Chapter VI. Development and the Sustainability Question.

"Sustainable development is development which meets the needs of the present without compromising the ability of future generations to meet their own needs."

- World commission on Environment and Development.
6.1 Introduction:

Sustainability is a dynamic concept born out of the environmental debate of the last quarter century. There is growing concern nationally and internationally about biodiversity and protection of plants and animals and community based activity. The Rio Summit emphasized economic growth and poverty alleviation for sustainable development. The basic prerequisite of sustainable development is the evolution of a development process with focus on the enhancement of the living conditions of population as a whole with emphasis on raising the standard of living of the poor.

Agenda 21 called all countries to develop national strategies for sustainable development to translate the words and commitments of Earth Summit into concrete policies and actions. The important issue in the 21st century is to create greater economic and societal well being without deterioration of the environment and depletion of the resources. (Hussain, 2009)

Sustainable development is a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be meet not only in the present but also for future generations. The term was used by the Brudtland Commission which coined what has become the most often-quoted definition of sustainable development as development that “meets the needs of the
present without compromising the ability of future generations to meet their own needs.

The United Nations 2005 world Summit outcome document refers to the "interdependent and mutually reinforcing pillars" of sustainable development as economic development, Social development and environmental protection. The Universal Declaration on Cultural Diversity (UNESCO, 2001) further elaborates the concept by stating that "......... cultural diversity is as necessary for humankind as biodiversity is for nature", it became "one of the roots of development understood not simply in terms of economic growth, but also as a means to achieve a more satisfactory intellectual, emotional, moral and spiritual existence". In this vision, cultural diversity is the fourth policy of sustainable development. According to Mahatma Gandhi "There's enough in the world to meet the needs of everyone but there's not enough to meet the greed of everyone".

Over the past 20 years the total population in the industrialized countries has increased by 28 percent. These countries are facing many problems such as environmental degradation, over dependence or non-renewal sources of energy, declining standards of living (Hussain, 2009). These problems all more acute in developing countries. The developing countries have formed their economic systems on Western models ignoring their indigenous requirements. A great deal of harm has been done to agriculture sector. The percentage of cultivable land has been decreasing over the years due to increase in population and non-judicial use of resources. This has given rise to man induced degradation. Forests are being
destroyed and concrete jungles are taking their place. It is within the cities that most of the world's resources are consumed. As most of these resources originate in rural areas, production decisions taken by urban enterprises bear a powerful influence on their existence. Rapid ecological changes are taking place in the fringes and rural areas surrounding cities. History has led to vast inequalities, leaving almost three-fourths of the world's people living in less-developed countries and one-fifth below the poverty line. This has been compounded further by the long-term impact of past industrialization; exploitation and environmental damage. Human health in its broadest sense of physical, mental and spiritual well-being is to a great extent dependent on the access of the citizen to a healthy environment. Citizens of developing countries continue to be vulnerable to a double burden of diseases. Traditional diseases such as malaria and cholera, caused by unsafe drinking water and lack of environmental hygiene, have not yet been controlled (Hanley, Shogren and White, 2004)

Development in this new century has to be even more conscious of its long-term impact. The problems are complex and the choices difficult. Our common future can only be achieved with a better understanding of our common concerns and shared responsibilities. According to Mahatma Gandhi “We can not have ecological movement designed to prevent violence against nature, unless the principles of non-violence become central to the ethics of human culture”

Moving towards sustainable development presents tremendous challenges. We humans forget that in order to survive, we need to adapt to nature and not
vice-versa. In Gandhian thought and action, humanity has all the tools it needs for sustainable development.

Developing and developed countries should also strive together to strengthen the capacity of their health care systems to deliver basic health services and to reduce environment-related health risks by sharing of health awareness and medical expertise globally. More and more people at community level are thinking about what is happening to their environment and their living levels. There is need for greater public participation. The local institutions must be involved in developing, promoting, and implementing policies at all levels. It is good governance that will serve as a driving force for sustainable development. Sustained development is about the future, and we can only think of the future when our present is not in crisis.

We conclude this introduction section by noting that, irrespective of the definition adopted for sustainability, there may be many paths that are sustainable over time: choosing amongst these paths is not an issue which we have addressed here (Pezzey, 1994)

6.2 Indicators of Sustainable Development:

In choosing the indicators of sustainable development, we have to look into the specific characteristics of the region under consideration in addition to giving emphasis on the general theory. The general definition of sustainable development adopted here is that every future generation must have the option of being as well off as its predecessor. Discounting is compatible with this if the
discount rate is less that of technological progress (Solow, 1992). A sustainable path has the characteristic that alone it this overall productive capacity is not reduced. What we need to know at each moment in time is how much of this productive base we can use up. This is given by environmentally adjusted net national product (Hanley, Shogren and White, 2004).

Assam is a large developing state with nearly two-thirds of the population depending directly on the climate sensitive sectors such as agriculture, forest, etc. the climate change under various scenarios is likely to have implications on food production, water supply, biodiversity and livelihoods. Thus, Assam has a significant stake in scientific advancement as well as an international understanding to promote mitigation and adaptation. Therefore in our sustainable development chapter we have choose the indicator climate change, agriculture, forest and urbanization. This requires improved scientific understanding, capacity building, networking and broad consultation processes.

Indicators chosen in the study are –

I) Agriculture.

II) Climate change.

III) Urbanization.

IV) Forest.
6.3 Agriculture.

Agriculture is one of the most important economic activities, of the Brahmaputra Valley, Assam. Almost 70 percent people involve in the agricultural activity (Dhar, 1994). As agriculture fulfills the basic needs of people of the region more emphasis has been given to develop agricultural production. In traditional agriculture the method of agriculture which is practiced with locally available seeds, organic fertilizers and traditional agricultural implements, does not harm the environment and maintain environmental balance but gives low yield. However with the help of traditional agricultural method does not fulfill the growing needs of people food.

