



Manoeuvring Science and Law to improve Agriculture when “Climate Changes”

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Abstract:

This essay provides an analysis on how Science and Law can reshape the outlook of Agriculture focusing the recent developments of the farmer's perception and adaptation of climate change affecting their livelihood which remains to be the most formidable challenge facing humanity. It is concerned with both ecological and economic risk. As the basis of comprehending anthropogenic activities, public opinion has provided a new perspective to verify the farmer's adaptation mechanism and processes about climate change. The essay glances through alternative policies that one could implement and educate oneself and others about the changing climate and its effect on the agriculture which is a vital source of feeding the population. The reference from this essay would help the farmers to plan effective adaptation strategies for a eco-friendly livelihood, both at the local and international levels.

Keywords: Farmer's Livelihood Challenges, Climate Change, Sustainable Agriculture, Strategies & Legal Policies, Environmental Philosophy, Ecology Refuges

Introduction

Science, Law and Agriculture

Science is knowledge. Science is the synergized human endeavor to understand, or to understand finer, the history of the natural world and how the natural works, with observable physical evidence as the basis of understanding.

Law is the set of rules and regulations enforced by the controlled authority to watch over the society and shield them from any disruption.

Agriculture is the science, art or occupation related with growing and raising of crops through tilling of soil with skilled labour and efficient technology, feeding, breeding and raising live stock for the purpose of consumption which sustains and enhances human life.

Analysing all the three aspects Science, Law and Agriculture, the common ground among them is the focus on the development of human kind. If science, law and agriculture are brought together, they can work marvelously on the betterment of the world.

Environment a focus of attention

“Each one of us is a cause of global warming, but each one of us can make choices to bring our individual carbon emissions to zero. The solutions are in our hands, we just have to have the determination to make it happen”

-Al Gore, Former Vice President of the United States & Environmentalist

Environment is comprehensive name of cosmos. It is a specific habitat, location, or site that is suitable or adequate for given purposes offoraging, resting, hunting, breeding, nesting, grooming for the



livelihood and survival of the human beings. This environment bounds the influences of all living species, climate, weather and natural resources that affect the human survival.

World today is confronted by a host of problems and challenges such as life-dispelling, life-eclipsing, life-depressing and life-teasing processes that led to socio-economic collapse and on the other hand socio-economic progress and social happiness can be achieved with life-embracing, life-enhancing, life-supporting and life-sustaining processes going on in an ecosystem that are linked with our very own thoughts and ideas on our own sustainability.

Climate change occurs when the long term weather patterns are altered through anthropogenic activities. Global warming is one measure of climate change and is a rise in the average global temperature. The population today has released so much of carbon dioxide and other greenhouse gasses that our planet's atmosphere is a thick, heat trapping blanket which has resulted in the climate change and threat to our very own existence.

Livelihood challenges faced by the farmers by the virtue of climate change

Given the current estimation of the human population, agriculture is a vital source of the livelihood. Most of the farmers in rural are below par due to their low purchasing power and large household to support.

It is certain that agriculture provides us with the food we all eat every day. But do we know how those agricultural practices impact global warming? Agriculture and climate change are inextricably linked, not

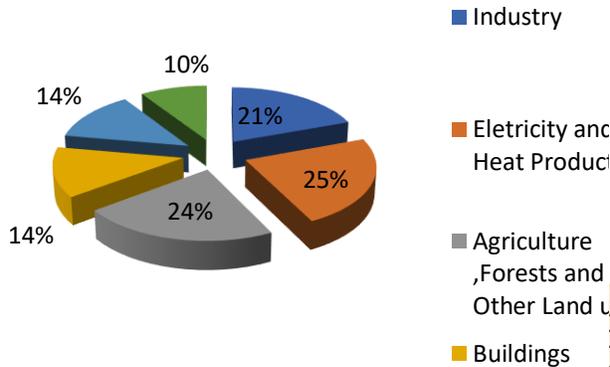
only does climate change affect agricultural crop production, but agriculture is one of the sources of several greenhouse gasses.

Agriculture dominates the planet, yet it has certain environmental costs that aren't sustainable, especially as the food demand rises due to the population explosion. This poses a fundamental challenge to the natural environment, which requires access to many of the same resources as the agricultural producers do and therefore environment is harmed by agriculture's external impacts such as climate change, deforestation, genetic engineering, soil degradation, pollutants, irrigation projects and wastes.

