CENTRE FOR INDIAN KNOWLEDGE SYSTEMS

SYSTEM OF RICE INTENSIFICATION IN THE CONTEXT OF CLIMATE CHANGE

Sustainable Agriculture and Climate Change Series 1of 3 | Alejandro Posada 2014

Contents

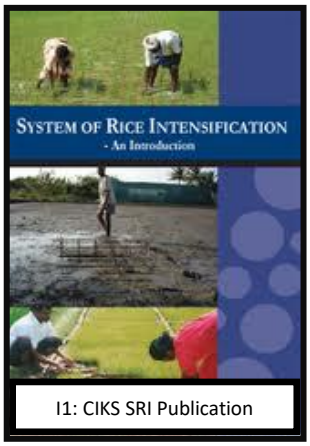
Abstract 1
Introduction 2
Climate Change in Indian Context 2
SRI and Introduction 4
SRI and Climate Change ..... **Error! Bookmark not defined.**
SRI and Climate Change Mitigation: ..... **Error! Bookmark not defined.**
SRI and Climate Change Adaptation 7
Conclusion: ..... **Error! Bookmark not defined.**
End Notes 9

Abstract

Climate Change is already affecting the livelihoods and food security of farmers in India. It is necessary to find sustainable and rooted solutions to this existing problem. This article makes a case for the resourceful and all-encompassing role that System of Rice Intensification, a sustainable agricultural practice, can play in mitigating and adapting to the effects of climate change. The article introduces the basic principles behind SRI and climate change, and thus facilitates the visualization of the relationship between the two.

Introduction

Agriculture continues to be a crucial sector of the ever growing Indian economy. The agricultural sector compromises 49% of the labor force and 17.4 % of the country's GDP[1]. Not only is the sector important for the country's economy but also for the food security of the nation. However the agricultural sector has suffered tremendously due to various economic factors; such as high cultivation cost, low premium for product and labor movement from rural to urban. The aforementioned stress has only been enlarged as a result of climate change impacts that are already being felt. Furthermore the agricultural restructuring of the Green Revolution has led to depletion of environmental and natural resources as well as to land degradation, making it even harder for farmers to adjust to the ever-changing climate[2].



I1: CIKS SRI Publication

Given the stress of the situation it is incredibly important for stakeholders at different levels to start looking for and implementing sustainable solutions for the agricultural sector in the context of climate change. The Centre for Indian Knowledge Systems (CIKS) has promoted a transition to organic agriculture alongside the revitalization of traditional agricultural knowledge in the state of Tamil Nadu.

The System of Rice Intensification (SRI) stands out as one of the practices that CIKS has promoted. According to the CIA Fact Book, within the agricultural sector Rice is the most important crop for the India Economy[3]. Rice is planted extensively throughout the state of Tamil Nadu. However, mostly due to its heavy dependence on rain, rice cultivation is especially vulnerable to climate change impacts. Predictions suggest that the rice sector will suffer as a result of the expected impacts of climate change[4]. The transition to SRI especially alongside organic practices has a potential to act as a catalyst in addressing the stress caused by climate change. The following sections briefly introduce the concept of Climate Change and SRI, facilitating the visualization of the relationship between the two.