On the other hand in commercial agriculture introduction of high yielding variety seeds, chemical fertilizers, pesticides, irrigation and mechanization. The main aim of commercial agriculture is to increase production, it damages the environment and increases inequality in the society on the other (Gupta, 1993).

From the above discussion we have seen that both the commercial agriculture and traditional agricultures suffers draw backs (Khanna, 1993). So, there is an urgent need to introduce such a system which will provide sustainability in agriculture.

Here in our study we are discussing the problems of commercial and traditional agriculture and suggest solution in order to achieve sustainability in the
Brahmaputra Valley agricultural system. The study was conducted in the commercial agricultural area of Barpeta and Nagaon, where rice and wheat respectively were cultivated as commercial crops. And the traditional agricultural areas where Jorhat and Kamrup.

6.3.1 Problems with commercial agriculture:

1) HYV. Variety Seeds

As we all know without the vital combination of chemical fertilizers and irrigation high yielding variety (HYV) seeds does not respond very well. Use of chemical fertilizer the turn leads to the creating of another problem. The uses of HYV seeds increases the total cost of inputs due to use of fertilizers, irrigation and pesticides, which is much higher than that used for traditional varieties and costs prove inhibitive to small farmers. (Khanna, 1993)

Since HYV seeds have become popular, traditional varieties are disappearing. If HYV suffers from a disease or pest it is necessary to try another local variety, because after some time HYV can not survive in that area. Multi variety cropping patterns are more resistant to disease and pests. Therefore it is essential to preserve traditional varieties.
Table: 6.1

Problems with high yielding variety seeds faced by the sample farmers.

<table>
<thead>
<tr>
<th>Sl. NO.</th>
<th>Study Area</th>
<th>Total sample</th>
<th>Used HYV seeds</th>
<th>Faced problem</th>
<th>Susceptible to diseases</th>
<th>Needs more water</th>
<th>Requires chemical fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CAA</td>
<td>175</td>
<td>67</td>
<td>24</td>
<td>13</td>
<td>10</td>
<td>67</td>
</tr>
<tr>
<td>2.</td>
<td>TAA</td>
<td>150</td>
<td>7</td>
<td>7</td>
<td>2</td>
<td>--</td>
<td>7</td>
</tr>
</tbody>
</table>

Source: Field work in the year 2004-05

Table 6.1 shows the number of sample farmers who used HYV seeds in the commercial agriculture area (CAA) and the traditional agriculture areas (TAA) have faced problems. Chi square value of farmers who faced problems with HYV seed and those farmers who did not face problems with HYV seeds was 22.85. Through chi square tests also it is proved that HYV seed has its negative effect. Particularly in the traditional agricultural area where irrigation facility is not available their use has totally failed.

ii) Fertilizer.

There is a probability that chemical fertilizers poison micro and macro-organism is the soil. Therefore it cause disease and pests in plants and indirectly affects the health of the farm animals and human beings. Any fertilizer not utilized by plant may increase the fertilizer percentage in the soil and may eventually make the soil infertile (Adams, 1990)
In Barpeta under Mundia block in Jaharpam out of the total number of interviewed farmers, seventeen farmers applied fertilizers, of these ten could not get enough water for irrigation, and their crops got dried up. They were therefore not able to get what yield they would have obtained without using chemical fertilizers.

Nitrogen, phosphorus and potassium and known as primary plant nutrients. chemical fertilizers particularly nitrogen and phosphorus cause leaching of nutrients from the soil. So, they decrease soil fertility in the long run. Once chemical fertilizer is used, it has to be used every year in order to continue to get a high yield. If chemical fertilizers are not used in consequent years, productions declines even below the original yield. In our study where we have taken out field work in the villages of Barpeta and Nagaon where commercial agriculture is prominent and chemical fertilizer is used on a large scale, farmers informed that they have to increase the amounts of chemical fertilizers about 5 to 10 percent every years, in order to keep their yield constant. From the total sample 95 percent farmers in Nalbari & 80 percent farmer in Kamrup have increased the dose of fertilizers every year.

Some the components contained in chemical fertilizers are hazardous to humans causing serious diseases. The Table 6.2 below shows the toxic components which are used in popular chemical fertilizers.
Table: 6.2

Season wise consumption of fertilizer in Assam (in tonne)

Fertilizer use: Nitrogen, phosphorous, and murate of potash.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Year</th>
<th>Kharif</th>
<th>Robe</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td>1999-2000</td>
<td>51526</td>
<td>58585</td>
<td>110111</td>
</tr>
<tr>
<td>02.</td>
<td>2000-2001</td>
<td>65361</td>
<td>75258</td>
<td>140619</td>
</tr>
<tr>
<td>03.</td>
<td>2001-2002</td>
<td>72813</td>
<td>80133</td>
<td>152946</td>
</tr>
<tr>
<td>04.</td>
<td>2002-2003</td>
<td>88179</td>
<td>86722</td>
<td>174901</td>
</tr>
<tr>
<td>05.</td>
<td>2003-2004</td>
<td>94164</td>
<td>95280</td>
<td>189444</td>
</tr>
</tbody>
</table>


Table: 6.3

<table>
<thead>
<tr>
<th>Toxic chemicals</th>
<th>Use in type of fertilizer</th>
<th>Health hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cadmium</td>
<td>Super Phosphate fertilizer</td>
<td>Kidney damage, Emphysemas possibly Carcinogenic,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teratogenic and Matagenic.</td>
</tr>
<tr>
<td>2. Urea</td>
<td>Nitrogen</td>
<td>Bronchial problems, Kidney damage.</td>
</tr>
</tbody>
</table>

Source: Krishnamurti, 1999

iii) Pesticides:

Though chemical pesticides control diseases and pest very quickly they have many negative effects. The long run, pesticides increase resistance in pests while
at the same time they kill predator and parasites of pest and insects which destroy them. Ultimately pesticides are beneficial to the harmful insects. Many pesticides have a direct effect on birds, animals and humans. Likewise water sources also get polluted and excessive use of pesticides also disturbs the food chain as they sources become more and more concentrated at each level of food chain. Thus by the time the food reaches humans it becomes increasingly harmful.

