The common phenomenon of past few years, which is mainly responsible for destruction of forest, medicinal species of plants, small creatures etc is burning forest. After the formation of Uttarakhand state the phenomenon of burning forest became very frequent. The data available through the print and electronic media made it clear that our government department were completely failed to stop the consequences. It was also observed that usually the government officials wake up after the maximum destruction took place.

The Burning Forest

While it is one of the reasons of wild animals like tiger, elephant etc are coming out from their original inhabitant and moving in the populated areas.

Destruction of Forest

Here I have collected the few cuttings of how we are destroying the forest. We adopt the illegal ways to destroy the forest while it is very essential to maintain the sustainable development.

सत्तर के दशक में जंगलों का व्यावसायिक दोहन रोकने के लिए चिपको आंदोलन खड़ा हुआ था। इसे सफलता भी मिली और वन संरक्षण अधिनियम अस्तित्व में आया। अब नए किस्म के चिपको की जरूरत है।
चंडी प्रसाद भट्ट, पर्यावरणविद

वनों को कैसे नुकसान पहुंचता है

बिजली परियोजनाएं, सड़क, भवन और विकास संबंधी दूसरी परियोजनाओं में बड़े पैमाने पर पेड़ों की बलि चढ़ाई जाती है। आंकड़े बताते हैं कि उत्तराखंड में 44868 हेक्टेयर वन भूमि को गैरवनभूमि में तब्दील किया जा चुका है। 5500 हेक्टेयर वनभूमि अकेले बिजली परियोजनाओं की भेंट चढ़ी है।

क्षतिपूर्ति वनीकरण का लक्ष्य हासिल नहीं

1980 में पारित वन संरक्षण अधिनियम में विकास योजनाओं के लिए वन भूमि का इस्तेमाल करने वालों के लिए क्षतिपूर्ति वनीकरण (केम्पा) को अनिवार्य बनाया गया था। लेकिन क्षतिपूर्ति वनीकरण का सिर्फ 12 फीसदी ही लक्ष्य पूरा किया जा सका है।

Statement of Chandi Prashad Bhatt

source:Amer Ujala

सरकारों में इच्छा शक्ति नहीं

जीईपी लागू होता तो विकास का पैमाना भी बदलता

चूल्हे की आग भी हरियाली की दुश्मन

पर्वतीय क्षेत्रों में रहने वाले बीपीएल परिवार काटते हैं पेड़

Lack of Political desire

Source: Amer Ujala

Analysis

This way it is evident that we still are not aware about the importance of our nature. While in our past the people of our country were much more aware and hence they himself try to conserve the environment. The Vedic text, the Buddhist text, the Jain text etc. made it clear that how much they were aware about their surroundings. Here we have produced the environment awareness of the Buddhist text and in the preaching of Buddha.

"Forest and environment in ancient India is having emphasis in the Book on developing concept rather than merely providing information and providing up to date knowledge relevant to the ancient environment. There are four Ashrams in Vedic religion to lead the life and one of them is “Vanprasth’ in which the man has to live in the forest. In the sixth century B.C. India witnessed an in lends intellectual of upheaval. Buddha was leading figure of that epoch besides questioning the established norms socio religious practices and spiritual values prevailing at that time. Then the Buddha stood at a distance to the North-east of the Bodhi tree and gazed at it for one week motionless eyes as mark of gratitude and appreciation for having sheltered him during his enlightenment. This is extremely significant in determining his attitude towards trees and forest.

As many religious people view it, Buddhist reality is profoundly ecological, and Buddhism itself is an ecological religion. It powerfully expresses human identification with nature. Buddhists believe that all things, including humans, exist by their interrelationship with all other parts of nature. To think of one's self as isolated from the rest of nature is being unrealistic. According to the Vietnamese monk Venerable Thich Nhat Hanh: "Buddhists believe that the reality of the interconnectedness of human beings, society and Nature will reveal itself more and more to us as we gradually recover—as we gradually cease to be possessed by anxiety, fear, and the dispersion of the mind. Among the three—human beings, society, and Nature—it is us who begin to effect change. But in order to effect change we must recover ourselves, one must be whole. Since this requires the kind of environment favorable to one's healing, one must seek the kind of lifestyle that is free from the destruction of one's humanness. Efforts to change the environment and to change oneself are both necessary. But we know how difficult it is to change the environment if individuals themselves are not in a state of equilibrium." In the words of Jose Kalapura:"The Buddha taught that respect for life and the natural world is essential. By living simply one can be in harmony with other creatures and learn to appreciate the interconnectedness of all lives. The simplicity of life involves developing openness to our environment and relating to the world with awareness and responsive perception. It also enables us to enjoy without possessing, and mutually benefit each other without manipulation."

In the words of Jose Kalapura,"The Buddha taught that respect for life and the natural world is essential. By living simply one can be in harmony with other creatures and learn to appreciate the interconnectedness of all lives. The simplicity of life involves developing openness to our environment and relating to the world with awareness and responsive perception. It also enables us to enjoy without possessing, and mutually benefit each other without manipulation."