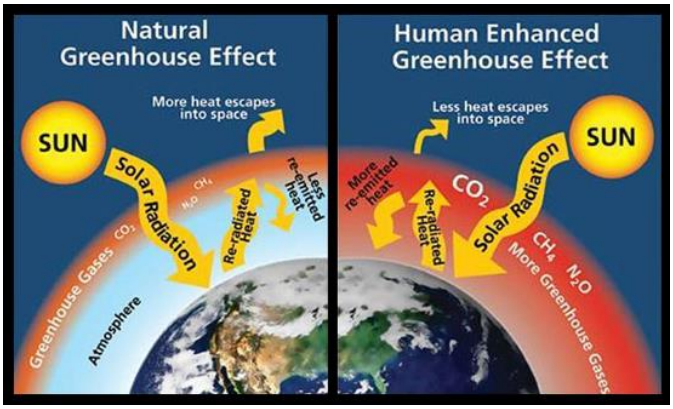
Climate Change in Indian Context

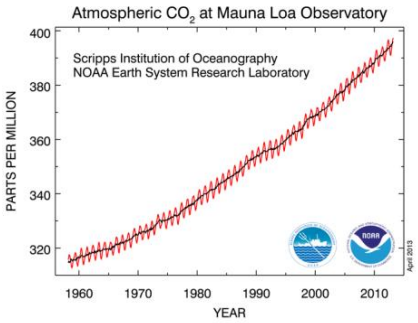
It is predicted that the global average surface temperature will be 2.5-4.7 C° higher by 2100 when compared to pre-industrial periods[5]. The IPCC estimates that a 1.5 C° rise and two mm increase in precipitation could result in a decline in rice yields by 3-15 % per cent[6]. The international Rice institute forecasts a 20% reduction in rice yields per Celsius increase[7]. Both forecast are catastrophic given the predicted increase in temperature. The changing climate is also predicted to cause[8]:

1. Increase in the occurrence of storm floods, droughts, fire
2. Changes in growing seasons
3. Increase incidence of disease and insect pest attacks
4. Habitat threats for some crop varieties
5. Overall volatility in Climatic factors

The phenomenon behind climatic change is known as the greenhouse effect, and there is strong evidence to suggest that humans are to blame. The theory explains that the warming is happening as a result of climate forcing. Climate forcings are changes in the balance of energy emitted by the sun and that emitted back by the earth as infrared radiation[9]. As the diagram A1 shows some of the energy emitted back by the earth gets re-radiated and trapped in the atmosphere by a layer of greenhouse gasses. Such as; CO2, water vapor, methane and nitrous oxide. Humans have increased the release of GHG into the atmosphere and thus enhanced the GHG effect. The level of decrease of 5-15 rainy days is predicted along with increase in heavy rainfall in the CO2 has increased exponentially from 280 ppm in mid 19th century to 400 ppm today as seen in diagram A2.

10





Above: Diagram A1

Human Enhanced Green House Effect

Left: Diagram A2

Increase in CO2 in the atmosphere

Agriculture is amongst the three major causes for GHG emissions compromising 10-12 % of global emission according to IPCC[11]. However those figure don't take into account external factors such as agricultural driven deforestation, it is estimated that if such factors were taken into account the number would be 32% of global emissions[12]. The major GHG contributions by agriculture are methane and nitrous oxide.

The agricultural sector in India will be greatly affected by climate change;

monsoon season[13]. In conclusion, the agricultural sector is both greatly suffering

from and contributing to Climate Change. As a result the international community has come up with two set of responses to Climate Change:

1. Mitigation: Attempt at a gradual reversal of the effects of climate change. Decrease and sequester GHG being released into the atmosphere.
2. Adaptation: adjustments to the inescapable changes brought forth by climate change

The following sections elucidate the way in which SRI has the potential of addressing mitigation and adaptation, offering a sustainable and rooted solution to the problems

SRI and Introduction

SRI field CIKS: Notice the spacing

SRI is a method that has been introduced into agriculture to increase productivity. In the method the cultivation, techniques like transplanting of very young seedlings, transplanting seedling with sufficient spacing, use of weeders to manage weed ect are adopted to increase yields. Moreover, use of inputs like seeds, irrigation water, and manure is lessened. The yield obtained through this method of cultivation is 25% more when compared to the conventional method of cultivation. Some of the advantages of SRI practices are:

- Nursery size less,
- seed requirement low,
- Irrigation requirement is also low,
- No problems with rats,
- Yield is more,
- Grain weight is more

