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Mitigation Strategies to Reduce GHG Emission from Agriculture, Livestock and Forestry in Bangladesh

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Abstract. The level of greenhouse gas (GHG) emission in Bangladesh is very low compared to other countries of the world but it is appallingly affected by the vulnerability of climate change. The emission of GHG from Bangladesh was 126.6 MtCO_2eq (metric tons carbon dioxide equivalent per capita) in 2010 which accounted to 0 .3% of global total GHG emission. This study aims to identify the sources of GHGs from agriculture, forestry and livestock sector in Bangladesh and proposes some ideas to mitigate emission from these sources. Emission from flooded rice fields, enteric fermentation, manure management, burning of agriculture residues, biomass burning are some imperative sources of GHGs. The actions for mitigating GHG emission involve midseason drainage, off-season incorporation of rice straw, substituting urea with ammonium sulphate, replacement of roughage with concentrated feed, use of dome digester, tillage and residue management, practice of bio-fuel instead of fossil-fuels, high efficiency fertilizer application and artificial and participatory woodlot plantation. The proposals prefer bottom-up approaches incorporating all possible stakeholders and intend to reduce substantial quantity of GHGs from the specified sectors.

Keywords: bangladesh, green house gas, agriculture, livestock, forestry, fossil fuel.

1. Introduction

In 2005, per capita Green House Gas (GHG) emission of Bangladesh was 0.6t CO_2eq (tones carbon dioxide equivalent) and it is expected to increase up to 1.7t CO_2eq in 2025. Though it is still much lower than current per capita emission of most of the other countries, Bangladesh is one of the most affected countries by climate change (Jilani, 2012). Agriculture, livestock, deforestation and fossil fuels are some of the major contributors of GHG emission in Bangladesh. Total CH_4 emission from agriculture and livestock sector is about 1259 million kilograms (kg), which is equivalent to 28,539 Global Warming Potential (GWP) on a 100 year time frame. About 4.6 million kg CH_4 is emitted from field burning of agriculture residues which is equivalent to GWP of about 97 on a 100 year time scale. Field burning of agriculture residues also produces about 97.3 million kg of CO gas, .11 million kg N_2O and about 3.87 million kg of NO gas. Net carbon flux from forestry for Bangladesh is about 6835 million kg of sequestered carbon for 1990 (BCAS, n.d.). So it is a burning question of the time to concentrate on implementing adaption and mitigation programs in these sectors. This study is focused on suggesting some mitigation strategies to reduce GHG emission from the above stated sectors.

2. Strategies to Mitigate GHG Emission

2.1. Lessening GHG emission from agriculture and livestock sector

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Agriculture can contribute to the reduction of GHG by: reducing emission (beneficial management practices that reduce emissions), removing emission (carbon sequestration) and using biomass energy (animal waste or plant biomass for energy). Strategies that can be taken are as follows:

- **Mid-season Drainage:** It involves the removal of surface floodwater from the rice crop for about one week towards the end of tillering and aeration of the soil. Shifting drainage time from vegetative period to reproductive period helps reduce CH_4 production and emission (ClimateTech Wiki, 2006). Reduction of redox potential associated with CH_4 planting occurs faster if the field had been flooded in the previous season. So CH_4 emissions could be further reduced by alternate wet and dry season cropping and organic amendment at the beginning of the previous season instead of immediately before rice production (Hardy, 2013; Yan, Yagi, Akiyama and Akimoto, 2005). Midseason drainage increases N_2O emissions. Mitigation of N_2O is possible if a field is frequently water logged by intermittent irrigation and drainage day is shortened (ClimateTechWiki, 2006).
- **Fertilizer Application:** Urea can be substituted by ammonium sulphate (inhibit methanogen) and ammonium phosphate (promote rice plant growth) (Towprayoon, 2004). Ammonium sulphate has a significant effect on N_2O reduction, and also slightly depresses CH_4 (Li, Salas, DeAngelo and Rose, n.d.).
- **Off Season Incorporation of Rice Straw:** If rice straw is applied in the fallow period instead of soil incorporation directly during puddling, it can reduce CH_4 emissions significantly. It would be best to apply composted rice straw to dry soil. After harvest, the residue is chopped and diced again in the soil (Richards and Sander, 2014).
- **System of Rice Intensification (SRI):** Aspects of SRI techniques are: wider spacing and earlier transplanting. SRI offers the potential to increase yields while decreasing GHG emissions, a win-win. But N_2O emissions are likely to be 1.5 times higher in SRI compared to flooded rice production due to the availability of oxygen (Hardy, 2013).
- **Replacement of roughage with concentrates:** In developing countries, CH_4 emissions from cattle can be reduced most cost-effectively by enhancing productivity through improving feed quality. High-concentrate feed produces less CH_4 than high-roughage feed. CH_4 production can be reduced if cattle are fed high-protein/low-fiber rations, specifically more concentrates. CH_4 emissions from ruminants can be significantly reduced by feeding starchy crop waste (Shibata and Terada, 2009).
- **Solutions to N_2O Emission:** Applying green manure (legume) rotation crops that provide free nitrogen, reducing fertilizer requirements, planting winter cover crops, such as winter rye and reducing nitrate leaching can help in this regard.
- **Solutions to CH_4 Emission:** Adjusting manure spreaders for crop fertilizer needs and incorporating manure into soils immediately, creating energy from manure waste with an anaerobic digester reduce CH_4 emission. Using covered or tank storage of manure storing at low temperatures, removing manure promptly from barn floors and encouraging beneficial insects (e.g., stable fly, horn fly, face fly) in the dung recycles nitrogen into the soil.
- **Substitution of bio fuels for fossil fuels:** The contribution of bio fuels to GHG reductions will be highly dependent on policies, fossil fuel prices, the specific fossil fuels replaced, the technologies used to convert biomass into energy and per acre yields of energy crops.

2.2. Lessening GHG emission from forestland

Artificial and Participatory Woodlot Plantation

Two main strategies can be taken for rapid artificial reforestation and to control GHG emission from forestland-

- **Reducing source of GHG in forest sector:** Introducing crop mixes, planting and management system, improved genetic strains to increase productivity per unit area and intensifying management on existing pasture to increase site productivity can be effective solution.

- **Expanding carbon sinks through sustainable forest management:** By expediting natural regeneration of deforested land and improving productivity of forest on available pasture can help in sustainable forest management.

Two kinds of forests can be generated:

- Protection forest (for watershed protection, erosion control, eco system regeneration)
- Production forest (bio fuel plantation, agro forest, carbon pump) (Kupfer & Karimanzir, n.d.)

Some important measures should be kept in mind in artificial reforestation -

- **Mangrove Plantation:**

a) Mono-specific mangrove cultures should be replaced by Silviculture (Siddiqi & Saenger, 2010).

b) The changing soil salinities and soil maturation of newly accreted lands require an integrated program of sequential planting of suitable species which are able to adapt to the changing conditions (Siddiqi & Saenger, 2010).

Special requirements should be fulfilled in two steps called species selection and nursery and planning techniques. *Sonneratia apetala* and *Avicennia officinalis*– these two species showed encouraging survival rates, and they dominate the mangrove plantations. In nursery and planting techniques, germination onset and success is largely controlled by salinity, which needs to be maintained below 20ppt; germination performance declines rapidly above 20ppt (Siddiqi & Saenger, 2010).

- **Inland plantation:** Attempts have been made to replace the natural low yield forests by valuable indigenous as well exotic species (*Acacia* species) (Kupfer & Karimanzir,n.d.).
- **Hill plantation:** For long rotation plantation, the trees are subjected to thinning for years to maintain good timber production (Kupfer & Karimanzir,n.d.).

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