Buddhist precepts direct the faithful to seek a right livelihood, an essential dimension of which is concern for the life of all creatures. This puts emphasis on "ahimsa" (avoiding injury to any sentient creature). The Buddhist king Asoka the Great established hospitals for both human and animals. He insisted on kindness to animals, and forbade their killing even for food. Buddhism teaches that if we wish to save the environment, we must first analyze our lives to determine how our self-deification is destroying the world by depleting, overpopulating, and polluting the Environment. Hence the Buddhist approaches to solving the global ecological crises than includes:

- Compassion, a feeling of sympathy for people who are suffering is the basis for a balanced view of the whole world and of the environment.
- The use of the "save and not waste" approach means that nothing in nature is spoiled or wasted. The destruction but with no other reason upsets the vital balance of life.
- Ecology is rebuilt through the philosophy of Sarvodaya (uplift of all), which is based on loving kindness, compassionate action, and altruistic joy

Hence the principle of Buddhism also establishes it as an ecological religion. There is close association with the ideals of Buddhism and the environment. This relationship between Buddhist ideals and the natural world can be explored within three contexts:

1. Nature as Friend

Once we treat nature as our friend, to cherish it, then we can see the need to change from the attitude of dominating nature to an attitude of working with nature we are an intrinsic part of

all existence rather than seeing ourselves as in control of it. In my opinion the above suggested path is the best way to conserve our environment. This does not mean that we are against the development. The development is the need of time but it should be eco-friendly.

2. Nature as a spiritual force

We can say that nature works as spiritual force which binds us to perform our action in right manner. Living close to nature is a very healing experience. Learning to trust yourself and being more of a friend than a judge one develops a lightness of being, a light confidence. One realizes the truth of the notion of impermanence—the sound of animals, the texture of trees, the subtle changes in the forest and land, the subtle changes in your own mind. By being mindful about the daily routine one pays attention to the flow of life—to see nature as a positive, joyful, spiritual force.

3. Nature as a way of life

The middle-path of Buddhism clearly tells us that if we accept the nature as a way of life, than we will create minimum destruction to the nature and it will remain healthy. The healthy ecological system is necessity of healthy life which becomes essential need of the day.

What we need?

If we are really interested to generate the sustainable livelihood in the mountainous Himalayan region, we must need the following steps-

- **Renewed political commitment:**
- **Renewed policy and its honest execution**
- **Awareness and participation of local people**
- **Stop indiscriminate use of natural resources.**
- **Stop unplanned road construction.**
- **Institutional and Educational Infrastructure.**
- **Setting up Agro-based Industries.**
- **Development of marketing facilities.**
- **Restoration of ancient heritage.**

In order to protect the environment we must protect ourselves. We protect ourselves by opposing selfishness with generosity, ignorance with wisdom, and hatred with loving kindness. Once we treat nature as our friend, to cherish it, then we can see the need to change from the attitude of dominating nature to an attitude of working with nature—we are an intrinsic part of all existence rather than seeing ourselves as in control of it. One realizes the truth of the notion of impermanence—the sound of animals, the texture of trees, the subtle changes in the forest and land, the subtle changes in your own mind. By being mindful about the daily routine one pays attention to the flow of life—to see nature as a positive, joyful, spiritual force.

One of the key factors for the creation of the state of Uttarakhand was to bring prosperity to a region which suffered from years of economic backwardness. Reasons for this included remoteness of the area, poor infrastructure, lack of local entrepreneurs and more importantly lack

of comprehensive policy. But still after 12 years of formation of state we lack the appropriate policy of development and to bring the prosperity for the region is a big question before us.

In my opinion the above suggested path is the best way to conserve our environment. This does not mean that we are against the development. The development is the need of time but it should be eco-friendly. What we will do of a development which bring calamities, hazards, disaster which causing the destruction of human life. The cause of rapidly rising number of incurable disease is due to the harm we have done to our ecological system in this long process of 'Development'.

Conclusion

The geography of state Uttarakhand is different from rest of the country and hence a different kind of policy is need of the state. Without the sustainable development policy we cannot able to bring the long term prosperity because the state is especially important from the point of view of environmental\regeneration.Therefore a renewed political commitment and honest implementation is the first requirement of the time. So we must keep the above problems in our mind to get the sustainable development of Himalayan regions."Like the Buddha, we too should look around us and be observant, because everything in the world is ready to teach us. With even a little intuitive wisdom we will be able to see clearly through the ways of the world. We will come to understand that everything in the world is a teacher. Trees and vines, for example, can all reveal the true nature of reality. With wisdom there is no need to question anyone, no need to study. We can learn from Nature enough to be enlightened, because everything follows the way of Truth. It does not diverge from Truth." By developing the right actions of not killing, stealing, or committing misconduct in sexual desires perhaps we can begin to live with nature, without breaking it or injuring the rhythm of life. In our livelihoods, by seeking work that does not harm other beings and refraining from trading in weapons, breathing things, meat, alcohol, and poisons, we can feel more at one with nature. We need to live as the Buddha taught us to live, in peace and harmony with nature, but this must start with ourselves. Thus it is very clear by the above example that to make sustainable development we must need innovative practices. If we are going to save this planet we need to seek a new ecological order, to look at the life we lead and then work together for the benefit of all; unless we work together no solution can be found. By moving away from self-centeredness, and agreeing to live more simply, we can help decrease much of the suffering in the world. As the Indian philosopher **Nagarjuna said**, "*Things derive their being and nature by mutual dependence and are nothing in themselves.*"