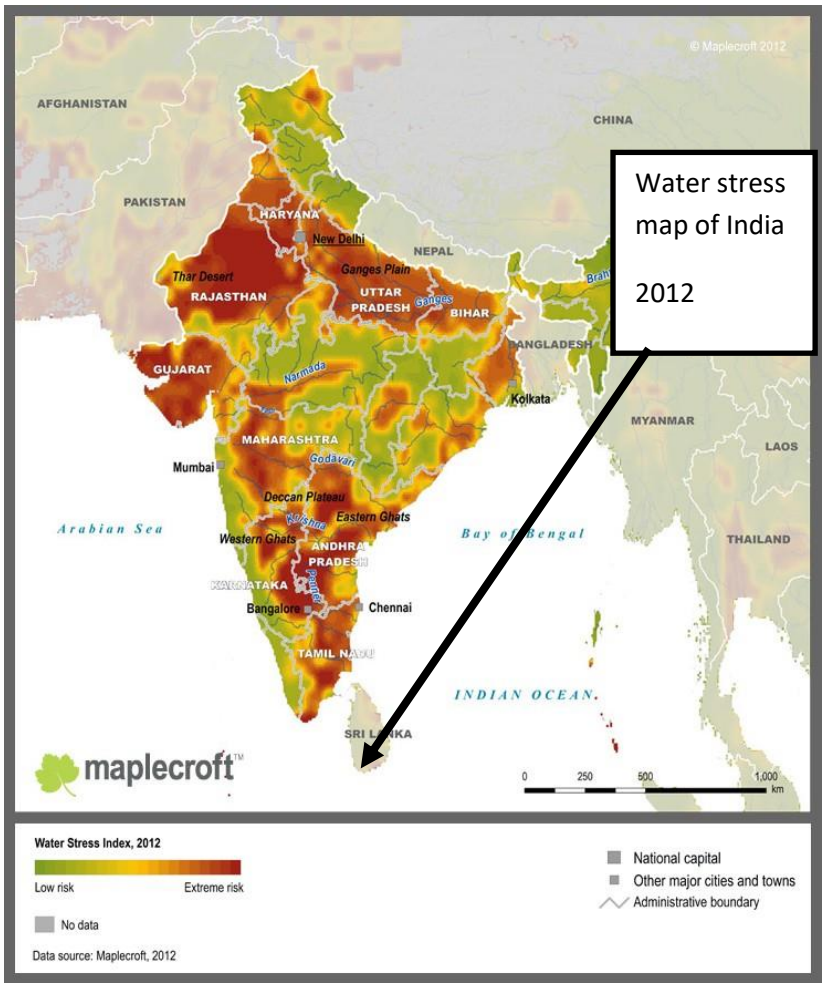
Difference in Yields from CIKS experiment with SRI

SRI Methods are not always promoted alongside Organic Agriculture. However as mentioned in previous sections CIKS has been promoting both methods simultaneously. Implementing SRI alongside organic agriculture can actually lead to a greater potential in addressing climate change.[14]

SRI and Climate Change

There is a straightforward connection between SRI methods of cultivation and Climate Change. The IPCC predicts that rainfall will decrease in most sub-tropical land regions[15]. The image to the right shows that Tamil Nadu is especially vulnerable to water stress. Experience from the field confirms that the water problem has been existent for at least the past two years. One of the main differences between SRI and conventional forms of paddy cultivation is that the fields do not require constant flooding. As a result the SRI method of cultivation is dependent upon significantly less water than conventional forms of agriculture. This allows farmers using SRI methods to lessen the risk induced by climate change.

However, beyond the straightforward connection there are various other ways in



which implementing SRI simultaneously alongside organic practices can contribute to climate change mitigation and adaptation. The following sections describe some of such contributions.

SRI and Climate Change Mitigation

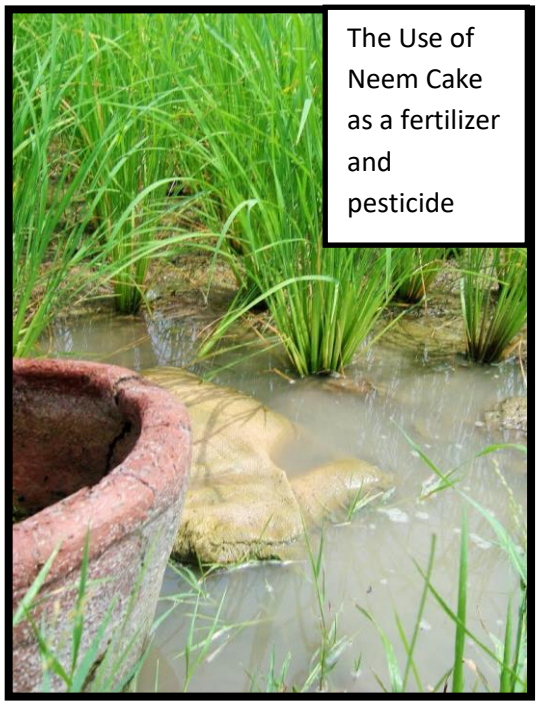
As mentioned in previous sections agriculture is significantly contributing to the release of GHG into the atmosphere. As a matter of fact is it estimated 45% of methane, 80% of nitrous dioxide, as well as some of the CO2 emissions are coming from agriculture. Paddy fields alone are said to contribute 11% of methane emissions[16]. Mitigation looks at lowering the emissions GHG as well sequestrating some of the GHG that have been released.