In our sample collection it has been we have seen that where pesticides are frequently used in large quality simple farmers complained about diseases like eye problems, diarrhea and skin disease. However in those areas pesticide where were not used no complain is about these kinds of disease among the sample farmers were found. Table 6.3 shows the toxic chemicals which are use in pesticides and cause for hazardous diseases among humans.

Table: 6.4

<table>
<thead>
<tr>
<th>Toxic chemical</th>
<th>Health Hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Arsenic</td>
<td>Dermatitis, muscular Paralysis, Damage to Liver and kidney, Possibly carcinogenic and teratogenic.</td>
</tr>
<tr>
<td>2. Chlorinated Organics.(DDT, BHC etc.)</td>
<td>Depression of central nervous system, possibly carcinogenic.</td>
</tr>
</tbody>
</table>

Source: Krishnamurti, 1999.
iv) Irrigation:

The introduction of surface irrigation through canals and tanks in commercial agriculture causes a rise in the water table. Continuous rise in water table causes water logging. In Barpeta in our study area Mundia in 1975 before introduction of irrigation water table was between six and nine meters from the ground level. In 1990 the water table has come up to zero to three meters. Besides agricultural land, residential areas have also been affected by the water logging. Foundations of houses have weakened and dampness has increased.

v) Mechanization:

Commercial agriculture reduces the labour requirement due to the introduction of machines. This leads to lesser employment opportunity in the agriculture. Use of tractors for ploughing and harvesting has become very common. Cropping patterns have also changed. This two way changes has reduced employment opportunity for the local people.

Irrigation was reasonably good in Barpeta and Nagaon area from the beginning. So farmers used to take two crops in a year. One year rice and wheat used to grown followed by in kharif as well as grains, and pulses in rabi in the next year. This way 400 to 450 man days per year per hectare employment was available. After introduction of surface irrigation sugarcane was introduce, which provides about 300 man days per year per hectare of work. Earlier while multi cropping pattern was used along with the traditional tools, about 350 man days of work per year was provide in Barpeta, but now after mechanization, only 175 man
days of work per hectare per year is provided. So from the view point of employment that commercial agricultural is not sustainable development.

vi) Mono-cropping pattern:

Commercialization of agriculture encourages the mono-cropping pattern. Many plant diseases and pests have very specific needs for food. They attack on just one variety of plants. Therefore in mono cropping pattern if there is an attack of pest or disease the whole crop is liable to be lost. While in traditional agriculture a multi cropping system is adopted, where a variety of crops are grown together, so that an area generally contains plants with different in resistance to specific pests and some vulnerable plants. If there is an attack of any disease or pest the whole cropping system does not suffer and the farmers' losses are minimized.

6.3.2 Problem with traditional agricultural:

i) Economic:

Under the traditional agriculture, the production is not enough to fulfill the requirements of the people as the yield rates are quite low. In Kamrup and Jorhat districts where traditional agricultural method is in practice on all average per hectare the yield is very low. On the other hand in Barpeta and Nagaon commercial agriculture it practiced the yield rates and much higher than Kamrup and Jorhat districts the major difference in the yield rate has been observed in wheat and rice, because high yielding verities of wheat and rice have become popular.
ii) Social:

In traditional agriculture, it is found that in a village almost every household has a small piece of land. These small holdings are uneconomic and do not provide even the minimum subsistence to the farmer. For certain agricultural operations there is a very high demand of labour, for instance at the time of sowing and harvesting. There is a lean period in agriculture when very little or no labour is required; this inequality of demand of labour makes the situation very uncertain, for the agricultural labourers. Therefore they ingrate outside to get employment. Non-availability of labour in time may lead to the damage for crop.

iii) Unscientific Method:

In traditional agriculture methods farmers use different kinds of components of organic matter for fertilizers. Most of the farmers spread the organic matter in the field, without properly composting them. This is a very unscientific method of fertilization. It increases the effect of pests in the crop. Farmers keep fertilizing components like dung, house waste, leaves etc. in the open field, without covering them. This material gets exposed to the sun and dries up quickly and does not rot properly. Many times these materials are blown off by wind or washed away by rain. These faulty methods of preparing compost degrade the quality of fertilizer.

In traditional agriculture farmers have to depend on nature for the water supply. If there is a failure of rain, farmers do not have any choice but to let their crop die. This in commercial agriculture monsoon failure does not affect any
operation of agriculture. Table 6.4 shows the irrigated area of sample farmers’ field in the commercial agriculture areas (CAA) and the traditional agriculture areas (TAA).

Table: 6.5

<table>
<thead>
<tr>
<th>Study area</th>
<th>Total cultivated land of sample Farmers (in hectares)</th>
<th>Percent to total irrigated</th>
<th>Cultivated land un irrigated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CAA</td>
<td>610</td>
<td>90</td>
<td>10</td>
</tr>
<tr>
<td>2. TAA</td>
<td>325</td>
<td>18</td>
<td>82</td>
</tr>
</tbody>
</table>

Sources: Field works.

N.B: Commercial agriculture areas (CAA)
Traditional agriculture areas (TAA).

6.3.3 Sustainable agricultural development:

Commercial and traditional agriculture both have their negative aspects. As we have already discuss to adopt commercial agriculture, because it gives short-term benefit however long term loss, On the other hand it is also difficult to stick with traditional agriculture, because it does not provide enough yield to feed a growing population. Commercial agriculture will not do justice to the society as well as to the environment. So, there is an urgent need to improve traditional way
of agriculture. We have seen that little changes will do remarkable improvement. And it will improve the environmental conditions and will be beneficial for the society.

i) Management of land:

There is a need for proper and balanced land management the proportionate land should be provided for forest, for grazing and for cultivation. Traditional skills like blacksmithy, carpentry, pottery, weaving etc. can be encouraged in the villages so that people do not depend only on the land for their livelihood. Therefore less land is required for cultivation. This way the best land can be put under cultivation, and barren and fallow land can be developed as grazing and forest land. By the growth of forests, soil erosion will be reduced and due to the availability of grazing land for animals they will not destroy agricultural land and agricultural production will increase, also the yield of milk will increase as enough fodder will be available.

ii) Use of organic fertilizers:

Farmers need to be encouraged to prepare and use manure in scientific and proper way. Farmer may given training to prepare proper farm yard manure, composite manure and green manure. So that organic material can be used optimally.

