

# The Scientific Methods and Modern Approaches to Mitigate the Effect of Climate Change and its Impact on the Livelihood Sustainability

Rajesh Kumar Dubey, Ashish Kumar Dubey, Falguni Tewari

Director, UGC-HRDC, JNVU Jodhpur, Rajasthan, India

CSIR - CSMCRI, Bhavnagar Gujrat, India

Research Assistant, Bio-control Laboratory, PBI, Lucknow, UP., India

**ABSTRACT:** Organic agriculture is the one of the oldest occupation and most modern system of farming affecting every walk of human life starting from food, shelter, raw materials for industries, health medications, clothing etc. As for as the health is concern the food is the best medicine and organic produce is the best food. This indicates that any change in agricultural output will drastically affect the human life in long term. The modern methods of petro-product based chemical agricultural practices and the threats of climate change due to the impact of global warming has sensitized human society and demands an immediate curative/preventive approaches to mitigate the climate change vulnerabilities. The problem is more acute for the families that are directly associated with the agricultural practices for their livelihood all over the world. The reduction in agri-output directly impact their livelihood and thus the social life. In country like India which is basically an agrarian society, with poor infrastructure and irrigation facilities the problem becomes more profound. Apart from this the climate change has produced a huge pressure on all natural resources directly or indirectly with impacts on overall biodiversity of the globe. A combination of various methods traditional as well as the modern techniques can be a possible solution ultimately helping in mitigating the effect of climate change and livelihood sustainability. The scope of the present review is to provide an integrated analysis of methods and modern approaches of organic agri-biotech in relation to mitigate the impact of climate change and promote the livelihood sustainability.

**KEYWORDS:** Climate change, Livelihood sustainability, Organic agri-biotech, Global warming

## I. INTRODUCTION

The Earth is the only habitable planet in our solar system, with a delicate balance, providing the base for the living world to sustain. Ancient Indian scholars regarded Earth as "Mother" since it supports the life forms in the same way as mother cares her child, this highlights the importance of our planet to us. Global rise of temperature due to the impact of green house gases has created an alarming situation for sustainable living. The problem of global warming was first pointed out in the 19th century with the increased concentration of various green house gases such as carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (NO<sub>2</sub>) etc. The interrelation between CO<sub>2</sub> and the global warming was first discovered by French scientist J.B.J. Fourier in the year 1824. The human growth and development activities like fossil fuel utilization, industrialization, deforestation, unsustainable agriculture practices has contributed greatly to emission of green house gases mainly CO<sub>2</sub> to the atmosphere resulting in global rise in temperature. It is found to increase by 0.74 °C since (1906-2005) (IPCC 2007) and is expected to 1.1 to 5.4 °C by 2100 (Herring D., 2012) The current projections has suggested that the global warming could be irreversible over the next several millennia (Solomon S., 2009). As a matter of fact the rise in temperature of globe has resulted in change in climatic conditions and is well recognized internationally.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 1, Januray 2016

The term climate change means that the significant statistical variations observed either in the mean state of climate persisting for an extended period, usually decades, or in its variability (<http://www.who.int/globalchange/climate/summary/en/index13.html>).

The climate change and the petro-chemical based agricultural practices has created a tough situation throughout the world, it can be understood in the terms that the changes in climate is reducing the agri-output whereas the petro-chemical based agricultural practices are harmful for human health as well as the biome, the situation is supplementing the problems. For the sustainable livelihood the methods and techniques potentially reducing the overall impact has to be applied. The utilization of green technologies and the modern organic-agribiotechnology has providing a possible solution. Now the strength of traditional Indian systems of agri-practices of organic farming has been recognized by the modern society. The methods of organic farming relies on the techniques such as crop rotation, green manure, compost, and biological pest control. Both fertilizers and pesticides are used in the organic farming practices but it excludes or strictly limits the use of petro-chemical based manufactured synthetic fertilizers, pesticides, insecticides, and fungicides. The International Federation of Organic agri-biotech Movements (IFOAM) was established in the year 1972 and is an umbrella organization for regulation and legal enforcement of standard organic agriculture. IFOAM defines the overarching goal of organic farming as- "*Organic-agribiotech is a production system that sustains the health of soils, ecosystem and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agri-biotech combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.*" In India the National Centre of Organic Farming, Ghaziabad under Ministry of Agriculture is promoting the organic farming as a facilitator and providing the assistance to organic farmers and the entrepreneurs under the National Programme for Organic Production (NPOP) programme.