References

International Transaction of Humanities and Social Sciences, ISSN-0975-3745,V-1 N-1
Robert A White, "Spiritual Foundations of an Ecologically Sustainable Society," The Journal of Bahá'í Studies 7.2 (1995), Pages 47-74
Uttaranchal 'the Abode of Gods'(2006)ISBN 81-87592-16-8 edt by A.P Agarwal
Seth Pran (1997) Successful Tourism management V-1
Sharma P, D(2009) ISBN 978-81-7133-905-1, Ecology and Environment
Gupta (2002) Tourism and Heritage Resources in Garhwal Himalaya
Basham A.J, Woder that was India
Dasgupta S.b, Introduction to Tantric Buddhism
Eliots Charles, Hinduism and Buddhism, 2 volumes

Kane P.V, History of Dharmshastra
Sean McDonagh, "To Care for the Earth," Geoffrey Chapman, (1989)
José Kalapura , "Science-Religion Dialogue & Ecology: An Asian perspective
Ajahn Chah, Forest Sangha Newsletter
Prakash, Cultural History of India,New Age Publication, N. Delhi
NCERT books
Dainik News Papers
NCERT Physics for senior secondary school

Climate Change as Drastic and Hazardous Problem for Hill Agriculture

38

Dr. Piyusha Singh*, Dr. Madhuri Singh and Dr. R.D. Singh*****

Abstract

In hilly areas Uttarakhand is rich in biodiversity. It is seen as profitable activity as it is rich in agro forestry and horticultural crops. Here women mass who sustain and take care of natural property, different agriculture operations, and traditional knowledge all contribute to hill agriculture. In Uttarakhand various agricultural practices are applied to make convenient to farmers so that educated youth take farming as an opportunity and profitable enterprise of earning. Climate change impacts on agriculture are being witnessed all over the world, but countries like India are more vulnerable in view of large population depending on agriculture, excessive pressure on natural resources and poor cropping mechanism. Several models predict that rising temperatures, increased climatic variability and extreme weather events could significantly impact food production in coming years. Hence it is of paramount importance to enhance the resilience of Indian agriculture to climatic variability and climate change. Women play a significant and crucial role in agricultural development and allied fields. Rural women's work ranges from crop production to harvesting operations, from live stock rearing to raising babies. In addition to her daily work routine, consisting of, cooking, cleaning, and other domestic chores, rural women are also heavily involved in all aspects of country's agricultural sector. Despite such a huge contribution, her role has yet not been recognized. By and large they have remained invisible workers. Therefore, efforts were made to analyze the work performed by women in agriculture. Objective of the work are, to enhance the resilience of Indian agriculture covering crops, livestock to climatic variability and climate change through development and application of improved production and risk management technologies. To demonstrate site specific technology packages on farmer's fields for adapting to current climate risks.

Key Notes:*Climate Change, Hill Agriculture*

Introduction

Today the Uttarakhand is facing a challenging task of maintaining food security to meet the demand of its fast growing population and subsequently providing employment. In district Tehri of Uttarakhand state, the women folk are playing a great and very significant role in the development of hill agriculture. The working women are largely concentrated in the primary sector essentially in agriculture, either as cultivators, agricultural labours. In the agriculture and vegetable production, operations women are constantly at work, taking the tools and implements to the field, breaking earth, digging, land preparation, carrying manure / fertilizers, mixing, transplanting/ sowing, weeding/ hoeing, irrigation, harvesting, curing, threshing, drying,

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cleaning, grading etc., carrying head loads of fodder, firewood, water, seeds, flour, grazing cattles, etc. Women perform all type of difficult works with great care though are of lesser strength to men But it is most unfortunate that the role of women in agriculture has not been highlighted much. By and large they have remained invisible workers. Keeping the above background in mind, an attempt was made to analyze the participation of women in farming operations in the hilly areas.

Material and Method

Dabari & Kaleth villages of block Thauldhar, district Tehri Garwhal is selected for the study, both village are 25 km away from Chamba on Uttarkashi High Way Uttrakhand. The site is in mid hill situation with north- south & east aspect, with an altitude ranging from 1200-1800m above mean sea level. Top portion of the villages is covered by forest and pasture lands where as middle potion is terraced with rainfed situation. Valley portion of the villages are partially irrigated. Farming system of the selected villages is mixed type i.e. food grain production along with lives stock rearing. Buffalo, Goat & Backyard Poultry are the main live stock of the villages. About 80-95% area is rainfed and valley past of the village is partially irrigated.