The implementation of SRI methods alongside organic agriculture contributes to climate change mitigation in the following ways:

1. Nitrous Dioxide: Under organic SRI the use of nitrogen fertilizers is substituted by bio-fertilizers such as; azolla, vermin-compost, and neem cake. SRI facilitates the use of bio-fertilizers due to the spacing between the crops as well as the use of weeders. Overall, not only are nitrous oxide emissions completely eliminated the soil is also made more fertile.

Azolla cultivation as a fertilizer for field

2. Carbon Dioxide: The promotion of organic SRI promotes the use of bio-fertilizers. This increases the organic matter in the soil, which in turn translates to an increase in carbon level in the soil. As a result organic SRI actually has the potential of sequestering carbon. At the same time carbon emissions from transportation of chemical fertilizers is eliminated[17].


The Use of Neem Cake as a fertilizer and pesticide

3. Methane: By avoiding the constant flooding of the field SRI also reduces the amount of methane emissions.[18]

Overall, SRI alongside organic agricultural practices has a great of potential of contributing to the mitigating of climate change. Organic SRI is able to either lower of sequester emissions from the three major gasses currently emitted by agriculture.


SRI Water Management

SRI and Climate Change Adaptation

Agriculture is contributing to the effects of climate change; however agriculture is also one of the economic sectors most vulnerable to climate change. In the Indian and specifically in Tamil Nadu context farmers are already facing the stresses brought forth by climate change. For the past two years severe drought and delayed rainfall have affected the paddy cultivators. As climate continues to change, farmers are not only expected to suffer from water scarcity but also soil deterioration and increase in pests. Given the current situation it is important for farmers to adapt to the changing climate. SRI alongside organic practices provides adaptation possibilities for farmers:

TNAU trials – after storm passed over the rice fields; conventional methods in foreground; SRI methods in center

Table 2. Crop performance in

N

Crop parameters	Conventional	SRI	Conventional	SRI
Plant height (cm)	99	122	30-45	60-75
No. of tillers plant^{-1}	5-8	10-21	2-4	10-18

1. Water Scarcity: organic SRI methods focus on efficient water conservation. Water is economized in two ways. First, fields are not constantly flooded and so water requirements are lower[19]. Second, by using organic fertilizers the organic matter of the soil increases. Such soil stores 20-30 percent of its weight in water, so rain and irrigation is not lost through leaching and evaporation[20].

2. Erratic rain fall: Paddy grown under SRI methods grows healthier and stronger due to the decrease in root competition as seedlings are spaced out[21]. As plants become stronger they are able to withstand the problems caused by erratic rainfall[22]. The picture above showcases the resilience of SRI crops.

3. Soil Deterioration: It is possible to adapt against expected deterioration of soil due to climate change. The use of bio-fertilizers

helps the restoration process of the fields. [23]

4. Increase in Pest: It has been noticed that plots that are not constantly flooded have less pests when compared to conventional flooded fields [24]. At the same time studies have shown that spacing between the crops decreases the incidence of rats. Since the amount of shadow is less, the fields become less attractive for rats.

SRI alongside organic practices allows farmers to successfully adapt to the climatic volatility brought forth by climate change. Transitioning to organic SRI will lower the risk that farmers face in the context of climate change

Conclusion:

Climate change can no longer be taken lightly as a set of precautions for the future, the effects of such a warming are affecting the everyday life of farmers the food security and economy of India. The effects are expected to increase exponentially and to continue affecting farmers. The International community has focused on mitigation of climate change. Although, mitigation is of great importance it has not happen at a fast enough rate. As a result looking for adaptations to the already existing effects is also necessary. Stakeholders at different levels must focus on the promotion of solutions that are sustainable and all encompassing.

The Centre for India Knowledge Systems has promoted the transition to organic agriculture via the revitalization of traditional forms of agriculture. System of Rice Intensification stands out as one of the practices that has been promoted by the Centre. Such a practice provides an all-encompassing sustainable solution for farmers in the face of climate change. The transition to SRI alongside organic forms of agriculture gives farmers the possibility of adapting to the existing impacts of climate change such as droughts. At the same time the farmers are contributing to the mitigation of Climate Change by lowering and sequestering the emissions of all major green-house gasses. Solutions to climate change must be sustainable and thus there must be incentive at all levels for farmers to implement the solution. Organic SRI is not only able to target adaptation and mitigation it also lowers production cost and increases yields and profits, making it attractive for farmers to transition. However, promoting a transition to organic SRI requires time, resources, training, research, and raising awareness. It is important that different stakeholders support sustainable efforts to face climate change.