## II. REVIEW OF LITERATURE

India is one of the oldest civilizations existing today in the world and the agricultural practices like organic farming has been reported to be in use in India since thousands of years. The great Indian civilization was most prosperous countries in the world before the British ruled. The term organic farming was first coined by Lord North Bourne in his book "Look to the land" in 1939. Sir Albert Howard a British botanist regarded organic agriculture as superior to that of the conventional agricultural practices in his famous book "Agricultural Testament". He is known as the "Father of modern organic farming". Lampkin in 1994 pointed out that the organic farming system is more diverse in terms of enterprise he conducted studies on economics of organic farming in different crops in South and West of England and parts of Scotland and Wales. Various studies were reviewed on the cost and returns of organic farming in different crops in Germany by Padel and Uli in 1994. John (1994) reviewed various field experiments on organic farming in Canada. In USA by various research study were conducted by Anderson in 1994 and it was concluded that the lower yield on organic farms contrasted with conventional farms were balanced by lower production cost. In recent studies Shirsagar (2008) studied the impact of organic farming on the economics of sugarcane cultivation in Maharashtra.

## III. CONCEPT

In modern times a multifaceted approach to mitigate the impact of climate change on the livelihood sustainability of society is a must. The proven technology along with the innovative one should be combined to get a good result. The organic agribiotech techniques along with the clean green technology has a potential to mitigate the climate change by its eco-friendly nature. The green technologies reduces the amount of green house gases being released in the atmosphere ultimately decreasing the entrapment of the amount of infra-red radiations in the environment, whereas the organic agribiotech practices provides an inclusive growth and sustainability platform.

## IV. CLIMATE CHANGE AND ITS IMPACT

### 4.1 Climate change

Today scientist know it clearly that the problem of climate change is caused by the human activities and mainly due to carbon dioxide emission. The CO<sub>2</sub> concentration was found to be about 40% higher in year 2012 than what it was in 19<sup>th</sup> century. The clearest evidence for surface warming comes from the widespread thermometer records in some