The main crops of the selected villages are Rainfed Rice, Millets, Soyabean Horsegram & Urd during Kharif and wheat & lentil during Rabi season. Vegetable cultivation mainly of French bean, Potato, pea, spinach & rye etc. fruit trees mainly of apricot, peach, Plum, walnut, Guava & citrus generally grown near the habitats. Natural agro forestry system of fodder trees in the terraces bunds of upper rainfed areas. Most of the families have some land which is partially irrigated and for away from the village is left uncultivated. Main problem of the area are Low productivity of crops, Inefficient land use, Inefficient farming system, Pea economic conditions, Wild animal damages (monkey & pigs), Low yield of live stock products. Due to small & fragmented land holding the seed replacement ration has been declined during the previous decade. One of the causes for this is the out migration from villages to nearby town for betterment of infrastructural livelihood facilities (hospital, school, transportation, electricity, etc). In view of opportunity, the village situated on Rishikesh- Gangotri highway, with open exposed panoramic view of Asia's largest man made Tehri Dam. This may provide opportunity for gaining income from agro- eco-tourism (i.e. value added products of locally available production).

Due to climate change the effected mid land productivity is going down decade by decade by making rural locations unfit for a comfortable happy farm family. The disease occurrence cycle in human, animal & crops has also been shifted from agriculture view point. The vaccination program of animal & occurrence of disease & pest in crops are causal factor for yield reduction. In villages the farmer's has stopped farming even on most suitable farming location due to the migration of monkey's wild boar, bear etc. from lower ridges to upward. Farmers are shifting towards tree farming with low level efforts; farming practices are confined to rainy season, only.

In Villages Yield reduction in crops, Yield reduction in animal product, drying up of perennial streams, Depletion of soil moisture, Disease occurrence time in crops and in animals, Length of growing season, Occurrence of drought spells & heavy rains. So the Various work done are Trench making, bunds, community plantation, drainage lines on upper reaches of watershed ridges line, Capturing/ harvesting of free flowing water from natural springs. Rain water harvesting at farm family level, Community plantation of Multi Purpose Trees (MPTs), Grass plantation on field bunds, Agro forestry, Fruit farming. Fortification of available organic material through minimum palletization with chemicals containing NPK and bio- fertilizers/ agents. Simulation for right time sowing. Improved seed replacement in millet based farming. Assessment of suitable vegetable nursery growing season for situation specific and drought tolerant varieties. Use of suitable mulch material addressing the problem of soil evaporation loss, soil temperature insulation, control of soil born diseases, etc. Custom hiring in form of farming services like farming tools, farming skill person, first aid for animals /crop clinic. Protected farming aids i.e. poly houses. Mixed farming, intercropping, ally farming, catch crops, etc. Seed availability for early maturing crops in case of crop compensation required by re-sowing during the main crop season. Intervention wise economic and social assessment for sustained benefits against climatic resilience.

Result

There is need to utilize our scientific and traditional knowledge together for enriched agriculture. First of all Soil Erosion rates on sloping lands, follow periods from 3 to 6 months, Crop herbaceous products used as fuel wood, steep slope cultivation more than 30%, mainly emphasis on monocropping not intercropping, maximum time spent in collection of fuel wood and fodder scarcity, external inputs which need for crop production is not available, lack of farming linkages, conversion of irrigated land into dry land farming due to water scarcity, permanent as well as seasonal migration of families, abandonment of agriculture land due to decline in soil fertility, appearance of stones/ rocks on cultivated land and the most important factor human population and area of farmland per household. Soil testing is an essential as well as beneficial way of good crop. First of all the farmers are tested their soil near by soil testing centers, state university or touch in krishi vigan kender then they come to know how much fertilizer or manures requirement in their Agriculture field. With help of Power tiller, Power weeders hoeing of field are done better. Power weeder is easy to carrying from one place to another even the youth are earned more if they take it as business to use of power tiller. They take training to handle the power tiller from their near by krishi vigan kendera or power tiller purchase agency and use as business to hoeing the field of farmers. Vermicompost is another useful and beneficial way to improve the fertility of the field. Here first of all forms vermipit today HDPE plastic vermipits are play major role. First framers are put animal dung in the vermipit 20-25 days then put the earthworms. Earthworms are farmers friends *Eisenia foetida* is better sp. Which eat the decomposable organic wastes and digested in the body and the materials not required for its nutrition are excreted. The excreta releases by earthworms are use as

vermicompost. It is a faster, ecofriendly, natural biodegdration process which turns wastes and garbage into gold, the nutrient rich very good quality of organic manure. Farmers can use all the cowdung and other decomposable organic wastes available with him for preparing vermicompost and use this vermicompost in their field. It will bring a far reaching sustainable impact and new hope in agriculture. Mulching is beneficial way of increasing the yield of vegetables. Moisture is maintained through use of plastic sheets of mulch. Mulch is usually applied towards the beginning of growing season. It serves initially to warm the soil by helping it retain heat which is lost during the night. Mulch stabilizes the soil temperature and moisture and prevents sunlight from germinating weeds seeds. Mulchs help and keep the soil well aerated by reducing soil compaction that results when raindrop hit the soil. They also reduce water runoff and soil erosion. They help and maintain a more uniform soil temperature and promote of soil microorganism and earth worm

