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Climate Smart Agriculture (CSA): Methods and Significant Effect of Alternate Wetting and Drying (AW&D) Practices on Cutting Methane Gas Emission from the Rice Cultivation Field

*Mr. Pankaj Budakoti
Agriculturist JAKOB-RP-D.O.O Ljubljana (Slovenia) Europe, (Former Assistant Professor Department of Agriculture, Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehradun, State Uttarakhand, India
*Corresponding Author's email: pankajbudakoti01@gmail.com

Since the starting of green revolution and industrialization and extreme exploiting of flora and fauna led specially in Agriculture practices to increasing emission of Greenhouse gases (GHS) into the environment. It raises climate changes. Due to these impact and attention of the world with climate changes events. The Food and Agriculture Organization of the United Nations (FAO) first proposed to develop "climate-smart agriculture" at the Hague Conference in 2010. The main goal is to achieve the climate change mitigation food security, reduction losses from biodiversity and enhance the carbon sinks and impact.Now the days with the climate change and Global warming. Agriculture and farming practices getting hampered. Sowing time is going to shift by the extreme change due to extreme drought, extreme rainfall, extreme heat waves and cyclones. These factors getting adverse impact in agriculture production and sustainable practices. Behind this main cause is global worming under this Greenhouse gases (GHSs). GHSs lead to global pollution. It's simple means increasing the air temperature by the extreme emission of potent gases. In this context Methane (Ch_4) gases is one of dangerous pollutant under the (GHSs). In the earth there are many sources of emission of methane gas and among of them paddy cultivation countries and field involves lead the GHSs. According to data agriculture contributes 10% to 12% emission of GHSs and Methane 40% and Nitrous oxide 60% (O. Edenhofer, et al. (Eds.), IPCC Climate Change 2014). 8% of GHSs is produce alone from paddy field. It's 28 times more potent as GHSs than carbon dioxide. Lowland flooded rice field account 12% of global methane mission and 1.5% global worming (Asian Development Bank).Rice is the staple food among of the cereals crops specially in south Asia part. In specially India Paddy cultivation field is contribute between 4-6% of global anthropogenic methane emissions it releasing 23 to 34 teragrams (Tg) of methane annually. Irrigated low land rice cultivation fields are responsible for approximately 3.97 Tg of methane emissions (Ministry of Agriculture & Farmers Welfare, 2 AUG 2024 5:25PM by PIB Bhubaneshwar) in each year.

Methane

Methane is a natural gas. Molecular formula is Ch_4 it have one carbon atom and four hydrogen atoms. Physical it is odourless, colourless and low weight of air. Insoluble in water and when its burn produce blue colour. 80 times greater than that of carbon dioxide (CO2) during the 20 years after it is released into the atmosphere. (IPCC).

Sources of Methane: some of common sources of methane emission. like humid area where carbon decomposition by anaerobic condition. 40% to 60% emission by human and animal activities. Such ruminant animals, paddy field, from gas extraction, decomposition of organic waste in lowland area. Automobile combustion, waste water treatment and certain industrial process.

Use of Methane: Cooking, heating and energy generation**,** Transportation use etc.

Producation of Methan gas from Rice field: Methane production in the flooded rice field is due to non-supply of oxygen and anaerobic decomposition of organic matter by bacteria called Methanogenic archaea. In these conditions, microscopic organisms called archaea use acetate and hydrogen to break down essential resources in a process called fermentation. Acetoclastic methanogenesis, certain archaea cleave acetate produced during anaerobic fermentation to yield methane and carbon dioxide. (**E. Hasan / Water Science 27 (2014) 69–77).**

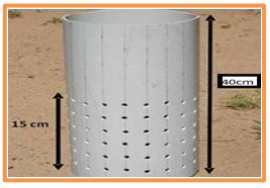
Factors effects of Methane gas production: According to study and research Continuous flooded condition in the paddy field may lead Methanogenic archaea bacteria. Improper decomposition of Organic matter before applies in the field effect microbe's population. Temperature raise between 30 to 38 c favourable for bacteria they effect methane emission. Increase the ph level upto 7.5 to 8.5 may be increased bacteria population. Amide and nitrate based fertilizers increased microbial population. Ammonium based fertilizers suppress methane production.