To regenerate the fertility of soil, farmers may encouraged to keep cultivated land fellow as lest once in every five years. For achieving economic viability in sustainable agriculture city garbage may converted into rice organic
fertilizers, with increase in urban population disposal of garbage is provide a great problem. Urban people may educated for keeping their garbage separately, e.g. kitchen waste, papers, plastic, and other wastes. After scientific processing urban garbage may be converted into bio-rich fertilizers. This process will provide rich organic manure for agriculture.

iii) Live stock energy:

It is very important to incorporate livestock in the agriculture rate system for achieving resource efficiency in agriculture. In our state enough human and livestock recourse are available there is no need to go for expensive machinery use of livestock energy can employ more people than machines. Utilization of livestock is more economic, because waste may be turned into farm manure (Khanna, 1993). This can improve the nutrient cycle of soil. Animal products may be used for human consumptions, which may improve their nutritional level. Livestock may be treated as a part of rural transportation system. This will save fuel consumed by automobiles and reduce pollution. In Barpeta in Gomafulbari area use of livestock energy may be encouraged. Remote villages of these areas are still not connected with roads. Transportation of agricultural products is a great problem. Unmettaled roads may be used for bullock carts. Marginal lands of these areas should be converted into grazing lands.
iv) Scientific approach of cultivation:

Multi cropping pattern is adopted systematically and scientifically it may be able to increase yield very significantly. In traditional agriculture usually sowing is done by broad casting method, if proper rows are made for the each crop, it will be more beneficial. Also proper crop rotation and crop sequence can be adopted to save soil fertility and ecological balance.

Irrigation is one of the important components of Assam agriculture. There is no need to build huge. This will have their long term negative effects. Instead of one big dam, number of small dams and check dams can be constructed. We have already seen that the effect big dams. A lots of NGO’s always opposite to construct that kind of dams. In our state we can mention about the Krishak Mukti Sangram Samity (KMSS) and other organization protests against construction of big dams in the North East India.

Ground water development may be encouraged. Development of catchments are through tree plantation is one of the most important task, for preservation of water. Availability of irrigation in time will be able to increase the yield rate.

There must be presents of godowns, availability of godown facility immediately after harvesting can reduce the post-harvest losses, due to the rodents or sudden change the weather like rain or hail stones. In traditional way of farmers have old and depreciated tools. If traditional tools with little improvement are provided to the farmers, it will help them to increase their yield to some extend.
Communication system should be strengthened, so that all information regarding agricultural technology, should reach to farmers in time. Also their problems such as disease or pest attack on the crop, requirement of seeds may be communicated to the related officials in time and be controlled accordingly.

6.4 Climate change

Climate change is one of the most important global environmental challenges with implications for food production water supply, health, energy etc. Historically, the responsibility for green house gas emissions increase lies largely with the industrialized world, though the developing countries are likely to be the source of an increasing proportion of future emissions. The projected climate change under various scenarios is likely to have implications an food production water supply, coastal settlements, forest ecosystems, energy security, health, etc.(Sathaye, Sukla and Ravindranath, 2006).

The most effective way to address climate change is to adopt a sustainable development pathway by shifting to environmentally sustainable technologies and promotion of energy efficiency, renewable energy, forest conservation reforestation, water conservation, etc.

So, the climate change issue is part of the larger challenge of sustainable development. According to the latest scientific assessment the earth's climate system has demonstrably changed on both global and regional scales science the pre industrial era. Further evidence shows that most of the warming
observed over the last 50 years, is attributable to human activities. The intergovernmental panel on climate change (IPCC, 2001) project that the global mean temperature may increase between 1.4 and 5.8 degree celsius by 2100. This unprecedented increase is expected to have severed impacts on the global by hydrological system. Ecosystems, sea level, crop production and related processes (Sathaye, Shukla and Ravindranath, 2006)

The climate change issue is part of the larger challenge of sustainable development. As a result, climate polices can be more effective when consistently imbalanced within broader strategies designed to make national and regional development paths more sustainable. The impact of climate variability and change, climate policy responses, and associated socio-economic development with affect the ability of countries to achieve sustainable development goals.

The UN conference on environment and development (UNCED) in 1992 at Rio de Janeiro led to FCCC (frame work convention on climate change) which laid the framework for the eventual stabilization of greenhouse gases in the atmosphere. Recognizing the common but differentiated responsibilities and respective capabilities, and social and economic conditions. The convention came into force in 1994, subsequently. The 1997 Kyoto protocol, which came into force in 2005, reasserted the importance of stabilizing greenhouse gas concentrations in the atmosphere and adhering to sustainable development principles.
India is a large developing country with nearly 700 million rural population directly depending on climate-sensitive sectors (agriculture, forests and fisheries) and natural resources (such as water, biodiversity mangroves coastal zones, grasslands) for their subsistence and livelihoods. Further, the adoptive capacity of dry land farmer, forest dwellers, fisher folk, and nomadic shepherds is very low. (Ravindranath and Sathaye, 2002)

So, the climate change issue is a part of the larger challenge of sustainable development. Some of the projected impacts of climate change in Assam are as follows:

6.4.1 Climate change and Agriculture:

Simulations using dynamic crop models indicate a decrease in yield of crops as temperature increases in different part of Assam. However, this is offset by an increase in CO2 at moderate rise in temperature and at higher warming; negative impact on crop productivity is projected due to reduced crop durations (Kumar, 2005)

We have seen that during the last one decade Assam has been witness to many climatic changes. Upper Brahmaputra Valleys faced severe floods. Thus the impact of climate change has adversely affected agricultural production resulting in huge loss of paddy and corn crops in the districts of Upper Brahmaputra, Middle Brahmaputra, and Lower Brahmaputra plains.