It is not agriculture that has affected the change in climate to the greater extent, but it's also the Multi National Companies (MNC's) lack of corporate social responsibility and the lack of regulation and implementation of better policies on the part of sovereign authorities and other anthropogenic activities (habits such as dumping of non-biodegradable wastes, smoking, burning of rubbers, fossil fuels and so on) that has depleted the natural resources and has added to the climate change which in fact has affected the agriculture on a greater scale.



Factors Affecting Environment due to Climate Change



Source: IPCC (2014); based on global emissions from 2010.

As per the global studies, unseasonal rain and volatile weather have affected Indian farmers, agriculture, economy, and politics, is no more an anomaly. According to the Former Union Agriculture Minister Sompal Shastri, “Around 62% of India’s people depend on agriculture. Until the problems of farmers are addressed, the economy will not boom.” Shastri said one of the biggest blows to farmers in recent times was unpredictable rainfall and other weather events.

Over 58% of the rural households depend on agriculture as their principal means of livelihood. Agriculture is one of the largest contributors to the Gross Domestic Product (GDP). India is one of the largest producer, consumer and exporter of the agricultural food products. India's fruit production has grown faster than vegetables, making it the second largest fruit producer in the world. India's horticulture output is estimated to be

287.3 million tons (MT) in 2016-17 after the first advance estimate. It ranks third in farm and agriculture outputs. Agricultural export constitutes 10 per cent of the country’s exports and is the fourth-largest exported principal commodity¹.

As per the report of 2012 The Third Assessment Report (TAR), 270 million i.e., 22% of the population of India is below its official poverty limit. The Third Assessment Report(TAR) of the intergovernmental panel on climate change (IPCC) reaffirms that the climate is changing in ways that cannot be accounted for by natural variability and that ‘global warming’ is happening².

Climate change which has emerged as one of the world’s biggest security threats, given that the competition for local resources and risks to food and livelihoods caused by extreme weather trigger migration and conflicts has given rise to the problem of “Ecology Refugees”³

The problem of being an ecology refugee may arise when the farmers or the poor have access to fewer financial and technical resources, poverty is closely related to vulnerability to climate change. The farmers in India are heavily dependent on climate-sensitive sectors like agriculture and forestry. This is accurate for a developing country like India where agriculture remains the major occupation of the economy, contributing nearly 27% of the total Gross

¹ India in Business Ministry of External affairs, Government of India, Economic Diplomacy Division, Agriculture Sector, February 2017
² The Third Assessment Report (TAR), 2012
³ State of Environment Report (MoEF), Government of India, 2009- Executive Summary.



Domestic Product (GDP) and employing nearly two-thirds of the country's population. Agriculture exports account for 13-18% of the total annual exports of the country. However, given that 62% of the cropped area is still dependent on rainfall, Indian agriculture continues to be fundamentally dependent on the weather.

Climate change will, in many parts of the country, adversely affect socio-economic sectors, including water resources, agriculture, forestry, fisheries and human settlements, ecological systems and human health, especially in developing country like India due to their vulnerability. Since 2009, many regions of India received scanty rainfall and faced severe draughts. In the year 2013, hailstorms and unseasonal rains destroyed large yields of rabi crop. The farmers again suffered with the freak weather events in the year 2014-2015. Most farmers in the region of Central India's Bundelkhand, who solely depend upon agriculture alone and hence grew only one crop a year suffered from inclement weather. Around fourty farmers committed suicide or plunged to their death from the stress related issues arising from the inexplicable change in monsoon in the state of Madhya Pradesh. In accordance to the figures stated by the Madhya Pradesh government, over 570,000 hectares (1.4 million acres) of rabi crops were damaged, the state was among the worst hit in the year 2015⁴.

Since agriculture in India is completely dependent on the climate therefore climate

change has a strong impact on the economy of the agriculture, including changes in the farm profitability, prices, supply, demand and trade. The magnitude and geographical distribution of such climate induced changes that may affect our ability to expand the food production as required to feed the populace.