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 1, Januray 2016

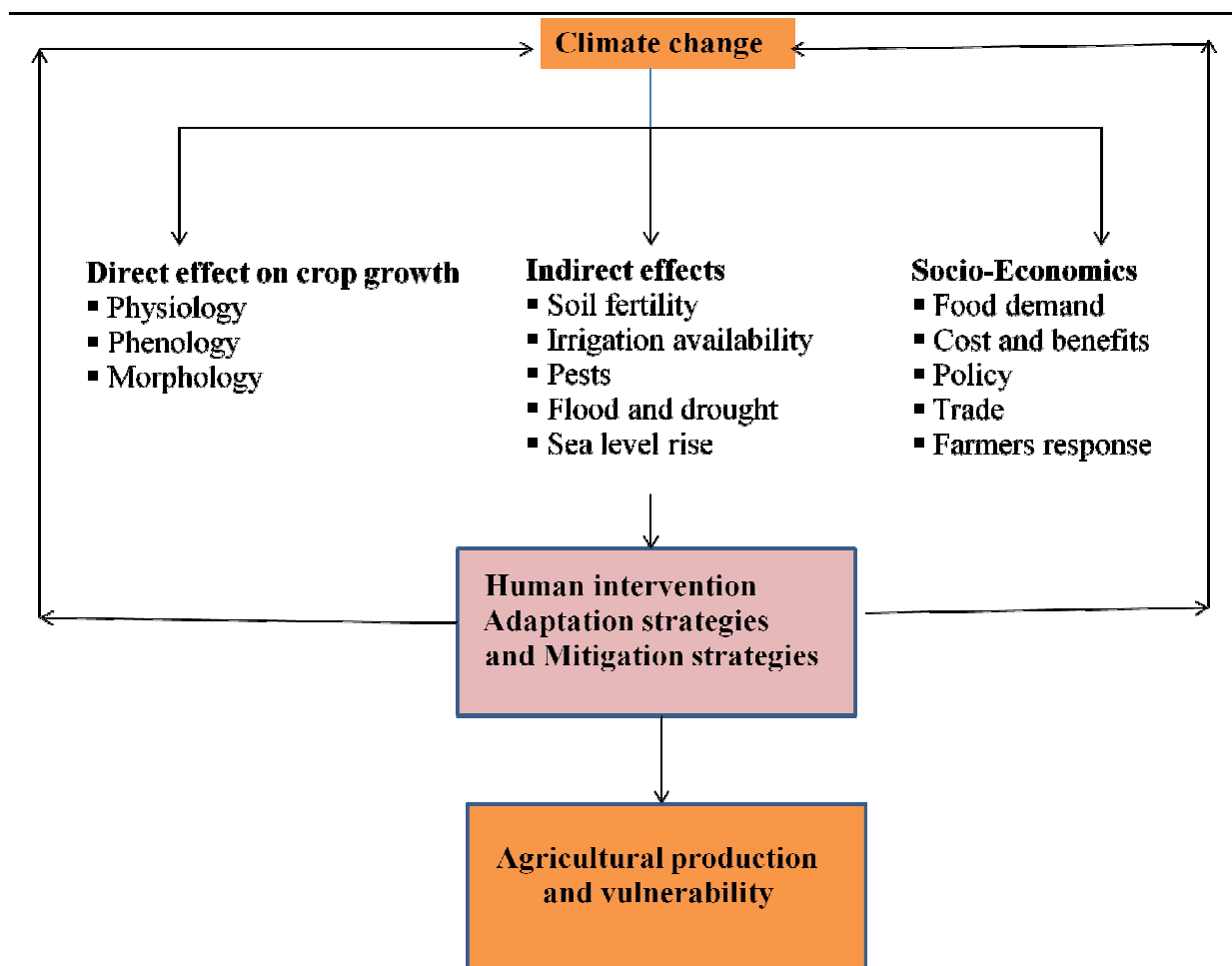
places it extends back to 19th century. It can be said that the scientific evidences pertaining to the global warming and climate change are irrevocable(Piyoosh bhavana).

### 4.2 The overall impact of climate change

The impact of climate change is huge, apart from affecting the overall biodiversity and ecosystem of earth it imposes a major challenge for the sustainable livelihood of human beings. The climate change is known to impact the biodiversity-from ecosystem to species level, the most obvious examples are that of flooding, rise of sea level, variation in ecosystem boundaries, some expanded in area while others diminished in size (Climate change- Biodiversity and Livelihood Impacts, Hannah Reid, 2<sup>nd</sup> Edition ).The study indicates that for many species the climate change imposes a greater threat to their survival than that caused by destruction of their natural habitats (Thomas C. D. et.al, 2004).

### 4.3. Impact of climate change on agriculture produce : quality as well as quantity

The climate change directly impacts to the world's food supply by disturbing the conditions required for growth and development of crops throughout the globe. The differences in raining pattern, high temperature, flooding, conditions of drought etc. are reducing both the quantity as well as the quality of agricultural produce, ultimately making it difficult to feed the growing population and the livelihood sustainability.



**Figure 1** Assessment of vulnerability of Agriculture to climate change (Source: Keysheet 6 Climate change impacts on agriculture in India).

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 1, Januray 2016

It is obvious from the above figure that the impact of climate change on agriculture is in a multifaceted way affecting everyone including the farmers. The unsustainable agricultural practices has arose the problem of climate change further, this is due to the high emission of green house gases such as carbon dioxide, apart from this such agri-practices are harming the human health in many ways. Now the modern society recognizes the impact of synthetic fertilizer and chemical based agriculture on human health and the environment. With the advancement in knowledge and the awareness now everyone demands healthy organic produce, so once again the organic farming has become choice of society. The power of organic farming can be increased by combining the traditional practices with that of modern knowledge, thus practicing the organic agri-biotech practices and the biodynamic farming, along with the traditional organic practices.