Climate – related disasters have brought widespread misery and huge economic loses to Assam especially in the Brahmaputra valleys districts, adversely
affecting public health, food security, agriculture water resources and biodiversity in the state. Floods are the most common annual occurrences in Assam, affecting one or three other part of the state, the most affected being the districts of the upper Brahmaputra plains and lower Brahmaputra plain.

Agriculture in India is very much weather dependent. It is ironic, then, that a significant percentage of green house-gas emission come from agriculture. Fossil-fuel intensive agriculture is contributing to the creation of the unpredictable weather conditions which all farmers will need to battle in the not so distant further. Scientist believes that the fluctuating weather conditions in a state suggest that the state is recycling under climatic chaos. For more that a decade now, the state has been experiencing contrasting extreme weather conditions. Agriculture has been worst affected in Assam by these climate changes. A little increase in temperature can reduce the production of paddy but help in the growth of wheat crops. Such changes may often till the farmers towards growing are crop at the expense of the other this would lead to imbalances in crop production.

As the production of food grain goes down, it create high levels of poverty many small and marginal farmers all indebts both to money lenders and government banks. As the weather gets hotter, the changes of paying bank loan become difficult, leading to stress and in some extreme cases suicides. The ill effects of climate change can also be seen on woman farmers, especially poor
woman farmers because of their low social and economic status. They also have lesser accessibility to livelihood resources and land holdings.

There is serious danger of climate changes in the form of severe droughts, floods, intense rainfall, and storms undermining development programme and millennium development goals aimed at reducing poverty.

We have seen that, in last budget central government is spending 2.5 percent of its total GDP on measures to control the adverse impact of climate change, which is big amounts for any developing nations. The zeal of rapid industrialization, deforestation and wisful consumption of natural resources is likely to make the situation worse. Policy makers at the state, regional and national level should take serious view of the economic, agricultural, health-veleted and environmental impacts of climate change.

The hydrological cycle is likely to be altered and the severity of draughts and intensity of floods in various parts of India is likely to increase (Sathaye, Sukla and Raviniranath, 2006) Further, a general reduction in the quality of available run-off is predicted.

Simulations using dynamic crop models indicate a decrease in yield of crops as temperature increase in different parts of states (Kumar, 2005). However this is offset by an increase in CO2 at moderate rise in temperature and at higher warming, negative impact on crop productivity is projected due to reduced crop durations.
Malaria is likely to persist in many districts and new areas may become malaria-prone and the duration of the malaria transmission windows is likely to widen in Upper Brahmaputra Valley and Lower Brahmaputra Valley.

6.5 Urbanization:

India is one of the largest country in the world, both in land area and its population. Almost 25 percent of the world’s people live in India. After independence it has emerge lots of urban dwellers. About 25 percent people live in urban centers in India. But we have seen that the urban reside in very low income and poorly serviced areas.

Table: 6.6
Growth of urban population in Assam.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Year</th>
<th>No. of towns</th>
<th>Total population</th>
<th>%of population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1971</td>
<td>72</td>
<td>128922</td>
<td>8.9</td>
</tr>
<tr>
<td>2.</td>
<td>1991</td>
<td>90</td>
<td>2241432</td>
<td>11.10</td>
</tr>
<tr>
<td>3.</td>
<td>2001</td>
<td>125</td>
<td>3439240</td>
<td>12.90</td>
</tr>
</tbody>
</table>


Though urbanization or growth of urban center has been slow in Assam, after independence in Assam there is increased of growth of urban centers. Urban centers are increasingly becoming the engines of natural economic growth and the magnets for new residents flooding in from rural areas. In our state always lots of people migrate from the rural areas to urban centre in search of work, education, health etc. As a result the sustainability of cities is under pressure. Government
always faced with the task of how to resolve urban problems from transportation to waste management from drinking water supply to the preservation of urban green space.

While planning for sustainable development of the towns, we should take into account the factor of climate change. Explaining implications of climate change for sustainable development the intergovernmental panel on climate change notes. Sustainable development represented a balance between the goals of environmental protection and human economic development and between the present and future needs. It implies equity in meeting the needs of people and integration of sectoral action across space and time (Cruz, 2007).

Climate change will hamper sustainable development of India as it increases the pressures on natural resources and the environment associated with rapid urbanization, industrialization and economic development. Urban areas are mostly face problems of air quality pollution, green house gases, and unsustainable consumption and of inadequate sanitation and water supply.
In the above mentioned descriptive model presented points out the causes of urbanization, and its negative and positive consequences. The first column indicates in the model is engines of economic growth are reflected in the acceleration of manufacturing, service, quaternary sector, along with the

Source: (After Dutta, 2008).

In the above mentioned descriptive model presented points out the causes of urbanization, and its negative and positive consequences. The first column indicates in the model is engines of economic growth are reflected in the acceleration of manufacturing, service, quaternary sector, along with the
development of the basic economic function and rise of export base. After the growth effects the traditional farming areas, where more advanced scientific and commercial farming will be taken place. This in turn causes a decline in the proportion of the total labour force needed in agriculture. On the other hand there is a good effect also that rising per capita GNP and GDP, causing a country to step up from low to high development, from low income to high income, from poverty to riches, this urbanization level start to grew the level of developed states.

After that with the rising per capita GDP, GNP this changes creates not only high levels of urbanization, but also low birth rate, long life expectancy, small family size, improved standard of living, more use of automobiles. Finally the society turns towards greater innovation, scientific advancement and enhancement of learning, positive consequences as indicated by items 10-16 (Fig. 6.7) are also the basic characteristics of urbanization.

