THE ROLE OF IPCC ON SUSTAINABLE DEVELOPMENT IN AGRICULTURE

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ABSTRACT

Recognizing the pressing global problem of climate change, the IPCC was formed in 1988 as an apex source to holistically address the issue. It strives to critically congregate best scientific, technical and socio-economic data on global climate change to produce various papers and reports which become standard works of reference (UNEP, 2004). IPCC has contributed extensively to unleash the mitigation potential from the perspective of agriculture, correlating it with climate change policy, environmental quality and ultimately, sustainable development (Working group II, 2007). Agriculture lands form 40-50% of the earth's land surface and contribute to 10-12% of the Greenhouse gas (GHG) emissions. In this sector, by improved crop, soil, water, livestock and water management, the mitigation of climate change can be approached in a cost-effective way than other sectors. Hence this paper dwells into the significant role of IPCC to progress towards sustainable development in agriculture sector. It would discuss about how agriculture management activities would decrease GHG emissions and increase carbon sequestration (Technical group V, 2002). In the warming world, precipitation is skewed, sea level is rising, glaciers are melting, acidic levels in oceans are rising and dissolved oxygen in sea water is declining (IPCC, 2014). Hence major river floods are likely, which is a threat to the food production. This paper would highlight the need to limit effects of climate change to achieve sustainable development as the focus, and would further discuss social equity and poverty eradication. It would explore adaptation and mitigation methods to enumerate short and long-term goals to combat climate change from reinvented livestock and crop systems, beneficial land use changes, improved fertilizers and advanced technological perspectives (IPCC, 1990). It would enforce the learnings from IPCC's contributions enumerating how agriculture must have a high synergy with sustainable development to address global climate change.

KEYWORD

Climate change, agriculture, mitigation, sustainable development

1. The warming world: An introduction

Climate change is the biggest crisis which humanity is facing. When weather patterns change across regions for a prolonged period of time, it is referred to as climate change. It is caused by various natural factors which include biotic processes, changes in solar radiation, tectonic movements and volcanic eruptions. These have been fed into by many human activities, which have led to the adverse situation of global warming.

The most evident of them is the water cycle. Precipitation in the warming world is not uniform. While the precipitation levels have increased and are likely to increase more along the high latitudes and the equatorial pacific, it is decreasing along the mid latitude and sub-tropical regions. This is closely related to the El-Nino oscillations whose variabilities are intensifying. This has its direct effect on ocean, cryosphere and sea levels (IPCC, 2014).

The oceans are expected to get warmer as the Atlantic meridional overturning circulation is expected to weaken in 21st century. The ice level in arctic is reducing drastically, hence the snow cover is expected to reduce by 7 to 25 percentage in this region. The permafrost extent at the northern latitudes are expected to decrease by 37 to 81 percentage, while the glaciers are expected to reduce by 15 to 55 percentage. It might even touch 85 percentage in the worse scenario. The sea levels increasing non-uniformly will also accelerate the acidification of the oceans. The vast expanses of coral reefs would be at the breach of extinction in this scenario. This would also imply that the amount of dissolved oxygen in the water will also reduce. The terrestrial, freshwater and marine species would face the risk of extinction. Fisheries and other ecosystem related services will suffer, specifically the ones in lower latitudes. This would lead to loss of carbon stored in the terrestrial biosphere. The change in this carbon cycle will amplify global warming (IPCC, 2014).

The coastal areas will also be subjected to submergence, flooding and erosion. Major rivers would flood leading to scarcity of usable water. The renewable surface water levels are expected to drop and the ground water in most of the subtropical regions are already dry. This would also be a major threat to the food security as the production, access and usage of agriculture products will suffer in a scenario of price instability. The urban areas would become hotspots of hunger as poverty will be intensified by the food shortage. A huge number of people will be displaced from their places of stay, adding to homelessness (IPCC, 2014).

Hence, limiting the effect of climate change is necessary to achieve sustainable development, equity and poverty eradication. It is important to safeguard the security of assets, maintenance of ecosystem goods, functions and services (IPCC, 2014). Researchers and scientists have proactively worked towards deciphering changes in climate in the past and have made predictions for the future through observations and models derived from theory. Massive records of global climate has been recorded based on geological evidences from cores dismantled from accumulations of ice, temperature profiles of boreholes, records of flora and fauna, glaciers,

stable isotope, layers of sediments and changes in sea levels. Constant efforts to link causes and effects are done in this field of research. IPCC plays a pivotal role in the same.