**4.4 Impact on livelihood sustainability**-The climate change has imposed a threat to the livelihood sustainability of the society by many ways such as, it impacted the food availability, leading to a state of malnutrition to poor, decrease in the overall income of family causing a low standard social life, the health of family, high cost of operation for the farmers and so on. The climate change has produced a state of shock for the poor and vulnerable of the society. Thus the livelihood sustainability is one of the most important issue that must be addressed with proper method and understanding.

The term livelihood sustainability has a broad meaning. The most accepted definition for livelihood sustainability is that " *A livelihood comprise the capabilities, assets (including both material and social) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base*" (Carney, 1998).

## V. LIVELIHOOD FRIENDLY TECHNOLOGIES

In the present scenario of climate change, a shift in technology utilization is one of the most important criteria to mitigate the impact of the changing climate. There are various clean, green and organic agribiotech practices that can have a profound impact on reduction of green house gases at vast level, ultimately diminishing the impact of climate change as a whole. Indian subcontinent is endowed with unique sustainable traditional practices that are beneficial for both the human society as well as the environment. The technologies supporting the sustainable growth and development of the society along with providing the livelihood opportunities without harming the natural resources can be termed as the livelihood friendly technologies.

### 5.1. Modern organic agribiotech technologies and biodynamic farming

The organic farming practices not only provides healthy nutritious food but also help in mitigation of climate change by decreasing carbon emission as well as carbon sequestration. The organic agri-practices along with the scientifically developed organic agribiotech practices are beneficial for both the health of environment and the society. The activated organic farming technique is known as the biodynamic farming. The organic farming practices has a long term benefit. Organic farming has been found to restore the soil health that has been destroyed by the ill-effect of chemical based farming methods. Organic agriculture avoids nutrient exploitation and increases soil organic matter content. According to a recent survey of organic and conventional farmers in Georgia, North Carolina, South Carolina, Alabama and Mississippi organic farming requires over 15% more labour than conventional farming and therefore provides more rural job opportunities (Pimental et al, 2005). Carbon sequestration is an important issue to combat the impact of climate change worldwide. It is found that the soil carbon sequestration is cost effective and may contribute to about 89% of total carbon mitigation (Smith et al, 2007). A Global Carbon Gap Map prepared FAO (2008) identifies areas of high carbon sequestration potentials. For India almost all major climatic zones and wide range of land-use system has vast opportunities of soil carbon sequestration.

Some of the major benefits of practices of organic agribiotech and the organic farming practices for higher ecological resilience to extreme climate events are outlined below.

1. It restores the soil organic matter content along with reducing the soil erosion, and improves physical soil structure.
2. Organic soil have better water holding capacity, thus the organic production is much more resistant to the climate extreme conditions such as drought and flood.
3. It is more energy efficient than conventional methods of agriculture practices. The FAO report (2002), found that the organic farming performs better than conventional agriculture, on a per hectare scale both with respect

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 1, January 2016

- to the direct energy consumption (i.e. fuel and oil) and indirect consumption (synthetic fertilizers, and pesticides), having high efficiency of energy use.
4. The Greenhouse gas emission were calculated to be 48-66% lower per hectare in organic farming systems in Europe.
  5. Organic production lowers risks of yield failure, stabilizes returns and hence enhances food security of small farmer's family
  6. The increasingly higher demand for organic produce is there in modern time, this is mainly due to the goodness of organic produce. It can be seen as follows
    - a) The organic produce are of better quality.
    - b) The organic produce have better taste and freshness.
    - c) They are far more nutritious, found to contain more antioxidants up to 40% more. The organic produce have higher levels of beneficial minerals like iron and zinc. A study in the *Journal of Agricultural Food Chemistry* (2003), found that the organic foods are better for fighting cancer.
    - d) It was found that the milk produced from organically fed cattle were more healthy, having 90% more antioxidants.