Hill agriculture is mainly based small millets and under utilized crops like finger millet, barnyard millet, amaranth, rice bean, buck wheat. Small millets are grown in different agro-ecological situation particularly as rainfed crops. The barnyard millet (jhangora) is used for preparation of various products ranging from boiled jhangora rice to thick porridge (kheer) preparation of jhangora rice along with curd and spices is called chachera. However popping and puffing papad, kachari and sattu are the other uses of barnyard millet in uttrakhand hills for increasing the cattles milk production the concentrate called pinda is given to the cattle by the villagers which is the mixture of flour of jhangora, wheat, maize, barley and some pulses (like soybean, rice bean etc. Millets are, however, a way of life. Millets are grown for food and fodder. They have immense untapped genetic and developmental potential. Small Millets could be a stabilizing force in the building up of national food grain buffer stocks. Practically devoid of stored grain pests, small millets have a long storage life and keeping quality. Recently, new high yielding varieties have been developed in various small millets but they have not yet reached the farmers. Intensive efforts should be made to popularize the same with the farmers and to replace the low yielding local varieties. Vast potentials do exist for substituting super cereals in industrial and food products. Small millets are cultivated in areas where they produce a more dependable harvest compared with any other crop. This has been largely responsible for their continued presence and cultivation in many parts of the world. There is now an increasing realization of this fact, and a greater awareness that these crops merit more research and development. The growing demand for food and a variety of food products also calls for interest and investment in small millets by plant scientists, people and peasants. Small millets, therefore, hold the key to the future of mankind. They are the potential Food Crops of Tomorrows' World.

Napier grass is used as fodder for animals. It is very beneficial crop it grows 12 months through out the year so the fodder provide through out the year. Hathi kaan is the high yielding variety of napier grass that gave green grass and used as fodder. The major cattle feeds are natural grass and napier provide fodder many cut through out year. Other feeds which depend on season and region for availability whereas napier grass provide fodder to all months. Ringal, Bhimal Khadik are the important agro forestry trees which are used for multipurpose they also

used for multipurpose they also helps in soil maintaince as they restrict soil erosion plantation like plum, walnut and they recharge the ground water and will ultimately flourish the traditional water resources of hills.

Post harvest management is also important issues in hills due to large amount of fruit products the fruits are not in use at a time but due to post harvest management it shall be use for large time like apple "jam, chutney" etc are from chulu kumani "chutney, oil" are used flower like burans "squash" are formed generally no large efforts are made to produce marketable surplus as there is lack of proper storage facilities of the produce of perishable nature. This is also providing new employment opportunities to the hill peoples by making it a profitable enterprise. The Indian farmers have evolved many coping mechanisms over time, but these mechanisms are often unable to cope with extreme weather events being witnessed in recent times. Therefore there is need to use modern science combined with indigenous wisdom of farmers to enhance the resilience of Indian agriculture to climate change. Besides undertaking research to develop location specific climate resilient agricultural technologies, there is need to make immediate efforts to transfer the already available climate resilient agricultural technologies to the farmers' field especially in more vulnerable regions.

The hilly landscape of the region, which is characterized by elevated ranges, foothills and valley has less than 10% of the geographical area under cultivation, although agriculture is the main occupation, with 83% of the total population dependent on agriculture for their livelihood. Slopes are broadly used for horticulture. Due to its peculiar topography and richness in horticulture biodiversity, the framers depend more on such sectors as forestry, horticulture and animal husbandry than on traditional agriculture.

The Hill Perspective based development strategies are essential for formulating farmer responsive plans, giving due consideration to the nature of marginality, fragility diversity and niches of area. Unemployment is widespread across the Himalayan states large force of educated unemployed rural youth from farming families is waiting for opportunities. There are large opportunities like make a business to power tiller, power weeder, and post harvest technology to make jam jelly etc. There are many areas in the hills that in fact have significant potentials for agriculture productivity increases and that the returns on investment in these areas may even surpass favored areas. Diversification of hill agriculture provides better choices and quality option for sustaining livelihoods of hill farmers. There is need of policies strategies development plans programs, technological research and extension support service, access to social capital human resources quality and quantity and access to market trade opportunities limitations to obtain success in hill agriculture.

References:

Becker, R. et al (1981)*: A Compositional Study of Amaranth Grain. Journal of Food Science, 46(4), p. 1175-1180.*

Chayal K and Dhaka B L(2010)*Analysis of Role Performance of Women in farm activities Ind Res. J. Ext. Edu. 10 (2):109-112.*

Choudhary H and Singh S (2003). *Farm women in agriculture operations. Agri.Ext.Rev.* ***15*** *(1):21-23.*

Grobelnik Mlakar, S. et al (2009). *Nutrition value and use of grain amaranth: potential future application in bread making. Agricultura, 7, p. 5-15.*

Khalida Jamali (2009).*The Role of Rural Women in Agriculture and it's Allied Fileds: A Case Study of Pakistan.European Journal of Social Sciences 7(3):71-77.*

Neelaveni S, Rambabu P and Punna Rao P 2002. *Developmental priorities of farm women in Agribusiness management. A case of an adopted village K. B. Palem. Manage Extension ResearchReview.****111****(2): 74-82.*

Singh D K , Singh A K , Yadav V P, Singh R B, Baghel R S and Singh Mayank (2009).
Association of Socio-economic Status with Economic Motivation of the Farmers Indian Res. J Ext. Edu. 9 (2):53-56.

