# Evaluating the amount of carbonic greenhouse gasses (GHGes) emission from rice paddies

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**Abstract**
Global temperature change is one of the most important issues of GHGes emission. A scientific consensus is forming that human activities including modern agriculture by increasing the emission of GHGes may play a key role in elevating the global temperatures. This study was conducted to evaluate the amount of three important carbonic GHGes emission from rice paddies. Carbonic GHGes emission for 3 kinds of rice cultivation in one field were measured at Khuzestan province in Iran. The 3 kinds of cultivation were: wet-bed-seeding (a), dry-bed-seeding (b) and transplanting (c). The experiment was performed with 4 sampling times at 4 different growth stages of rice cultivation and three repeats in a completely randomized design. We used a chamber method and gas chromatograph technique to measure the emission of $CH_4$, $CO_2$ and CO from rice paddies. Results showed that the highest emitted gas was $CO_2$ and its highest emission happened at (a) and at the rice cultivation stage. On the whole $CH_4$ emission was greatest for (a) and for all kinds of cultivation was high at the tillering and ripening stages and low at the rice cultivation and shooting stages.

**Key Words**
Rice paddy, carbonic greenhouse gas, emission

## Introduction

Agriculture represents a significant source of the world's total anthropogenic greenhouse gas emission. In this regard flooded rice paddies have an important role in the global budget of $CH_4$ and $CO_2$ (IPCC, 1995). Methane is one of the most important GHGes with a 10 year life time and with 21 times as much greenhouse effect as $CO_2$ in 100 years (Neue *et al*., 1995) and it is the most abundant carbonic gas at atmosphere after $CO_2$. The current global average atmospheric concentration of $CH_4$, is 1.78 ppmv (Dlugokencky 2001). Global annual methane emission from rice fields were estimated to range from 25 to 100 Tg which contributed 10 to 30% of global methane emission (Crutzen, 1991; IPCC 1995). Atmospheric $CO_2$ is also increasing at the rate of 5% a year. Burning fuel and changing land use are two major human activities that result in this increase (Lal and Kimbel, 1995). Organic carbon in the soil is the main source of greenhouse gas emission from the soil (Post and Kwon, 2000). In croplands, organic carbon is supplied to the soil as root exudates, dead roots and stubble of crops. Some other additional organic carbon is also supplied by organic matter incorporation (Nishimura *et al*., 2008). The amount of organic carbon stored in paddy soils is greater than in upland soils because of different biochemical processes and mechanisms specifically caused by the presence of flooded water in paddy soils (Liping and Erda, 2001). The dynamics of carbon in paddy fields significantly differs from that in fields with upland crop cultivation in which the aerobic decomposition process is dominant. During the submerged period of paddy rice cultivation, $CO_2$ production in the soil is severely restricted under anaerobic conditions. Instead, $CH_4$ is actively produced in the soil and emitted to the atmosphere mainly through the rice plants (Nishimura *et al*., 2008). However $CH_4$ and $CO_2$ emission in paddy soils is universal and inevitable. For this study evaluating the effects of different kinds of rice cultivation on carbonic GHGes emission, $CH_4$, $CO_2$ and CO emissions were measured at different stages of rice cultivation from one field with 3 kinds of rice cultivation. To determine which kind of cultivation and which stage of growth cause more carbonic GHGes emission.

## Materials and methods

*Materials*

This study was conducted in one field 70 Km North West from Ahvaz between Karkhe and Karoon rivers.

*Methods*

12 static chambers were built to collect the gasses. The chamber framework was built from poly-ethylene tube with 1 cm thickness and 20 cm diameter. One side of the tubes was locked with transparent polyethylene with 1 cm thickness and 2 orifices were constructed for a pipe (for air sampling) and a thermometer in the middle of framework. Nine chambers with 1 m height were used for rice cultivation. Although rice plants do not produce methane rice cultivation is a major way for methane to escape from soil

to atmosphere (about 50 to 80% of total methane emission). It is necessary that the plant is placed in the chamber. On the other hand, to measure net soil carbonic gasses emission, 3 other chambers with 40 cm height were without plants and with waterlogged soil (d) were used to measure $CH_4$, $CO_2$ and CO on collected soil air, chambers were placed in fields and inserted 5-7 cm in to soil and packed with mud, then after 4 h air sampling was done with a 60 mL syringe and the thermometer was read. Air sampling has been done 4 times during this study. 1 h after sampling air sampling were translocated to the laboratory and were read by a Gas Chromatograph (GC) system with FID (Flame Ionization Detector) and TCD (Thermal Conductivity Detector) detectors. Reading data were then revised for standard temperature and figures were drawn with Excel software.

