The Impact of Emissions Trading on Rice Production of India

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Introduction and Background

- Global warming due to the increased emission of greenhouse gases (GHGs) is the direct consequence of climate change.
- The flexibility mechanisms or market-based approaches, such as Joint Implementation, Clean Development Mechanism (CDM) and Emissions Trading were introduced under Kyoto protocol to reduce global warming.
- Research has proven that emission trading is the most cost-effective market-based approach to reduce GHG emissions (Breen, 2008).
- Developing countries, especially India, could be the major emitters of GHGs in the future, owing to their higher population and economic growth rates.
- India has an agrarian economy and therefore, agricultural sector forms the second most important source of India's total greenhouse gas emissions.
- Indian agriculture accounts for 5 per cent of the global methane budget (Reiner et al., 2009). Agricultural sector accounted for 83 % of all India methane emissions in 2005, that included 53 % from livestock-related activities, **20 % from rice cultivation** and 10 % from biomass burning (Garg, et al., 2006).
- In Indian agricultural sector rice is the largest single crop grown on an area of 44 million hectares (Barah, 2005).

Hence, it is imminent that methane emissions from rice cultivation can be seen as a potential contributor to global warming in the near future.

Mitigation of methane emissions by applying GHG reduction techniques on a crop, such as rice, would have an immense impact on the rural population, especially farmers, who are dependent on agriculture. As Indian population is heavily dependent on rice as a staple food and also as it contributes 43.2 per cent to the total food grain production, any increase in rice price will have an adverse effect on the purchasing power of the lower income strata of society.

Research Question

The question of how market mechanisms, such as emissions trading for GHG mitigation would affect the farmers can be of great importance in the field of rural development from climate change point of view. There has been very less research done in employing market mechanisms to curtail greenhouse gas emissions in the agricultural sector. This study is an attempt to employ emissions trading, the most cost effective market-based approach, to reduce methane emissions from rice fields in India.

- ❖ What is the effect of emissions trading on demand and supply of rice in India ?
- ❖ Rice being the staple food, what is the corresponding change in price of rice in Indian market?

Data and Methods

- Data required for the study is obtained from secondary data sources like online journals and government websites.
- The methane emission estimates used for this analysis are in the range of 2.14 - 8.23 $mgCH_4/ m^2/ha$ for rice fields of India (Singh, et al., 1998).
- The methane emissions from rice cultivation are valued using the concepts of global warming potential and price of carbon dioxide-equivalent.
- Methane emissions from rice fields are converted into monetary terms to be able to determine the shift in the production of rice.
- The market price of carbon (MPC) for 2009 and also the shadow price of carbon (SPC) are used here for valuing the methane emissions that are converted into CO2-eq terms.
- The effect of emissions trading on the production of rice in India is analysed using the concepts of iso-elastic supply function and shift parameter. The internalisation of external costs of methane emissions from rice fields, form the basis of the analysis.
- Assuming a single market model the framework used is split into supply effects and demand effects.

- *Supply Function*:
  - $Q_s = c(1+f)\,(p_s)^{\varepsilon^s}; \quad \varepsilon^s > 0$
  - $c = \frac{Q}{(p_s)\varepsilon^s}$
  - $f = (C_1 - C_0)/C_0 \ * \ 100$

- *Demand and Price Effects*
  - $\varepsilon^d = \frac{Q_s - Q}{p_d - p_s} \times \frac{p_s}{Q}$