Thus the practices of organic farming and the organic agri-biotech provides a holistic approach, to combat the impact of climate change, and provides a platform of inclusive growth for sustainable livelihood of the society.

## 5.2. The eco-friendly clean technologies

The clean technologies provide a tool of minimizing the emission of green house gases to the environment and thus reducing the global warming and climate change. One good example is the Brazilian ethanol programme, which was launched in the year 1975 is the largest commercial application of biomass for energy production and use. It has reduced the city air pollution and it is estimated to decreased the 6-10 million tons of carbon emissions per year since 1980.(Lèbre La Rovere, E and A Ribeiro Romeiro, 2003).

Cleaner production has been defined as "*the continuous application of an integrated preventive environmental strategy to processes and products to reduce risks to humans and environment*" (Nowosielski R., Babilas R., Pilarczyk W., 2006). For the production process to be cleaner it includes the conservation of raw materials and energy, elimination of toxic raw materials and reduction in the quantity and toxicity of all wastes (Verspeek F., 1996, Mieras M.C.M. van Dam, Meester M.A.M., Sloep P.B., 1995).

## 5.3. The green technology

The green technologies are important in that it involves use of nontoxic materials and methods of operations which is beneficial for both the environment and the human society, for example use of biodegradable materials, natural dyes and colours, methods of productions with less harmful by-products. They reduces the green house gas emission by reducing the steps of operation.

The term green technology encompasses a broad perspective and refers to the environmental friendly solutions. Green technology in that respect can be used as environmental healing technology that reduces environmental damages created by the products and technology for peoples conveniences. Green technology promises to augment farm profitability, at the same time reducing the environmental degradation and conserving natural resources (<http://www.ers.usda.gov/publications/aib752/aib752d.pdf>).

The risks associated with the dirty technologies such as petroleum based products are alarmingly rising (United Nations-Nations UNIES Economic and social commission for Asia and Pacific: A feasibility study on the application of green technology for sustainable agricultural development: Assessing the policy impact in selected member countries of ESCAP-APCAEM). The modern society has recognized the potential benefits and hence is shifting towards the greener technologies for both production and utilization.

## 5.4 The green growth and livelihood sustainability

The present patterns of growth are not only unsustainable but it is deeply inefficient also, as a result they stand in the way of sustainable development and its objectives of social, environmental and the economic sustainability (Inclusive green growth the pathway to sustainable development, The World Bank, 2012). That is why we have to follow the path of green growth in order to mitigate the impact of climate change along with the health of the society by stopping or reducing the use of harmful synthetic chemicals. The harmful synthetic chemicals becomes part of the food chain ultimately destructing the health and environment both. One good example is use of DDT as insecticide, that has been banned in most of the countries.

For the livelihood sustainability the technologies and methods for green growth is an imperative, leading to the sustainable development through green economy. The term "Green Economy" was first coined in a government report

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 1, Januray 2016

of United Kingdom by leading environmental economists, entitled as "Blueprint for a Green Economy" (Pearce, Markandya, and Barbier, 1989). The United Nations Environment Programme (UNEP) has defined the green economy as "One that results in improved human well-being and social equity, while significantly reducing environmental risk and ecological scarcities. It is low carbon , resource efficient and socially inclusive"(UNEP, 2011) (United Nations: A guide to the green economy).

## VI. SUSTAINABILITY

Today the human society is facing many problems that are mainly anthropogenic in nature one of which is the problem of global warming and climate change. Due to lack of vision and responsibility the sustainable growth has been compromised. Now the society recognizes the depth of problem. The approaches for sustainable growth and development is a must. The sustainability can be referred to that the capability to absorb the stress or shock and reverse back on the path of growth and development without undermining the natural resource base. The practices of organic farming and organic agribiotechnology provides a sustainable approach by incorporating various streams together, as depicted in the following diagram.