End Notes

[1] CIA fact book
[2] Manas Ranjan, Senapati, Behera Bhagirathi, and Mishra Sruti Ranjan. "Impact of Climate Change on Indian Agriculture & Its Mitigating Priorities." *American Journal of Environmental Protection,* 1.4 (2013): 109-11. Web.
[3] CIA Fact Book
[4] Manas Ranjan, Senapati, Behera Bhagirathi, and Mishra Sruti Ranjan. "Impact of Climate Change on Indian Agriculture & Its Mitigating Priorities." *American Journal of Environmental Protection,* 1.4 (2013): 109-11. Web.
[5] "Climate Change: A Summary of the Science." *The Royal Society* (2010): n. pag. Print.
[6] Manas Ranjan, Senapati, Behera Bhagirathi, and Mishra Sruti Ranjan. "Impact of Climate Change on Indian Agriculture & Its Mitigating Priorities." *American Journal of Environmental Protection,* 1.4 (2013): 109-11. Web.
[7] Manas Ranjan, Senapati, Behera Bhagirathi, and Mishra Sruti Ranjan. "Impact of Climate Change on Indian Agriculture & Its Mitigating Priorities." *American Journal of Environmental Protection,* 1.4 (2013): 109-11. Web.
[8] Sindhu, J. S. "Potential Impacts of Climate Change on Agriculture." *Indian Journal on Science and Technology* 4.3 (2011): n. pag. Web. <http://www.indjst.org/index.php/indjst/article/view/29998>.
[9] "Climate Change: A Summary of the Science." *The Royal Society* (2010): n. pag. Print.

[11] "Organic Agriculture a Guide to Climate Change and Food Security." *IFOAM*(2009): n. pag. Print.
[12] "Organic Agriculture a Guide to Climate Change and Food Security." *IFOAM*(2009): n. pag. Print.
[13] Manas Ranjan, Senapati, Behera Bhagirathi, and Mishra Sruti Ranjan. "Impact of Climate Change on Indian Agriculture & Its Mitigating Priorities." *American Journal of Environmental Protection,* 1.4 (2013): 109-11. Web
[14] Senthil, K., V. Suresh, K. Parimala, and S. Arumugasamy. "System of Rice Intensification." *Centre For Indian Knowledge Systems* (2009): n. pag. Print.
[15] Sindhu, J. S. "Potential Impacts of Climate Change on Agriculture." *Indian Journal on Science and Technology* 4.3 (2011): n. pag. Web. <http://www.indjst.org/index.php/indjst/article/view/29998>.
[16] "Organic Agriculture a Guide to Climate Change and Food Security." *IFOAM*(2009): n. pag. Print.

[17] Andre, Leu. "Organic Farming and Climate Change." *Spice India* (2010): n. pag. Print.
[18] "Organic Agriculture a Guide to Climate Change and Food Security." *IFOAM*(2009): n. pag. Print.
[19] Senthil, K., V. Suresh, K. Parimala, and S. Arumugasamy. "System of Rice Intensification." *Centre For Indian Knowledge Systems* (2009): n. pag. Print.
[20] Andre, Leu. "Organic Farming and Climate Change." *Spice India* (2010): n. pag. Print.
[21] "System of Crop Intensification: A Step towards Climate Resilient Agriculture." *WORT* (n.d.): n. pag. Web.
[22] Adhikari, P., D. Sen, and N. Hphoff. "System of Rice Intensification as a Resource-conserving Methodology: Contributing to Food Security in an Era of Climate Change." *State Agricultural Technologists Service Association* 14.Annual Technical Issue (2010): 26-44. Print.
[23] "Organic Agriculture a Guide to Climate Change and Food Security." *IFOAM*(2009): n. pag. Print.
[24] Mishra, Abha. "System of Rice Intensification (SRI): A Quest for Interactive Science to Mitigate the Climate Change Vulnerability." *IOP Conference Series: Earth and Environmental* Science 6.24 (2009): 242028. Web.