Singh P, Jhamtani A, Bhadauria C, Srivastava R, Singh R and Singh J (2004). *Participation of women in agriculture. Ind. J. Ext. Edu.****30*** *(3&4****):****23-27.*

Twidwell, E.K, A. Boe, K.D. Kephart. (1992). *Planting date effects on yield and quality of foxtail millet and three annual legumes. Can J Plant Sci 72:819-827.*

Sustainable Development of Fractal Image Coding on Self-similarity

39

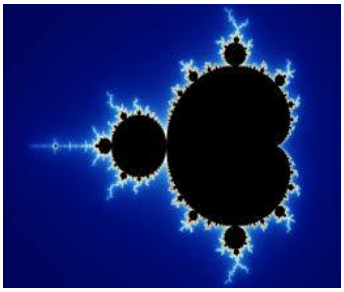
Shankar Lal

Abstract.

In the present paper, we have studied sustainable development of fractal image coding on self–similarity with geometry of manifold. The fractal of manifold has development the computer's ability to visually display the properties of fractal geometry of manifold. Manifold are important role of dealing the extended of n-dimensional space whose shape and size are not fixed as fractal that is, clouds, trees, brain, nervous system, respiratory system, snowflakes, mountains ranges, lighting, river and much, much more. Now in section one, introductory part of this paper is fundamental concept of fractal image encoding. In the section two, define the fractal nature of life itself, such as the human all possesses all the function of the entire human body as well as describes various types of self-similarity found within the image that is Environment and psychology. In section three, we have also studied cracking the code of sustainable development begins the process of expanding on this fractal model. In section four, we have study a planning process, process, not a design checking and use the SLDI code of sustainable development. In section five, six, seven, eight, nine and ten are describes sustainable development of fractal Encoding, comparison and improved encoding technique, sustainable size of domain blocks, Multi-component dictionary and sustainable weight of the decoded. And in the end, we have discussed in made followed by improved of fractal image coding on self-similarity.

Keyword: *fractal, SLDI code, creaking code, design, self-similarity.*

1. Introduction



The image can be represented in the memory with very limited space by using fractal approach. For this we need only the pattern and the transformation rules within its structure, we can generate an encoding scheme based on fractal. The phenomenon builds on self-similarities within the image. Images blocks found else-whore in the image.

The fractal is generated a rough or fragmented geometric shape that can be split into parts, each of which is a reduced-size copy of the whole [1]. The ideal of fractal has introduced by Benoit Mandelbrot in 1975 and was derived from the Latin fractious meaning "broken" or "fractured"

Sustainable development of fractal image on coding has very good features, by which the decoded images of larger size can be got without block effect. The second is high compression ratio. Ratio of 10000:1 was recorded in the article of Barnsley, who is called the father of fractal image encoding. The third important characteristic is that the encoding process includes many short finding processes, whereas the decoding process is an iterative process. Furthermore, decoding process is much faster than the encoding process. Although encoding process is slow, we can use parallel algorithm to improve the efficiency [3]

All these features of fractal image encoding come from Iterated function system (IFS) it's the theoretical foundation of fractal image encoding. In fractal image encoding, as image is

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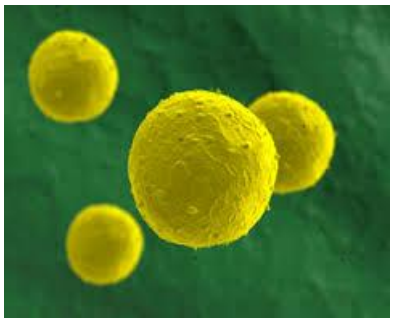
partitioned into a set of image blocks called ranges. The blocks is used as a code book from affine mappings of their intensity values [4]

The fractal image coding has been used in many image processing applications such as feature extractions, image signatures, and texture segmentation. It has the advantage of very fast decompression as well as the promise of potentially very high compression ratios. Another advantage of fractal image compression is its multi-resolution property, an image can be decoded at higher or lower resolutions than the original, and it is possibly to "Zoom-in" or section of the image. These advantages makes fractal image coding a very attractive method for applications in multimedia [5]. The drawback of fractal image coding in that block matching process is very time-consuming. Plenty of research focused on how to improve the speed of fractal image coding.

2. **Fractal Nature of Life itself**

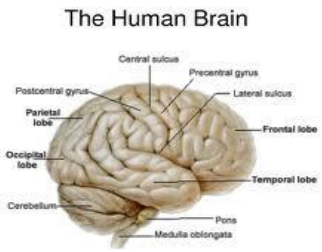


Fractal geometry has expanded in the field of cell biology such as the human all posses all the functioning of the entire human body. All the functions of the human body are already present in every living cell. Each cell has its own intelligence and all the functions of the whole human being. They know how to grow, reproduce, digest food, respiratory system, defecate, communicate etc. It means everything humans can do, each cell in our body.