What are Alternate wetting and drying (AW&D) and Method of installation

Alternate wetting and drying (AW&D) technology developed by the IRRI Manila Philippines. According to IRRI Aalternate Wetting and Drying (AWD) is a water-saving technology that farmers can apply to reduce their irrigation water consumption in rice fields without decreasing its yield. In AWD, irrigation water is applied a few days after the disappearance of the ponded water. Hence, the field gets alternately flooded and non-flooded. The number of days of non-flooded soil between irrigations can vary from 1 to more than 10 days depending on the number of factors such as soil type, weather, and crop growth stage. It can be use both purpose water saving and reduction of methane gas emission. It is design for the increased water use efficiency in the rice field, it is special design the low land rice field area where the irrigation controlled by tube wells, pumps and summer civil system. It required the continuous monitoring by the farmers.

Installation method of (AW&D): Step-1: First take the 40cm pvc water tube pipe or Bamboo diameter should about 7cm to 10cm keep ensure the water should be visible inside the pipe.

Step-2: To implement AWD in rice fields. Make some holes from bottom to mid of pipe upto 15cm. tube should be perforated with 0.5 cm holes, spaced 2 cm apart, allowing water to flow freely through it.



Step-3 Insert the 40cm tube into the rice field after 10 to 15 day after transplanting, and maintain the water in the transplanted field. Tube should be inserting 1m to 2m away from the bunds. Monitor the water level in the tube every day.

Fig: (https://www.icar-iirr.org/index.php/en/institute-research/institue-technologies-developed?layout=edit&id=113)

Work and Monitoring: After buried installation of Pipe we have to apply conventional irrigation in the transplanted rice field. After some days we monitor the water level gradually water seepage from the small holes and goes to downward and disappear from the (15cm) pipe. Field should re-irrigated again and maintain water as per rice required level. This process will be continuing. Wetting and Drying called AWD (Alternate wetting and Alternate Drying). Continuous monitoring and cleaning of pipe required.

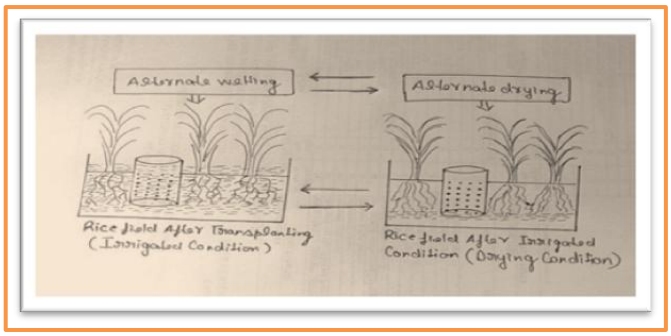


Fig: AWD (Alternate wetting and Alternate Drying)

Advantage

AWD (Alternate wetting and Alternate Drying) have significant advantage it including the water savings up to 15-40% without reduction of yield loss. It enhances root proliferation and anchorage, reducing plant lodging during the flowering and grain filling stage. Those farmers using pump and summer civil irrigation, AWD lowers fuel costs and pumping expenses and other leading to an increased per hectare. On the other hand Alternate wetting and Alternate Drying reduces methane emissions by 30-50%. It's depending on water management and rice. Under this AWD also increases zinc availability in both soil and grains, improving crop nutrition. As a sustainable water-saving technology, AWD is well-suited for lowland paddy rice production under irrigation. For the handling and monitoring it not required any continuous technical guidance. Ones install and keep watch normal field condition.

Conclusion and Summary

In the Context of methane gas emission and climate change and their impact. Among the others causes of GHS (Green houses Gas) emission Rice farming is one of them. Climate smart farming is most significant option in the agriculture production. Especially in rice production because rice is one of most staple food in the world and for Asian countries. Rice need more water for sowing till harvesting. But along with production of rice crop, methane emission also increasing and hampering the environment due to this effect shifting the agriculture regime and conventional sowing season. extreme emission of methane happens in flooded and water stagnated area as it promotes the emission of methane gas and it increase the Methanogenic archaea bacteria in the field Rice. Exact this favourable condition required rice crop production. Therefore long stand water in the rice field promote more Methanogenic archaea bacteria. If we maintain the control irrigation in the rice field. And if field remain dry and wet for some time then we can control bacteria population. If bacterial population remain control it is possible emission of methane gas can be control. Therefore IRRI has introduced the AWD (Alternate wetting and Alternate Drying). Under this we need the 40cm pvc pipe with some designated whole and put the field. It required continues monitoring if we find inside the water of pipe goes below to 15cm it means it's time to irrigation. And then wait for drying and then wetting. Significant yield advantage up to 15% to 20%. Water saving upto 20% to 40%. No any certain technical guidance is required Easy and simple. Through the AWD We can increase the water use efficiency. AWD adoption is depending on the choice of the farmer. And it expend on limited area where application of water in controlled way.

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