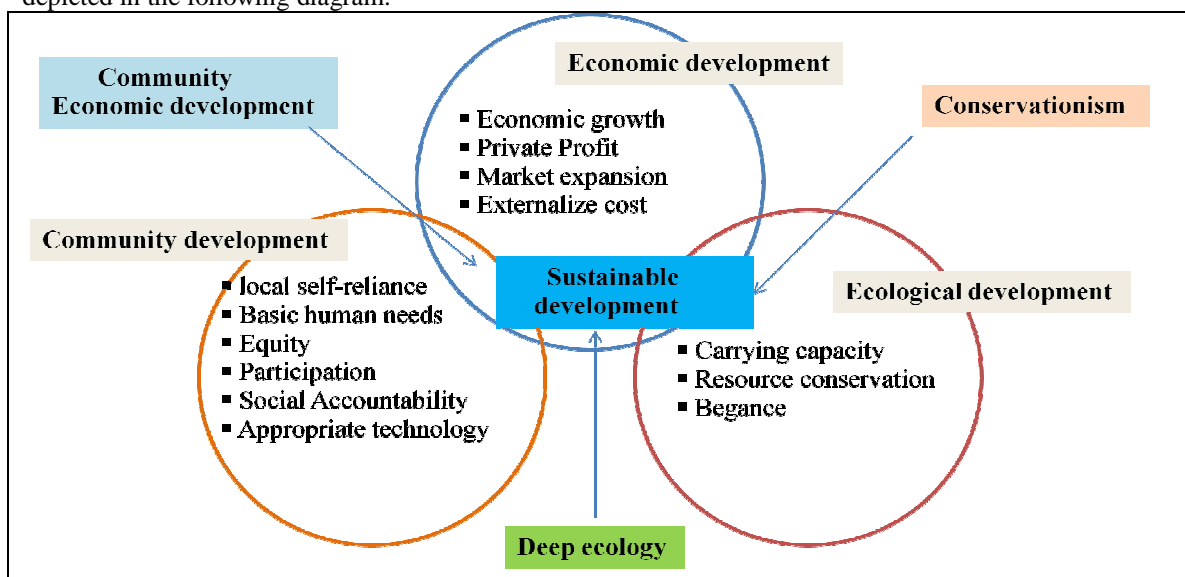


Figure 2: Sustainable Agriculture Development (Source: Green Growth Eco-livelihood & Sustainability).

The sustainable developments are an overarching goal of international community since the UN Conference on environment and development in 1992. The conference called upon the national strategies for sustainable development incorporating the policy measures that were outlined in the Rio declaration and Agenda 21 (United Nations: A guide to the green economy).

## VII. CONCLUSION

The unsustainable practices for growth and development of the society has resulted in the global warming because of increased emission of green house gases, such as carbon dioxide, methane, nitrous oxide etc. leading to the problems of climate change. The impact of climate change is huge with effects both on the natural biodiversity as well as the society at large. In order to mitigate the impact of climate change, an imperative shift in technology utilization is required. The practices of modern organic agri-biotech, clean and green technologies along with the traditional proven knowledge has a potential to diminish the impacts of climate change along with enhancing the human health by providing nutritious, healthy agricultural produce. Ultimately benefitting the society by uplifting the poor and providing a platform for the livelihood sustainability.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 1, January 2016

## ACKNOWLEDGEMENT

The author is thankful to the Director UGC-HRDC Jai Narayan Vyas University, Jodhpur Rajasthan, and acknowledges him for providing gracious guidance and support throughout the work.