Self-Similarity of Nature: - Nature is comprised of a population of self-similar humans, each made up of trillions of cells. As cell evolve, as people evolve, so does humanity. Biologically, the entire population of the world is akin to a cell. It's a self-similar pattern of increasing scale. The old phenomena, "it is above, so it is below," becomes the geometry of life and the Law of humanity.

The following video introduces the laws of fractal geometry of biology.

(i) ***The Environment: -*** One of the largest fractal relationships in real life is the self-Similarity of objects in nature, Clouds, trees, snowflakes, crystals, mountain ranges, lighting, river networks, coastlines, and much, much more can be produced remarkably accurately within a computer using relatively simple fractal geometry equation.



(ii) ***The Human Body: -*** The brain, nervous system, respiratory system, circulatory system, and everything else in the human body, is a product of fractal geometry at work. Significant advances in medicine are currently being developed using fractal geometry.

(iii) ***Psychology: -*** In fact, fractal geometry has immense consequence on our mental and physical quality of life. Individual behavior based on the "code" of instructions that are built into individual's psyche. Behavior, over time, reflects self-similarity and predictability. In fact psychologists are beginning to define individual identity based on the patterns of self-similarity embodied in behavior. Through the

exploration and code, psychologists can begin to heal mentally sick patients. Fractal patterns of mental activity in sleep and wakefulness have been evaluated from EEG recordings. This has important implications for dreams from the brain's attempt to bring meaning to the image evoked by a stimulation of the brain's visual and moter centers during rapid movement sleep.

3. Cracking the code of sustainable Development

Sustainable development is built on a self-similar pattern that replicates itself on increasing and decreasing scale, based, on a fundamental "code", for sustainable development. The code is comprised of three elements as well as it must optimizer balance each of the following.

1. Utility - the "satisfaction", "incentive", "desire" or "pure state" that is to be attained.
2. Effectiveness – doing the "right" things with accuracy and completeness.
3. Efficiency - achieving the lowest possible input/output ratio.

To embody these instruction usually, the SLDI code is represented as a three sided fractal geometry called sierpinski's, triangle. It begins with penetrates deeper into project decision-making, replicating itself thousand of all various areas, aspects and phases of the project developed process from planning through design, construction, maintenance and back to planning again.

As the matrix goes deeper, the bases instruction of optimization or balancing utility, efficiencies and effectiveness to replicate itself. The matrix in penetrated deeper, the basic "code" of optimizing utility, efficiency and effectiveness continues to replicate itself, the universal principles of sustainable development begins the process of expanding on these fractal model.

4. **Planning process**

The SLDI code differs in fundamental ways from the majority of other systems in that it was not developed a prescriptive checklist to specify a narrowly defined set of products. The SLDI code provides the basic instruction upon. The SLDI code is equally applicable regardless of project type, scale, terrain, climate etc. Again SLDI code provides the "code" or programming that provides the user with the tools to enhance the quality of their work by combing and balancing virtually unlimited possibilities into sustainable end. In fact SLDI code, like many computer programs, is applicable on projects of any type, regardless of science. The code enhances the quality of outcomes however diverse they may be, toward greater sustainability from a holistic people planet and profit perspective using the constructs of fractal geometry, the SLDI code uses the practical method. The SLDI code is offering this fractal model.

5. **Sustainable development of Fractal encoding**

Within this broad frame work, the differences between the majorities of existing fractal coding schemes may be classified into the following categories [6].

(i) Partition imposed on the images in supported by the range blocks

(ii) Composition of the pool of domain blocks,

(iii) Class of transforms applied to the domain blocks,
(iv) Type of search used in locating suitable domain blocks,
(v) Representation and quantization of the transform parameters.

The basic process of sustainable development of fractal image encoding is as follows: the image of sustainable development is first partitioned into non-overlapping regions called range blocks R, of size B×B. Domain blocks are extracted from the original image. The size of domain blocks should be larger then that of range block to fulfill the contractive requirement, generally, each domain block is of size 2B×2B [7]

Sustainable development of Fractal method needs a huge amount of processing time for compression because of the large search area and matching times. As a consequence, the matching algorithms have a computational complexity O [B^4] that demands an exhaustive processing time. Generally speaking, the attempts to speed up the sustainable development of fractal encoding consist of modifying the following two aspects [7]

First, modify the composition of the domain pool.

Second, the search types in block matching.

The first methods still have some disadvantages:

(a) Because of the preprocessing for classification, the complexity of algorithm in increased.
(b) What is the beat rule for classification? Should we use the different kind of sustainable image?
(c) The classification number is fixed, speed up ability is limited and continuity between classes is poor. For the second method, it makes the use of the mathematical tool, getting the sub optimal instead of the optimum. Therefore quality of image will be decreased.