6.5.1 Negative Consequences:

Though there is lots of advantage of positive consequences, however there is present of negative consequences also. In figure above mentioned indicated 17 to 24 has already mention. Those are – There is a present of rural to urban migration. Massive rural migration has also fostered the growth of several mega cities, because of great numbers of migrants are attracted to large cities. When low skilled poor migrants from rural areas move to urban areas, they become a new kind of proletariat with little to lose. They take up any kind of job and live on the
pavements, in temporary shelters and in the poorest housing conditions of slums. Most of them end up being employed in the informal sector. Thus the slum dwelling, urban poor develop their own culture of deprivation, poverty, lack of education, and insanitary living. They are mostly incapable of rapid upward movement (Dutta and Noble, 2008). The magnitude of the problem can be gauged by Delhi, where roughly a third of the city’s entire population is estimated to live in squatter settlement at the lowest income levels (Haider 2000).

The increasing population and the wide knowledge and awareness of new facilities cause demands for increased and better infrastructure facilities such as water supply, sewage, garbage collection, electricity supply, school and mass transport (Dutta and Noble, 2008). Due to financial constraints, cities rarely can cope with the increased demand for infrastructure and mass transport. The use of huge amount of mass transport leads a urban area to air and noise pollution which is one of the main cause of damage of environment and at the same time it heightened health concerns.

From the above study we have seen that how urbanization has also a negative consequences. In our study area in the Brahmaputra Valley also we have seen that the developed districts i.e. Kamrup, Dibrugarh, Jorhat, Tinsukia and Nagaon we have seen that positive consequences, their manufacturing, service sector, economic activities, contribution to GNP and GDP goes up and at the same time we have also seen in our study that improved standard of living, use more automobiles. small family size etc. but on the other hand the negative
consequences are also started slowly. So, there is urgent need of sustainable urban development in the Brahmaputra Valley. For sustainable development of urbanization Prof. Ashok K. Dutta has suggest a model in ‘Challenges to Asian urbanization in the 21st century. These are as follows:

i) Strong family planning.

ii) Creation of employment opportunities in medium and small cities.

iii) Rural industrialize and modernization of farming economy to countract rural push.

iv) Planned accommodation of new immigrants in cities.

v) Redevelopment of old city core.

vi) Air, water pollution remission.

vii) Application of pragmatically based strategic and consensus building based on continuous planning approach.

viii) Global coordination for problem resolution.

Recommended steps for meeting the challenges of urbanization. (After Dutta, 2008)

In the Brahmaputra Valley, a strong family planning program is necessary both in urban and rural areas. Natural urban population growth may be controlled by reducing the birth rate. In Brahmaputra Valley that already have populations ten lakh or more than ten lakh are becoming not only congested, but over burdened, leading to the failure of infrastructure facilities, especially transport, water supply and sewage, for example Guwahati and Dibrugarh. Rural
development both in agriculture and industries, will not only improve rural income, but also discourage rural push (Dutta, 2008). Thus, in Brahmaputra Valley also improvement in agriculture requires turning agriculture from traditional approaches to commercial agriculture. Thus rural industrialization and development of agriculture, where products may compete in the market fosters rural development and there will discourage surplus rural labour from migrating to urban areas.

Cities are increasingly becoming the engines of national economic growth and the magnets for new residents flooding in from rural areas. Globalization is having a significant effect on cities, forcing them to compete for international business with other cities worldwide and within their own countries (http://www.rece.org).

As a result, the sustainability of cities is under pressure. Decision makers at all levels are faced with the task of how to resolve urban problems from transportation to waste management, from drinking water supply to the preservation of urban green space.

6.6 Forest

The forestry sector, perhaps more than any other, is well positioned to provide worldwide leadership in the practice of sustainable development. (NFAP, 1999). The forest community is accustomed to a long-term perspective, it is reasonably knowledgeable about the response of forest ecosystems to natural and
human disturbances, it is comfortable with the sustained yield principle, and in a few instances it has attempted to practice a multiple and integrated use of forest. As compared to many other industrial sectors, it is relatively easier for the forest community to expand its scope from sustained yield to sustainable development, which requires a shift from forest management to forest ecosystem management.

As a part of the demands on forestry to meet present needs and our ethical responsibility toward future generations, the following definition of sustainable forest development is proposed. (Maini, 1988)

The state of Assam is well known for its extensive forest area with varieties of flora and fauna. The total area under forest is 23688 square km (1999 estimate of the State Forest Department). This constitutes 30.20 per cent of total geographical area of the state.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Year</th>
<th>Total forest area</th>
<th>Lost of forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td>1998</td>
<td>2023658.47</td>
<td>----</td>
</tr>
<tr>
<td>02.</td>
<td>2001</td>
<td>1845178.90</td>
<td>- 178479.57</td>
</tr>
<tr>
<td>03.</td>
<td>2002</td>
<td>1816261.06</td>
<td>- 28917.84</td>
</tr>
<tr>
<td>04.</td>
<td>2003</td>
<td>1902309.84</td>
<td>+ 86048.78</td>
</tr>
<tr>
<td>05.</td>
<td>2004</td>
<td>2119063.00</td>
<td>+ 216753.16</td>
</tr>
<tr>
<td>06.</td>
<td>2005</td>
<td>2088183.00</td>
<td>- 30880</td>
</tr>
<tr>
<td>07.</td>
<td>2006</td>
<td>2088182.94</td>
<td>- 00.06</td>
</tr>
<tr>
<td>08.</td>
<td>2007</td>
<td>2075163.86</td>
<td>- 13019.08</td>
</tr>
</tbody>
</table>

Source: Statistical Handbook of Assam, various issues.
The forest products of Assam comprise mainly industrial wood, fuel wood, bamboo, stone, thatch, cane, sand, etc. Among these industrial wood and fuel wood are the two main forest products. The forest provides economic support to about 15 lakh people particularly in rural areas of Assam. The state government earns a good amount of revenue from various forest products. There is a sharp decline of revenue earned from timber during the year 1997-98 (Table 6.7).