## REFERENCES

1. Allison I, Bindoff NL, Bindschadler RA, Cox PM, NobletN de, England MH, Francis JE, Gruber N, Haywood AM, Karoly DJ, Kaser G, Quéré C Le, Lenton TM, Mann ME, McNeil BI, Pitman AJ, Rahmstorf S, Rignot E, Schellnhuber HJ, Schneider SH, Sherwood SC, Somerville RCJ, Steffen K, Steig EJ, Visbeck M, Weaver AJ, The Copenhagen Diagnosis. Updating the World on the Latest Climate Science. The University of New South Wales Climate Change Research Centre (CCRC), Sydney, Australia (2009). 60pp.
2. Climate change- Biodiversity and Livelihood Impacts, Hannah Reid, 2<sup>nd</sup> Edition
3. Dubey Rajesh Kumar, Biodynamic Organic Agriculture: A sustainable export friendly agriculture technology consultation workshop on organic food: Production, Quality assurance and Marketing India (2007).
4. Dubey Rajesh Kumar, Green Growth Eco-Livelihood & Sustainability (2016), (First Edition).
5. FAO(2001) Government role of promotion of Green Agriculture(available at [www.fao.org/DOCREP/ARTICLE/AGRIPPA658\\_en06.htm](http://www.fao.org/DOCREP/ARTICLE/AGRIPPA658_en06.htm))
6. Herring D., Climate watch magazine global temperature predictions, NOAA climate portal (2012).
7. <http://www.ers.usda.gov/publications/aib752/aib752d.pdf>. Inclusive green growth the pathway to sustainable development, The World Bank, (2012).
8. <http://www.who.int/globalchange/climate/summary/en/index13.html>
9. IFOAM basic standards for organic production and processing (2002). (Available at <http://www.ifoam.org>)
10. Lampkin NH., "Economics of organic farming in Britain" in The Economics of organic farming - An International Perspective (eds. by Lampkin NH and Padel S., CAB International Publishers)
11. Lèbre La Rovere, E and A Ribeiro Romeiro, The development and climate phase I: Country study Brasil. Centro Clima COPPE, Federal University of Rio de Janeiro, Brazil. (2003).
12. Mieras M.C.M. van Dam, Meester M.A.M., Sloep P.B., Sustainability, cleaner production and international learning resource, Journal of Cleaner Production 3 (1995), 3-8.
13. Nowosielski R., Babilas R., Pilarczyk W., Sustainable technology as a basis of cleaner production, (2006).
14. Organic agriculture and poverty reduction in Asia: China and India Focus (2005b). Rome: IFAD
15. Pimentel D., Hepperly P., Hanson J, Douds D., Seidel R., Environmental, Energetic and economic comparisons of organic and conventional farming systems, (2005). Bio-science, 55, PP 573-82.
16. Rautela Piyoosh, and Karki Bhavna, "Impact of Climate Change on Life and Livelihood of Indigenous People of Higher Himalaya in Uttarakhand, India." American Journal of Environmental Protection, vol. 3, no. 4 (2015): 112-124. doi: 10.12691/env-3-4-2.
17. Smith P., Martino D., Cai Z, Gwary, D., Janzen H., Kumar P., McCarl B., Ogle S, O'Mara F., Rice, C, Scholes B., Sirotenko, O, Howden M., McAllister T., Pan G, Romaninkov V., Schneider U., Towprayoon, S. 2007. Policy and technological constant to implementaion of greenhouse gas mitigation options in agriculture. Agric.Ecosyst.Environ., 118 pp 6-28
18. Solomon S., "irreversible climate change due to the carbon dioxide emission" Proceedings of the National Academy of Sciences, the United States of America(PNAS) US National Academy of Sciences, (2009) 106 (6) 1704 Bibcode:2009 PNAS.106.1704
19. The adoption of organic agriculture among small farmers in Latin America and the Caribbean: Thematic Evaluation. Rome: IFAD (2003).
20. Thomas C. D. et.al. 'Extinction risk from climate change'. Nature, (2004), 427: 145-148
21. United Nations: A guide to the green economy
22. United Nations-Nations UNIES Economic and social commission for Asia and Pacific: A feasibility study on the application of green technology for sustainable agricultural development: Assessing the policy impact in selected member countries of ESCAP-APCAEM.
23. Varspeek F., capacity building for transfer of cleaner production practices and technologies. Cleaner production in Poland 2, (1996), 24-28.
24. World food Security: The challenges of climate change of climate change and bio energy. ([http://www.faopacific.ws/Portals/167/publication/current%20updates/WFD2008\\_globalreport.pdf](http://www.faopacific.ws/Portals/167/publication/current%20updates/WFD2008_globalreport.pdf))