Agriculture is sensitive to short-term changes in weather and to seasonal, annual and long term variations in climate. Hence the burgeoning population, along with human induced climate change and environmental problems are increasingly proving to be a limiting factor for enhancing farm productivity and ensuring food security for the poor.

The productivity of agriculture is negatively influenced by the climate change in two different ways: first, directly, due to variations in the temperature, precipitation and Carbon dioxide levels and second, indirectly, through changes in soil, distribution and frequency of infestation by pests, insects, diseases or weeds. Acute water shortage conditions and thermal stress together could gravely affect wheat and, more severely, rice productivity in India even under the positive effects of elevated Carbon dioxide in the future. At the same time there is an increased prospect of climate extremes, such as the timing of onset of monsoon and intensities and frequencies of droughts and floods.

A drought is a natural impact due to the prolonged period of dry weather especially an extended one i.e., injurious to crops and it results in prolonged shortages in its water supply, surface water or ground water. A

⁴ Centre for Science and Environment (CSE) Report, 2015



drought can last for months or years and it can have considerable impact on the agriculture of the affected area and harm the livelihood of the farmers.

Case study:

Six taluks of Karnataka have been declared drought-affected. With the district suffering drought for the second straight year, the zilla panchayat has identified 1,634 human habitats as vulnerable to drinking water crisis during the summer and 352 human habitats as critically-problematic areas. The district received 1,410 mm of rain in 2016-2017 against the average of 2,230 mm.

The zilla panchayat has taken up 765 new drinking water works in vulnerable places that includes drilling new borewells and laying distribution pipelines of which 633 works have been already completed⁵. These new projects have enhanced the conditions of the framers and the other habitants.

Drought in severe cases leads to deteriorate soil conditions which will suppress both root growth and causes the decomposition of organic matter and will increase the vulnerability to erosion which eventually will pave way to “Desertification”. Damage to the environment by human activities is probably one of the reasons for desertification⁶. Increased evaporation from the soil and accelerated transpiration from the plants themselves will cause soil moisture stress. This is merely due to climate change and its impact on the soil

would be catastrophic which in turn would deplete the crop yield.

Case study:

Kanem (an empire that was located in the present countries of Chad, Nigeria and Libya) covers 115,000 km² and has a population of 280,000 people. The natural environments of Kanem has suffered degradation in the past few decades, due to the prolonged drought periods that have ruthlessly affected the country since the 1960s, and continue to affect it. Currently it threatens the livelihood of 14% of the population of the Chad.

But it has been largely due to the government mobilization and then assistance of NGOs that a number of villages and certain *wadis* have been saved from being engulfed by sand. The successful actions implemented by the Kanem Agro-Forestry Pastoral Development Project can be used as a model for future interventions against

drought.

The strategy used to fight dusterification in Kanem hinges on the following four imperatives:

- The protection of threatened sights and the regeneration of ecological resources.
- The improvement of production systems.
- The reinforcement of institutional capacity.
- The development of national scheme of land plant.

It is within the framework of this combat strategy that the Agro-Forestry Pastoral Development Project in operation in Kanem from 1993-1998 contributed to saving the

⁵ The Hindu, Karnataka, February 24th, 2017

⁶ Macmillan Encyclopedia of the Environment, General Ed., Stephan R. Kellert, Yale University, New York.



environment and its habitants⁷. Thus for this reason the regions of Kanem were successful in reversing desertification.

The occupation of agriculture is least acknowledged and therefore whatever efforts put by the government in support of the farmers is not feasible as the efforts are not communicated to the farmers in a right manner. Hence the non-recognition of the social status of the farmers is one of the demotivating factors.

Since India is the largest producer, consumer and exporter of agricultural produce it is the duty of the government to address the issues related to the field of agriculture and protect the interests of the farmers and work for their wellbeing.