**Results and discussion**

Results show that the amount of methane emission in (a) was more than the emission in (b); and (c) had the lowest amount of methane emission. This is due to the waterlogged soil with reduction conditions occurring since one month before the cultivation in (a) and (b) and dry soil with aerobic condition until cultivation time in (c). Also the higher amount of methane emission in (a) than (b) is for warmer water due to sunshine while seedlings in (b) protected the water from sunshine. Methane emission for (c) was more than in (d) in tillering and shooting stages. It is also due to a longer waterlogged time in (d) than in (c). Methane emission was high for tillering and ripening stages and low for shooting stage for all kinds of cultivation. This was due to the smaller size of seedlings at tillering than at shooting and warmer water around seedlings at the tillering stage and the highest reduction condition at the ripening stage. Due to the increasing growth of above ground biomass as compared to roots at the shooting stage, most of the assimilates were consumed within the above ground biomass and little of them remained for roots to grow, so the roots will have smaller discharges. Methane production by microorganisms that depend on these discharges, will be restricted and methane emission will decrease. $CO_2$ was the highest emitted gas and the greatest amount of emission happened for (a) at the rice cultivation stage. This is due to the warmer water around the seedlings in (a) than (b) and better oxidation condition during the cultivation stage. CO emission is high at the cultivation stage but very low at other stages. This is due to the better oxidation condition at the cultivation stage and high soil moisture at the other stages that caused oxidation of CO and prevented emission.

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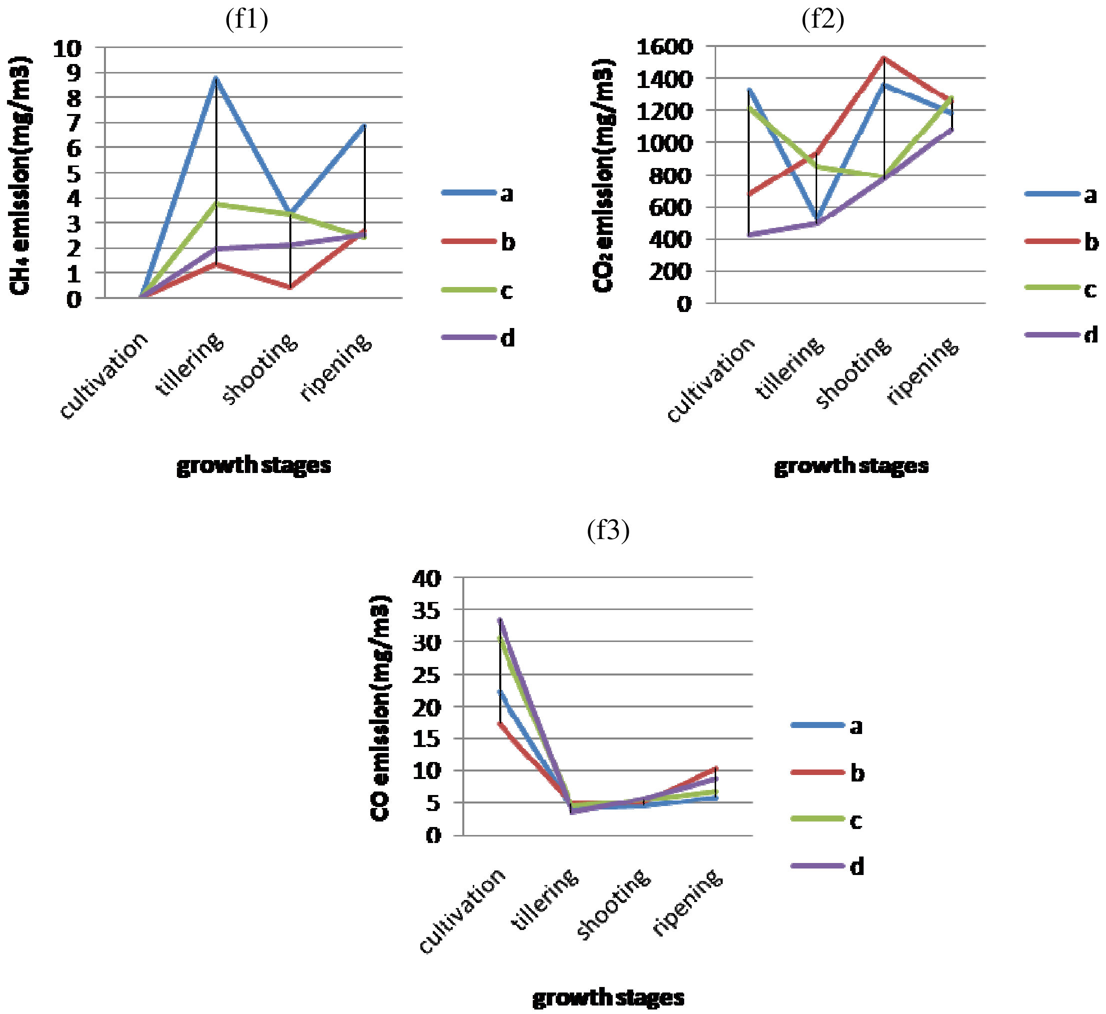


**Figure 1. $CH_4$ emission at different growth stages of rice cultivation (f1) $CO_2$ emission at different growth stages of rice cultivation (f2) CO emission at different growth stages of rice cultivation (f3).**