2. The role of IPCC

As highlighted in the preceding section, human activities are increasingly interfering with natural systems. The problems so caused are so complex, that policy makers need a primary, reliable source of information to study the causes, the socio-economic and environmental impacts and to explore the response options. The IPCC was hence established to make unbiased assessment of the scientific, technical as well as the socio-economic information on the problem of climate change. The IPCC gathers data from all around the world from the perspective of policy relevance (WMO, 2004).

IPCC produces many reports for the scholars and researchers to use, worldwide. The assessment reports present a scientific basis for concern regarding climate change. The special reports showcase the response to specific issues. The methodology reports talk about the methods and practices for national greenhouse gas inventories. The technical papers provide technical information on an array of scientific topics (WMO, 2004).

The IPCC has three working groups to look into research areas in detail. Working group, I looks at the scientific aspect of the climate system and its changes. While Working group II assesses the vulnerability of the socio-economic and natural systems, which is the adaptive approach, group III assess options for limiting the greenhouse gases, a mitigation approach (WMO, 2004). Both of these approaches are crucial to combat climate change.

3. Mitigation and adaptation as sustainable strategies

Mitigation is controlling the human sources of climate change. It strives to enhance processes to remove GHGs from the environment. Mitigation strategies generally have long term benefits. It is advocated that policy objectives have to be achieved for short term benefits in the mitigation approach. Since it has long term benefits, it is often seen to have synergy with sustainable development. This would include integrating economic growth with other goals such as poverty eradication, environmental protection, job creation, security and justice. Studies on sustainable development are generally based on interaction of various policy instruments and hence has its overlaps with climate mitigation strategies. Mitigation might involve anything ranging from a city plan to improvement of household instruments to combat climate change. The mitigation strategies often talk about low emission growth, which focuses on promoting renewables and improving energy efficiency (UNEP, 2016).

Adapting refers to lower the risks of the consequences of climate change. Hence adaptation has evident short term benefits. Since the history of civilizations, human beings have been adapting to the prevailing climatic conditions by aligning their homes, lifestyle and livelihoods with the same. Climate change is however more erratic. Adaptive strategies can be well planned or spontaneous. It encompasses large infrastructure changes such as building defenses to control rising sea level to domestic level changes (UNEP, 2016). IPCC splits vulnerability to climate

change as exposure, sensitivity and capacity to adapt to the hazards. Adaptive strategies can help to reduce the vulnerability of these hazards, and is needed especially in the lower income countries which are more vulnerable to the effects of climate change.

The characteristics of adaptation is to safeguard the security of assets and maintenance of ecosystem goods. It is centered on risk reduction. It is enhanced by complimentary actions starting from individuals up till governments. It strives towards reducing exposure to current climate change through transformations in economic, social, technical and political decisions for sustainable development. IPCC identifies mitigation as more long term and looks at technical changes such as substantial reduction in anthropogenic GHG emissions and non-CO₂ climate forcing agents (IPCC, 2014). It will hence be the focus of this technical paper to enumerate the role of IPCC on sustainable development in agriculture.

4. Mitigating climate change through agriculture

Mitigation techniques are used in many sectors such as energy, resources, land use, agriculture etc. Agriculture lands cover 40-50% of the earth's land surface. It is to be noted that it contributes to significantly of about 10-12% of the overall emissions of GHGs. Mitigation measures in this sector include improved crop and grazing management, restoration of organic soil contents, improved water and rice management and improved livestock and manure management. The question here would naturally be why this paper discusses mitigation strategies, especially in the agriculture sector. It is significant as IPCC has put forward that the mitigation in agriculture sector is far more cost effective than any other sector (Working group II, 2007). Also, agriculture mitigation has high synergy with sustainable development policy and has socio economic and environmental impacts. Hence it is one of the best approaches for mitigating climate change in a sustainable manner.