### Table 6.7
Revenue Earned by the Forest Department in Assam. (Rs crore)

<table>
<thead>
<tr>
<th>Year</th>
<th>Timber</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991-92</td>
<td>10.86</td>
<td>6.67</td>
<td>17.53</td>
</tr>
<tr>
<td>1993-94</td>
<td>14.53</td>
<td>8.07</td>
<td>22.60</td>
</tr>
<tr>
<td>1994-95</td>
<td>10.70</td>
<td>6.23</td>
<td>16.93</td>
</tr>
<tr>
<td>1995-96</td>
<td>11.03</td>
<td>6.73</td>
<td>17.76</td>
</tr>
<tr>
<td>1996-97</td>
<td>9.16</td>
<td>6.12</td>
<td>15.28</td>
</tr>
<tr>
<td>1997-98</td>
<td>0.50</td>
<td>7.22</td>
<td>7.72</td>
</tr>
<tr>
<td>1998-99</td>
<td>0.50</td>
<td>9.01</td>
<td>9.51</td>
</tr>
<tr>
<td>1999-2000</td>
<td>1.98</td>
<td>9.30</td>
<td>11.28</td>
</tr>
<tr>
<td>2000-01</td>
<td>2.86</td>
<td>8.51</td>
<td>11.37</td>
</tr>
</tbody>
</table>

Source: Principal Chief Conservator of Forest, Assam

Table 6.8 shows that Assam has lost 820 square km of forest in just six year. If we look at the area under reserved forest we can see that most of the forest divisions experienced a declining trend in their coverage in the late nineties. The table shows that the forest coverage has been has drastically reduced in Dhubri, Doomdooma, Goalpara, Hamren, Kamrup East, Kamrup West, Karbi Anglong East, Kokrajhar Wildlife, Lakhimpur, Mangaldai Wildlife, Nagaon Wildlife, Sonitpur East and in Tinsukia Wildlife Divisions. It also shows that in most of the forest divisions there is a check on the decline of forest area after 1995-96.
Table 6.8
Forest Area in Assam

<table>
<thead>
<tr>
<th></th>
<th>1993</th>
<th>1995</th>
<th>1997</th>
<th>1999</th>
<th>Loss during the six years in sq. km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assam</td>
<td>24,508</td>
<td>24,061</td>
<td>23,824</td>
<td>23,688</td>
<td>-820</td>
</tr>
</tbody>
</table>

Source: Principal Chief Conservator of Forest, Assam

Increased pressure on forest resources of the country over the last few decades has threatened the livelihoods of millions of forest dwellers and other poor people living in the vicinity of the forest. Forest resources have been important for the prosperity of any nation and its communities. They are an essential natural resource providing multiple benefits to people besides other important functions such as biodiversity conservation, global carbon storage and storehouse for future option values. The rich and the poor all are dependent on forest resources, directly or indirectly, and forestry in many developing countries, including India is also seen as a means for eradicating rural poverty and achieving sustainable development. (Rawat, et al., 2008)

There are some major forms of Non-Timber Forest Products (NTFP) in the state like bamboo, cane, thatch, grass, bark, etc. Most of the bamboo forests of the state have been leased out to the paper mills of the state. Moreover many household and non-household industries of the state is based on bamboo and cane products. The National Industrial Classification data of Census of India for Assam shows that persons engaged in manufactures of bamboo and cane furniture and
fixtures and other related non-timber based products show 148.5 per cent growth during the period 1971-91. Whereas persons engaged in timber based industries show 72.6 per cent growth during the same period in the state. This shows the possibilities of sustainable job opportunities in NTFP sector.

Table 6.9
Growth of Workers Engaged in wood based industries

<table>
<thead>
<tr>
<th>Industries</th>
<th>NIC code</th>
<th>1971</th>
<th>1991</th>
<th>Growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood and Wood Products</td>
<td>27</td>
<td></td>
<td></td>
<td>72.6</td>
</tr>
<tr>
<td>Wooden and cane boxes, baskets, made entirely or mainly of cane, rattan,</td>
<td>272-1970</td>
<td>3,411</td>
<td>3,867</td>
<td>13.37</td>
</tr>
<tr>
<td>bamboo, willow, fibres, leaves, grass etc.</td>
<td>273-1987</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufactures of bamboo &amp; cane furniture and fixtures</td>
<td>277</td>
<td>2,420</td>
<td>9,030</td>
<td>273.14</td>
</tr>
<tr>
<td>Manufactures of products of wood, bamboo, cane, reed and grass</td>
<td>279</td>
<td>1,313</td>
<td>4,857</td>
<td>267.91</td>
</tr>
<tr>
<td>Total workers in NTFP</td>
<td></td>
<td>7,144</td>
<td>17,754</td>
<td>148.5</td>
</tr>
<tr>
<td>Wooden goods, treated timber</td>
<td>273-1970</td>
<td>11,709</td>
<td>7,437</td>
<td>-30.5</td>
</tr>
<tr>
<td>272-1987</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufactures of wooden and fixtures</td>
<td>276</td>
<td>10,927</td>
<td>22,599</td>
<td>106.8</td>
</tr>
</tbody>
</table>

Source: Census of India, Economic Tables, Assam 1971, 1991
The pressure on existing forest resources is immense in India. Having only 2.5 percent of the world’s geographic area and 1.85 percent of the world’s forest area, we have 17 percent of the world’s population and 18 percent of live stock population (NFAP, 1999). In Assam there exists immense pressure on forest resources and as such a time-series analysis of its health is necessary. 10 day NDVI composites from the SPOT Vegetation satellites were assessed and a gain-loss assessment was undertaken for the study area and the changes during the growing season months (May to October) during 1998-2009 were determined. These are visualized using a GIS (Fig.6.1).