(6) Comparison and improved encoding technique

The most important sustainable development of fractal image encoding technique is based on iterated function system (IFS) where images are compressed into compact Local IFS (LIFS) code at encoding stage and sustainable fractal images are generated to approximate the original image at the decoding stage. In the method, the first step is to partition the image into non-overlapping domain regions Di, i=1,2,…..m. The set of domain regions must over the entire image, but they can be of any size or shape [8]In this technique, it the closet matches are not found between the range and domain blocks, the block is then subdivided into four equal size sub squares.

(7) Sustainable size of domain blocks

In traditional fractal image encoding (FIE) schemes, domain blocks are always larger (usually twice) than range blocks. In fact, range blocks do not find their similar blocks in the original image; instead, they are try to find the most similar parts in the down-sampled image. This means that the traditional FIE scheme exploits the self-similarity of different scales. However, in real natural images the same scale similarity commonly exists. For example, the left eye of a person is using similar with the right one; they are same-sized instead of different sized. But the traditional FIE schemes do not exploit such kind of self-similarity. Moreover, in traditional FIE scheme, every range block searches for the most similar blocks in the down-sampled small image, so the number of all potential domain image, blocks decreases the similarity degree between a range block and its matched domain block also decreases resulting poor reconstructed quality. Since the same-scale similarity most commonly exist in nature

images, so if we are able to use this kind of similarity, the encoding performance must be improved.

(8) Sustainable weight of the decoded images

In order to the visual quality of the decoded image, the edge regions of the image are encoded with sustainable weights. The contract scaling factor and luminance offset factor in the affine transform are derived by minimizing the weighted difference measure. Experimental results show that this method improves the visual quality of the decode images in terms of weighted peak single to noise ratio [10].

(9) Multi-component dictionary

During the matching processing a sustainable fractal image coding, domain blocks are used unevenly. Some of the domain blocks are matched for many times, but some others are matches much less even to none. The reason for this phenomenon is there are highly redundancies existing between domain blocks. Therefore, if we only keep those domain blocks which are highly matched, then the capacity of domain pool can be considerably reduced. In this method, a multi-component dictionary is constructed in terms of geometric properties of the local structures by spare coding [7]

(10) Discussion

The key point of this paper is the concept of self-similarity which is the backbone encoding the image compactly. After partitioning the image self-similarity is search among the blocks. The concept of fractal nature of life itself introduced law of fractal geometry in nature. The conceptual difference is discussed among various method of fractal image based coding of self-similarity. The work can be extended for self-similarity in comparison and improved encoding technique as well as shape and size blocks as well as weight of the decoded images. In mathematics, a self-similar object or approximately similar to a part of itself, that is, the whole has the same shape as one or more of the parts. For, instance, a side of the Koch snowflake is both symmetrical and scale-invariant; it can be continually magnified 3x without changing shape.

References

1- ***Mandelbrot, B.B.:*** *The fractal Geometry of nature,1982.*
2- ***Mandelbroit, B. :*** *Like life itself, sustainable development is Fractal, 1975.*
3- ***Shen, Jia-Li, Ming-Quan Zhou, Yan-Lin Luo, Xin Zheng, Ying – Ying Wang :*** *Fractal image coding based on local similarity, 2007.*
4- ***Mario Polvere and Michele Nappi :*** *Speed – up in Fractal image coding : comparison of methods, 2000.*
5- ***Shen Furao and Osamv Hasegawa :*** *An Effective Fractal image coding method without search, 2004.*
6- ***Brendt Wohlberg and Gerhard de Jager :*** *A Review of the Fractal image coding Literature, 1999.*
7- ***Ying Zhao, Jing Hu, Dongxiang Chi, Ming Li :*** *A Novel Fractal image coding based on Basis block Dictionary, 2009.*
8- ***Dong Sheng Cai Mitsuyasu Hirobe :*** *Optimal Fractal image coding, 1999.*
9- ***Yao Zhao and Baozong Yuan :*** *A Novel scheme for Fractal image coding, 2001.*
10- ***Shuenn – Shyang Wang and Wei-Kai Liao :*** *Weighted fractal image coding, 2007*
11- ***Al-Hilo, Eman A., George, Loay E. :*** *Speeding – up Fractal colored image compression using moments features, 2008.*
12- ***Arumugam, S., Sankaragomathi, I.B., Ganesan, L.:*** *Proposed texture compression Algorithm Based on Fractal Wavelet theory, 2007.*
13- ***Fisher, Y. :*** *Fractal image compression, 1992.*

14- ***Fisher, Y. :*** *Fractal image compression- theory and application, 1994.*
15- ***Hutchinson, J. :*** *Fractal and Self-similarity, 1981.*
16- ***Saupe, D. , Hamzaoui, R., Hartenstein, H. :*** *Fractal image compression : an introductory overview, 1996.*
17- ***Saupe, D., Ruhl, M. Hartenstein, H. :*** *Optimal Heerarchical partitions for Fractal image compression, 1998*
18- ***Zhang H., Zhang, X. Cao, S. :*** *Analysis and evaluation of some image compression techniques, 2000.*