The mitigation potential of all gases from agriculture is about 5000-6000 Mt CO₂-eq/ year. Soil carbon sequestration is the method which contributes to maximum mitigation potential of approximately 89%. Out of the overall mitigation potentials of gases, CH₄ and N₂O account for 9% and 17% of the total emissions. There are low price and high price strategies which can be applied in the agriculture sector. The low-price strategies include consistent improvements to existing production, fertilizer application and management. The high price strategies include land use changes and other interventions which are context specific. An additional mitigation of 770 Mt CO₂-eq/ year is estimated to be achieved by 2030 in agriculture, which is maximum compared to transportation and building sectors. This includes substituting fossil fuels with crop residue, dung and energy crops (Working group II, 2007).

4.1. Short and long-term options

IPCC has extensively worked on recommendations for sustainable development in this sector. The short-term options in this sector are many. Firstly, the livestock management can be an immediate solution. The management of waste, with increased supplemental feeding practices along with production and growth enhancing agents can be resorted to. Improved fertilizer

composition, along with judicious use of animal compost can help. Also, it is suggested to shift areas which are only marginally suitable for agriculture to perennial cover crops which include fodder and pastoral use. This will increase the carbon uptake. Following this, minimum or no till approaches can be adopted to as well (Technical group V, 2002).

The long-term options include the concentration on rice cultivation for sustainable improvement. The water regimes in this can be managed, which can increase cultivation along with efficient use of fertilizers. This can reduce the methane emissions by 10-30%. The livestock can also be managed by improvements in the technology. The fertilizers can be engineered better to ensure controlled nitrogen conversion rates and alternative systems such as desertification can be resorted to (Technical group V, 2002).

4.2. Other responsive strategies

IPCC is promoting global discussions through workshops and symposiums on agriculture production, emission, forecasts and to exchange knowledge in the research area. Guidelines for future research to investigate climate change while strengthening, supporting and extending the tropical forestry action plan must be carried out in the following responsive areas.

Firstly, the GHG emission from flooded rice cultivation must be addressed. These fields are major source of methane, which is generated due to the anaerobic decay of organic matter. The area of biogeochemistry must be studied to improve production, oxidation and regulation of the same. The climate, soil, water, fertilizers must be studied from a seasonal variant perspective. Field level measurement techniques must be followed (IPCC, 1990).

Secondly, the role of managed livestock in the global methane budget must be understood. Ruminant animals are production houses of methane. The animal waste also contributes to methane emission. Methods like methane recovery management from animal waste can be adopted. Supplemental feeding practices and strategic supplement of nutrients to animals will decrease methane emissions and increase efficiency. Diet modification methods and reduction of protozoa must also be looked into (IPCC, 1990).

Thirdly, the greenhouse emissions from tropical agriculture must be managed. The assortment of agriculture activities leads to emissions. The conversion of forest land to agriculture land must be reduced. The decrease in reduction in burning of crop residue, agroforestry systems and use of fertilizers with slower conversion rates will help in management (IPCC, 1990).

Fourthly, the greenhouse emissions from temperate agriculture must also be managed. The assortment in crop patterns lead to N₂O emissions and CO₂ fluxes. These emissions must be measured to work towards reduction of gas emissions through maintaining production levels. The soil must be seen as a sink for nitrous oxides (IPCC, 1990). To summarize, in agriculture sector, methane emissions from ruminants and rice cultivation must be reduced and nitrogen loss from cultivation, especially in the form of nitrous oxides must be reduced (IPCC, 1990).

5. Potential impacts of mitigation activities in the agriculture sector

IPCC advocates that the interaction between mitigation and adaptation must occur simultaneously, even though they differ in spatial and geographic characteristics. The benefits of mitigation are likely to emerge over decades while short term changes must have policy support. Mitigation often refers to future climate change, but a likely subset is more vulnerable which must be modified to maintain the efficacy of mitigation measures. However, non-climate policies including macroeconomic approaches and intersectional approach of agriculture and environment have found to have larger impact on agriculture than climate change policies. There is however a significant technical potential for mitigation in agriculture. Implementing the various activities discussed in the agriculture sector would help in reducing greenhouse emissions and improve carbon sequestration. This will ultimately result in promoting sustainable agriculture. The agriculture management involves sequestration of carbon as the most important process. The implementation has however been a challenge, which has to be overcome by economic interventions at policy level like global sharing of technology (Working group II, 2007)

It is predicted by IPCC working group II that the GHG emissions will increase in the future due to population growth and changing diet patterns. As the demand for food increases, there will be increase in emissions if the supporting livestock increases along with the use of nitrogen fertilizers. Hence new mitigation practices have to be adopted to reduce the carbon loss from soil. These will have positive impacts to combat climate change.