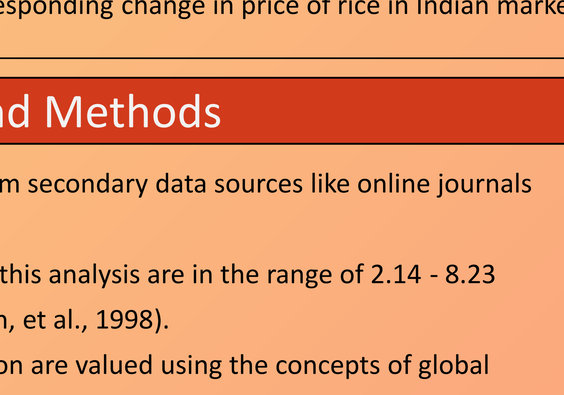

Fig. 1 Hypothetical shift in the supply curve

Results

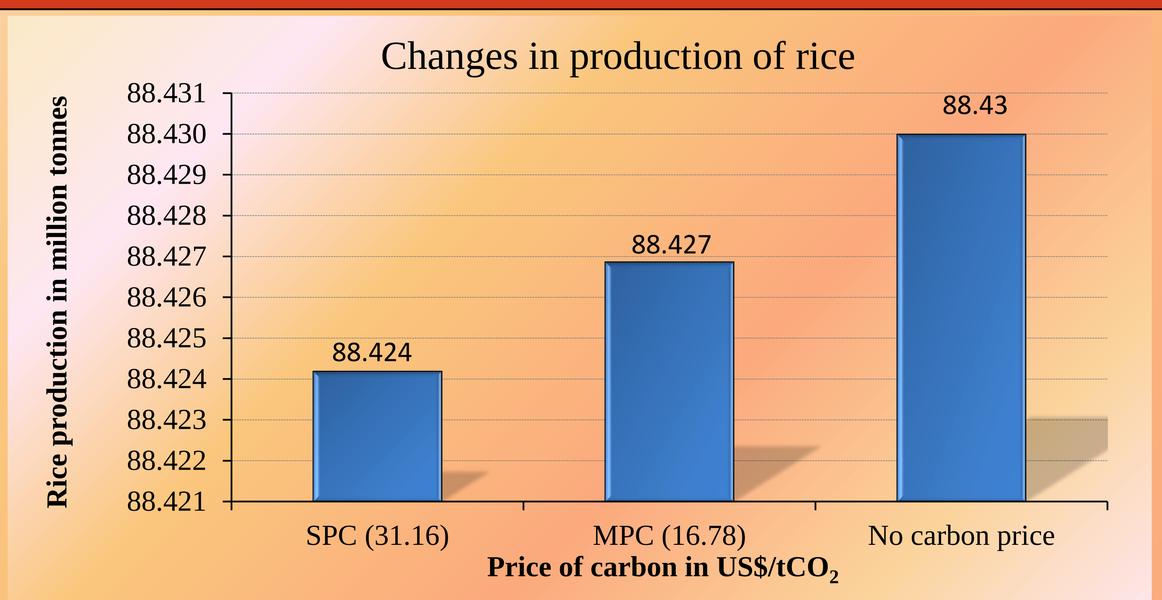

Fig 2 Changes in the rice production on price internalisation of methane emissions

Table 1 Change in rice production expressed as percentage

Price of carbon in US$/tonne of CO_2-eq	Production of rice in million tonnes	% change in production
MPC (16.78)	88.427	-0.0035
SPC (31.16)	88.42	-0.0066
No carbon price	88.43	0

- The production of rice has reduced to a comparatively larger extent under SPC than MPC when compared with the "no carbon price" situation.
- Although there has been a reduction in the production of rice due to the price internalisation of CO_2 costs, the reduction is very negligible.
- The new equilibrium price obtained as a result of the shift in the supply of rice is US$ 134.21/ tonne of rice which implies that there has been no change in the demand and price of rice following the shift in its supply due to price internalisation of CO_2 costs.

Discussion

- If emission rights or allowances are allocated by the government , it serves as an incentive to the rice farmer to adopt GHG mitigation strategies in paddy cultivation so that the emissions can be minimised below the allotted cap.
- The trade of allowances between the farmers depending on the shortage and surplus of emissions brings benefit to farmers, simultaneously attaining GHG mitigation in a profitable way.
- The farmer with a higher marginal abatement cost chooses to buy a permit from the other farmer whose marginal cost of abatement is lower.
- Subsequently, the cost of production of rice increases and supply decreases due to cost of methane emission and cost of GHG mitigation strategy employed by the farmer
- Theoretically , this leads to a new market equilibrium with a increase in price of rice and decrease in demand as the cost of mitigation employed by the farmer is passed on to the consumer.

Conclusions

- As per the results, there is no change in the demand or price of rice, because being a essential food commodity with an inelastic demand, price signal from internalised methane emission costs is not passed onto the consumer.
- It is unattractive for the rice growing farmers, as they see no incentive to reduce the methane emissions from their rice fields so that they can trade their allowances or emission rights.
- The farmer loses as he has to bear the extra costs while the consumer is at no loss because the price remains unchanged.
- However, when a proper national emissions trading scheme is put in place for agriculture sector, the results may change depending on the allocation of allowances to the paddy farmers, GHG mitigation strategies followed and the price of carbon.

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