Strategies for combating the challenges:

‘A sustainable Agriculture is a system of agriculture that is committed to maintain and preserve the agriculture base of soil, water , and atmosphere ensuring future generations) the capacity to feed themselves with an adequate supply of safe and wholesome food’

-Gracet, 1990

Sustainable development of agriculture refers to a wide range of strategies for addressing the issues effecting the agriculture. Prima facie, in order to mitigate and reduce the impacts of climate change, the first priority must be a swift and

significant reduction in Green House Gas (GHG) emissions. Conversion of more land to organic farming or conventional mixed farming systems can assist in the reduction of the usage of inorganic nitrogen fertilizers. The alternative method would be by implementing judicious applications of fertilizer based on “Nitrogen Budgets”. Biodiversity and water quality will also eventually be benefited. In accordance to the World Agriculture Report, International Assesment of Agricultural Knowledge, Science and Technology for Development (IAASTD), both the traditional and local knowledge network and innovative technologies enhance the capacity to respond to environmental stresses. “Sustainable agricultural practices are part of the solution to current environmental change”, resolves IAASTD⁸.

Efficient strategies to improve the strength of the agriculture to meet its diverse demands and varied pressures:

- The population dependent on the agriculture must undergo improvised training and specialized education.
- Standard of living of the agriculture dependents must be improved through provisions by facilitating better infrastructure like transportation, distribution and market needs.
- Research on new variety development (Credible alternative/Renewable energy

⁷Edited by G. Ali Heshmati & Victor R. Squires, Combating Desertification in Asia, Africa and the Middle East: Proven practices(2013)

⁸ Sustainable Agriculture: A part of solution to current environment change, Kavita Bhatnagar and Shiwani Bhatnagar, IAASTD.2008. International Assessment of Agricultural Knowledge, Science and Technology for Development.



sources: solar energy, wind energy, tide energy, green building, carbon credit, biomass, hydropower, geothermal) must be given prime importance.

- Insuring of crops would ensure protection to the farmer interest during unfortunate natural calamities and uncertainties. Few of the schemes introduced by the government of India are: Pradhan Mantri Fasal Bima Yojana, Comprehensive Crop Insurance Scheme (CCIS), Experimental Crop Insurance, Farm Insurance Scheme and National Insurance Scheme (NAIS).

- Using of cooperatives to spread awareness:

Cooperative membership has a high impact compared to other socio-economic factors. Farmer's cooperatives should be expanded for better diffusion and for intensifying the innovations with regard to the conservation of environment and development of sustainable agriculture.

- New avenues in irrigation:

Micro Irrigation system should be adopted so that there is efficient and judicious use of scarce water resources. A study was conducted by the National Mission for Sustainable Agriculture on micro irrigation in 64 districts of 13 states (Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Haryana, Karnataka, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Sikkim, Uttar Pradesh and Uttarakhand), revealed that there were significant reductions in the use of water and fertiliser but the yield of crops increased up to 45% in wheat, 20% in gram and 40% in soybean. However, high initial costs deter farmers to adopt this technology. While big

farmers can easily avail this technology, the government should consider giving subsidies to small farmers to boost the adoption of this technology⁹.

- Promotion of sustainable farmers by organizing trekking events or educational projects to the farmers to operate both as an awareness raiser and a fundraiser. The farmers could be sent to the significant location and made to meet other farmers to educate and analyse their pertaining issues and its solutions and raise their own awareness. This way it could influence and support more sustainable farmers and farming practices. Since agriculture is at the behest of the weather, the farmers are facing new challenges with the changing climate driving floods, droughts and fires. Therefore sustainable farming offers these deprived farmers a positive future. A step forward sustainable farming practices or methodology not just cultivates amazing, healthy, clean food, it also directs and benefits the farmers towards a more sustainable and resilient environment or business.

- Approach of Carbon Sequestration:

Carbon Farming: it is a technique of cultivation that takes carbon dioxide out of the atmosphere which causes global warming and converts it into carbon-based compounds in the soil that aid plant growth. It has long been touted as a way to enlist farmers in the fight against climate change. The growing market for carbon sequestration could enable the farmers to

⁹ National Mission on Micro Irrigation Impact study prepared for the Government of India, 2015



profit from such good deeds. If the farmers resort to these techniques, then they will be paid by the polluting corporations which purchase the “carbon credits” to offset their carbon emissions.

- One of the efficient methods of sustainable development is through “green buildings”. Green building is both the construction and the usage of eco-friendly processes that are environmentally responsible and resource-efficient throughout the lifecycle of a building. It efficiently utilizes energy, water and other resources. It protects the occupants' health and reduces waste, pollution and environmental degradation. The green building architects seek out environmentally responsible supplies for all of the materials that they use in the construction process which facilitates natural ventilation, natural lighting and more greener farms. Construction of green buildings would facilitate the utilization of given land and reduce the emission of carbon dioxide into the atmosphere. It makes it simpler for the farmers to monitor the growing of the crops.
- **Reversing desertification is an expensive procedure for the developing countries. Hence desertification can be avoided by turning to alternative livelihoods that do not depend on traditional land uses, are less demanding on local land and natural resource use, yet provide sustainable income.** Such livelihoods include dry land aquaculture or production of fish, crustaceans and industrial compounds produced by microalgae, greenhouse agriculture, and tourism-related activities. They generate

relatively high income per land and water unit in some places.

Regulations that government can implement to help farmers (Successes associated with different policy approaches)

- 1) Strict regulations, such as limits on pesticide use or abstracting water, which can be enforced through penalties.
- 2) Integrated Pest Management (IPM): It is a sustainable method to manage pests with the combination of biological, cultural, physical and chemical tools in a manner that minimizes the economic, health and environmental risks.
- 3) Conditions are to be placed in such a way that it encourages the farmers through the provisions of financial support and to carry on new and ecofriendly farming methods.
- 4) Community-based approaches, which support farmers and local stakeholders to work collectively in addressing environmental impacts.
- 5) Conservation and Protection of Biodiversity by optimizing the use of natural resources.
- 6) Creating public awareness about the benefits and implications of environment.
- 7) Prioritizing environment protection and developing eco-friendly technological processes by using biofertilisers or eco-friendly fertilizers.



- 7) Development of waste land by adopting afforestation projects.
- 8) Development of suitable biotechnology to clean hazardous wastes in the environment.
- 9) Choices of suitable techniques to treat the pollutants before their discharge into environment.
- 10) The Maharashtra government has decided to provide an accident policy insurance cover to 1.35 crore farmers in the state wherein their kin will be entitled to an amount of Rs 2 lakhs. The policy will safeguard the farmers against death or accident. This policy has to be adopted all over the country to secure the lives of farmers.
- 11) Policy must be formulated by the Government of India to promote environmental education amongst farmer's children regarding new farming technologies as well the impact of the farming methods from the past. These children could positively make a difference through environmental education and help their illiterate parents whose occupation is agriculture. Curriculum or the course work must contain chapters and practical assessment on these aspects which would benefit the children and the farmers to adapt to the changing environment and take initiatives to protect themselves from the loss of livelihood.
- 12) The government can also implement such policies where in the farmers are motivated to accept one or more of these approaches where they incur small socioeconomic costs relative to the benefits that they receive from achieving environmental objective.
- 13) The government of India has imposed Clean Environment Cess which is a kind of carbon tax and is levied in India as a duty of Excise under section 83 (3) of the Finance Act, 2010 on Coal, Lignite and Peat (goods specified in the Tenth Schedule to the Finance Act, 2010) in order to finance and promote clean environment initiatives, funding research in this area of clean environment or for any such related purposes regarding environment assessment which could benefit the climate change in a good way.
- Agriculture is an anthropocentric approach, no soul can live without food therefore agriculture has the potential to make the earth greener and its judicious development can conserve the natural resources and reduce the carbon dioxide level in the atmosphere. Therefore the policies and practices which regulates the use of the inputs and conserve nature must be encouraged.
- Conclusion**
In conclusion, all the citizens of earth need to join in and try to cease global warming and other repercussions on climate change that effect the livelihood of people. If the earth's temperatures continue to intensify in the future, living things would become extinct due to the high-reaching temperatures. Reminiscing the words of Abraham Lincoln, "We will be remembered in spite of ourselves. The fiery trial through which we pass will light us down, in honour or dishonour, to the last generation...we shall nobly save, or meanly lose, the last best hope of earth." This our aspiration now- we are the last faith of Earth. We should foster it. Or we - and all living things we



cherish – are history. The harmony between the nature and human beings should be nurtured. Science along with Law can help resolve these intricacies and can be made valuable to agriculture. Happiness, welfare and prosperity becomes synonymous with science and law.

“RURAL AWAKENING TODAY, WILL LIBERATE A BETTER TOMORROW.”

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