Firstly, cropland management practices must be taken up. Agronomy is an important aspect of this which will improve sustainable agriculture practices which will conversely improve yields and carbon storage in the soil. By reducing leaching and volatile loss, nutrients in the soil can be managed. Weed control methods can lead to tillage management which will leave the soil nutrients less disturbed. Effective irrigation methods can be taken up for water management, which will also lead to practices like rice management (Working group II, 2007).

Secondly, pasture improvement practices which include increasing grazing intensity, improved productivity, fire management and grass species introduction will have good effect on reduction of emissions. Thirdly, management of organic soil and restoration of degraded land will have positive impacts on controlling emissions. Fourthly, livestock management, which includes better feeding practices, dietary additives and controlled animal breeding have positive impacts. Finally, manure management and bioenergy practices will lead to resurfacing of sustainable agriculture (Working group II, 2007).

Farmer centric participatory approaches must be taken with consideration of local or indigenous technologies. Use of organic materials in low input farming systems and improvising in agriculture biodiversity with the use of local crops can help in mitigation. Diversifying monotonous crop patterns will also be useful.

CONCLUSION

The food, water, energy, climate nexus is intermittent to the people-progress and sustainability nexus. The priority in this must be safe and secure access to nutritious food to all cadres of the society, while ensuring the combatting of climate change. The synergies and tradeoffs in strategies for minimizing risks involved must be constructed from local to regional perspectives which would facilitate linkages and investigations across various disciplines, as the issue is complex in nature. With respect to mitigation in agriculture sector, the importance of choice of greenhouse gas metric especially for high emission of methane must be studied. There is a need to strengthen sectoral research and integrated modelling along with the assessment of influence of climate change on crops. The potential of mitigation in this field intersects with forestry, bioenergy, land and water sectors etc. Hence it also has impacts on societal role of reducing poverty, reducing erratic land conversions and use changes, preserving biodiversity and thereby improving overall resilience (IPCC, 2015).

The agriculture production systems are one of the sources for the GHG but can also act a sinks for the same. For reducing emissions, the agriculture mitigation strategies must be coupled with industry and energy sector reductions. The policies must encompass technical, instrumental and institutional arrangements. Reforestation must be adopted in national development plans and further forest loss must be minimized. These forest management solutions must be integrated with the agriculture sector. The productivity of sustainable agriculture must be promoted along with increasing public awareness. In the agriculture sector, the burning of biomass must be reduced while adopting appropriate alternative practices. The existing agriculture systems must be modified, and not waste the biomass by burning it, instead of which it must be converted into organic matter. The methane emissions must be largely reduced through management of livestock waste management, along with expansion of supplementary feeding practices. More fertilizer options with less nitrogen content must be resorted to (IPCC, 1990).

Agriculture is the only sector that can not only reduce GHGs, but also remove them in a safe and cost-effective manner without reducing the productivity. It is one of the sectors which benefits from the synergies between climate change adaptation and mitigation, provided that facilitative conditions are achieved. Enabling environments in developing countries must be achieved to even enhance the capabilities of individual to contribute to the processes. The effective management of livestock systems will lead to lesser emissions and improve storage in sinks and productivity. Male and female farmers must be provided with equal access to information of impacts of climate change and its mitigation measures. The conservation and management of peatlands will lead to less emissions, while maintaining the ecosystem services and helping communities to adapt to climate change. The farmers must be exposed to digital tools and precision agriculture techniques.

There is a need to develop a strong database and institutional arrangements to identify and develop solutions, to which IPCC is a significant contributor. IPCC works towards developing relevant literature for studies and further research in this area. It aims to reconcile views through workshops, seminars and conferences to disseminate information. It aims to compile policy relevant work to understand the current state of climate change. It incessantly creates new benchmarks for international climate negotiations, for a sustainable tomorrow. Hence besides creating a reliable database for other researchers to involve in sustainable development in the agriculture sector, IPCC has itself been a great contributor in creating awareness on the cause of the problem and the probable directions for solutions. It is given the world a platform to work towards sustainable development in agriculture.

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