The forestry sector (including irrigated/rainfed crops) shows a sharply declining trend in terms of NDVI values based on SPOT vegetation satellite data. Only 7 per cent of the area of the Brahmaputra Valley shows a positive trend whereas 89 per cent area shows a decline in greenness of vegetal cover (Table 6.10). These were derived on the basis of analysis of 216 SPOT vegetation images (10 day composites over the 12 year period).
Figure 6.1: Brahmaputra Valley: Changes in NDVI.
Table 6.10
NDVI changes in the Brahmaputra Valley: 1998-2009

<table>
<thead>
<tr>
<th>Category</th>
<th>Pixel Count</th>
<th>Proportion of area</th>
</tr>
</thead>
<tbody>
<tr>
<td>No change</td>
<td>1307</td>
<td>2.11</td>
</tr>
<tr>
<td>Moderately positive</td>
<td>1433</td>
<td>2.31</td>
</tr>
<tr>
<td>Highly positive</td>
<td>4336</td>
<td>6.98</td>
</tr>
<tr>
<td>Highly negative</td>
<td>25280</td>
<td>40.72</td>
</tr>
<tr>
<td>Moderately negative</td>
<td>29725</td>
<td>47.88</td>
</tr>
</tbody>
</table>

In this context, it is imperative to preserve the forest and manage them sustainable so as to ensure secure livelihood of the forest dependent communities as well as conserving our biological diversity. The pressure of population for settlement and grazing, the removal of forest cover for timber and firewood, and the shifting cultivation put together have led to massive depletion of the forest cover. There has been increasing realization that forests provide numerous benefits to mankind including improvement of the quality of environment. Forest provide us goods and services and maintain life support systems like timber, fuel wood, fodder and a wide range of non timber products. Further forest are source of natural habitat for biodiversity, provide means for recreation and opportunity for eco-tourism. Besides that forests also help in watershed development, regulate water regime, conserve soil, and control floods (Sachdeva, 2003) and the Brahmaputra Valley along with the rest of north east India can make gains from forest based carbon credits and from avenues such as avoided deforestation.

Sustainable development implies use of natural resources such that the future generations can attain the same level of well being an enjoyed by the present generation. Thus there is an urgent need to devise ways and means to optimally
utilize forests in the study area, particularly since the gain-loss scenario as determined by NDVI is not encouraging at all.

6.7 Findings:

i) It has been discussed that how small changes can improve the traditional agriculture. Commercialization of agriculture is not the solution of the low yield, hunger and poverty. The problem is not just the lower level of production, but the distribution pattern. Distribution of every resource of agriculture like seeds, implements, water, fertilizers land social services and profit is unequal. Even mountains of food can not solve the problem of poverty and hunger unless it is distributed equally, there is no need to go for commercialization of agriculture and disturb ecological and social balance. It is much better to have slow growth of traditional agriculture. Land is a precious gift of nature; it should be utilized, not destroyed.

ii) Climate policy alone will not solve the climate change problem. Climate outcome will be influenced not only by climate –specific policies but also by the development path chosen. Worlds which is already experiencing the adverse impacts of climate change, can not afford to ‘wait and see’ or follow the historic, unsustainable, carbon-intensive development paths of industrialized countries. Developing countries like India have an outstanding backlog of sustainable
development poverty reduction priorities, into which climate change mitigation and adaptation policies must now be integrated.

**iii)** The hydrological cycle is likely to be altered and the severity of draughts and intensity of floods in various parts of India is likely to increase (Sathaye et al., 2006) Further, a general reduction in the quality of available run-off is predicted.

**iv)** Simulations using dynamic crop models indicate a decrease in yield of crops as temperature increase in different parts of Assam (Rupa Kumar, K, 2005). However this is offset by an increase in CO$_2$ at moderate rise in temperature and at higher warming, negative impact on crop productivity is projected due to reduced crop durations.

**v)** The forestry sector (including irrigated/rainfed crops) shows a sharply declining trend in terms of NDVI values based on SPOT vegetation satellite data. Only 7 per cent of the area of the Brahmaputra Valley shows a positive trend whereas 89 per cent area shows a decline in greenness of vegetal cover based on growing season (May to October) data between 1998 and 2009.

**vi)** Involvement of local people in protection and management of the forest seems to be the only way out for sustainability of forest area in Assam at least as far as meeting needs for fuelwood, fodder and other non-timber forest products are concerned. There is a shift in the approach in the Forest Policy of 1988 with more focus on involvement of people is in the right direction.
vii) The service from the poor villagers in the management and protection of forest cannot be expected unless economic security is provided to them. In most cases they are fully or partially dependent on the forest for their livelihood. There is need to make provisions for other support activities for the people to be fully involved in joint forest management programme (JFM).

eviii) There is the need to think of evolving a cost-effective alternative to fuel wood to the villagers; otherwise they will continue to exploit the forest. The use of kerosene and LPG is minimal in most of the villages due to their low economic status.

ix) Unrestricted encroachment must be stopped in the forest areas of Assam. The rapid population growth in the state has put pressure on the land of Assam. So, the people have encroached the forest areas. The Revenue Department of the state is probably the main protagonist since the department is providing patta (settlement rights) to the settlers in the forest areas.

x) Innovative use of market mechanism may be made to promote sustainable forestry, through long-term lease and penalty for misuse monitored by the stock market.

xi) There is the need to evolve alternatives to timber for meeting household and industrial consumption requirements. The Forest Policy, 1988 states that the long-term solution for meeting the existing gap lies in increasing the productivity of the forests, but to relieve the existing pressure on forests for the demand of railway sleepers, construction industry (particularly in the public sector), furniture
and panelling, mine-pit props, paper and paperboard, etc. substitution of wood needs to be taken recourse to.

xii) On the front of domestic energy, fuelwood needs to be substituted as far as practicable with alternate sources like bio-gas, LPG and solar energy. Nowadays there is an increasing trend to use fabricated steel in lieu of wood, mostly in urban areas of the state. Above all massive plantation is the way out for sustainability of the forest areas of the state.
References:


