

Advanced Global Agricultural Sciences-1 report

39-156244

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Theme of study

「effects of water saving irrigation on nitrogen dynamics in rice paddy of Colombia」

Name of the project

「Development and Adoption of Latin American Low-input Rice Production System Through Genetic Improvement and Advanced Field-management Technologies」

Background

Rice is one of staple food in Colombia, which is grown widely after coffee and maize. The rice production in Colombia reaches 2.5 million tons (unhulled rice). Colombia is a one of the major rice producing countries in Latin America after Brazil and Peru.

Rice production in Colombia has been adopting cross-field irrigation. The water use efficiency under this irrigation is low. It is needed to improve the water use efficiency for meeting the increasing demand for the dry-season cropping and for resolving the problem of water scarcity.

In addition, the rice production cost in Colombia is 20% higher than that of the United States owing to unsuitable water and fertilizer management. If the import of cheap rice made in the United States increases followed the schedule of FTA between the United States and Colombia signed in 2006, it will affect to rice farmers in Colombia.

Therefore it is needed to develop resource saving rice cropping system.

The purpose of my research is proving the effects of water saving irrigation on nitrogen dynamics in farmers' field of Colombia.

Country

Colombia

Duration

13 of October 2015~ 30 of September 2016

Content of research

Proving the effects of water saving irrigation on nitrogen budget (nitrogen input, ammonia volatilization, nitrogen leaching, runoff, uptake by plant) in the farmers' field of Colombia.

Accepting organization

International Center for Tropical Agriculture (CIAT)

Accepting researcher

Dr. Manabu Ishitani

Basic data of Colombia

Colombia, officially the Republic of Colombia, is a country situated in the northwest of South America. The population of Colombia is the third highest in the Latin America after Brazil and Mexico. Colombia is famous as the exporting country of coffee, emerald, cut-flower and also cocaine.



Fig1. National flag

Capital: Bogotá

Area: 1,139,000km² (about three times bigger than Japan)

Population: about 44.5 million

Language: Spanish

Religion: Catholic (95%)

Major industry: agriculture (coffee, banana, sugarcane, potato, rice, tropical fruit), mining (petroleum, coal, gold, emerald)

Main exporting items: coffee, emerald, cut-flowers, petroleum

GNI per person: 7,020US\$ (2012, world bank)

Food: as staple food, Colombian people eat empanada, ingredient made of potato and mince meat is wrapped by maize dough and fried, arepa, bread of maize, and rice for lunch.

Lunch is most important in Colombia. In general, they eat steamed indica rice, roasted meat, paste of beans, salad and juice as lunch. In restaurant, they cost only 1.5~3 US\$.



Fig2. Map of Latin America



Fig3. General lunch



Fig4. Arepa sold on the street

Tobitate! ryuugaku Japan
~program for becoming representative of
Japan~



This is a campaign to promote overseas study for development of global human resources conducted by both of public and private sectors.

Thanks to this scholarship, I can conduct my investigation in Colombia without the anxiety of money.

This has the following key features: the first is generous supports. You can get expenses for local activity, travel expenses and tuition fees.

The second is that you can conduct various kinds of activity such as, not only exchange study abroad, but also internship, volunteer and fieldwork.

The final is that you are enrolled to the community for developing global human resources. You have chance to meet person playing an active part in the world.

CIAT
~International Center for Tropical
Agriculture~



The official name of CIAT is

international center for tropical agriculture. This institute is a member of the CGIAR consortium.

They are established in 1967 in Cali, Colombia and conducting researched mainly about cassava, beans, tropical forage and rice. The mission is to reduce hunger and poverty, and improve human nutrition in the tropics through the research aimed at increasing the eco-efficiency of agriculture.

I stayed in CIAT only for 3 weeks. There are many assistant and workers from Colombia in Colombia. I had felt that the entry level is high before I went there but in real, the atmosphere of CIAT is so free and rough so it is very good environment for concentrating for the experiment.

What I felt in CIAT is the importance of planning of experiment. In Japan, I didn't think about the budget for experiment well because I could get and order everything easily. But stay in CIAT made me think about budget because, for example, I heard salary for field-workers are paid from research expenses. To use research expenses effeciently, it is necessary to plan experiment well.



Fig5. Labolatry in CIAT



Fig6. Experimetal field in CIAT

**FEDEARROZ~FEDERACIÓN
NACIONAL DE ARROCEROS~**

Fedearroz is a national association for rice producers established in 1947.

Headquarter of Fedearroz is in

Bogota and there are 20 branches. Their main activities are conducting research, transferring technology to farmers and selling agricultural materials to farmers.





Fig7. Outer appearance of Fedearroz

Schedule so far

13 October	Arrival to Colombia
14 October	First visiting Fedearroz Ibague, farmers
15 ~25 October	Preparation of Pre-experiment in Ibague
26 October~9 November	Pre-experiment in Ibague
10 ~16 November	Analysis of pre-experiment in Ibague, Preparation of Pre-experiment in CIAT
17 November	Moving to Cali
18 November	First visiting CIAT
19 ~ 23 November	Preparation for the seminar
24 November	Conducting presentation about my research
25 ~ 27 November	Preparation for pre-experiment in CIAT
28 November ~ 4 December	Pre-experiment in CIAT
5,6 December	Holiday
7 December	Moving to Ibague

Pre-experiment in Ibague

Experimental place: three rice farmers in Ibague, Tolima, Colombia

Duration: 26 October 2015~9 November 2015

Purpose: ①confirming the experimental equipment to work in Colombia, ②
investigating the amount of ammonia volatilization and nitrogen leaching of farm for
the first time in Colombia

Contents: monitoring of the amount of ammonia volatilization, nitrogen leaching, soil
water content, soil pH before and after fertilization

Preparation: there is not experimental equipment like beaker. So I started from shopping of substitute for experimental equipment. A large selection of materials is available at DIY stores in Colombia.

Plot: 6 plots with $2\text{m} \times 2\text{m}$ were made. For the three of them, nitrogen fertilizer was applied with the amount of farmers' practice and for the other three plots, 50% amount of farmers' practice. After first sampling at 27 October, fertilizer was applied manually.

Ammonia volatilization: Ammonia volatilization was captured by [vented chamber method]. The vented chamber was made of round PVC tube. Two pieces of round sponge were put into each chamber after they were moistened with a 15 mL phosphateglycerol solution. The sponge inside the chamber was to absorb NH_3 volatilized from the soil, and the top sponge was for absorbing NH_3 from the ambient air. One set of this equipment is set in the center of each plot. Sampling was conducted every day for one week after fertilization, every 2-3 days for another week. After sampling, ammonia in the phosphate solution in each sponge inside the vented chamber was extracted with 300mL of 1M KCl. Ammonium quantities in the KCl extract solution were determined by ammonium electrode.

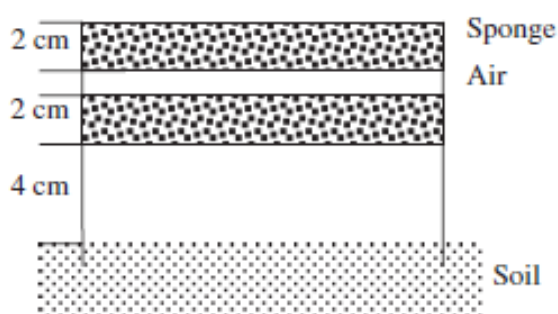


Fig8. Cross-section view of vented chamber



Fig 9. Bird's eye view of vented chamber



Fig 10. Ammonia electrode

Nitrogen leaching: 「Mizuto-ru」 was used for sampling groundwater at a depth of 60cm. The nitrate concentration of sampled groundwater is used as indicator of nitrogen leaching. Hole until the depth of 60cm was dug by the auger and mizto-ru was installed to this hole. By absorbing with syringe, groundwater is sampled. Nitrate concentration and ammonium concentration in sampled groundwater is measured by compact nitrate ion meter and ammonia electrode.



Fig 11.mizuto-ru and syringe



Fig 12.mizuto-ru and syringe

Soil pH: soil pH is measured at the beginning, intermediate, and ending of the experiment. Three points of surface soil around vented chamber are sampled. Three points of soil are mixed, 20g of them are mixed with 50mL of water. After soil is deposited, the pH of supernatant liquid is measured by compact pH meter.

Soil water content: soil water content of the three points around each vented chamber was measured by TDR.

Results: It was possible to conduct a series of experiment without problem in Colombia. Now I know the time which is needed for the experiment. The proposal of main experiment is changed based on pre-experiment.

The amount of ammonia volatilization was higher than Japan. Although this pre-experiment was conducted under imperfect condition because there were no plant, this is first time to show the amount of ammonia volatilization numerically in Colombia.



Fig 13. With colleague in the farmers' field

The amount of ammonia volatilization was different between the nitrogen treatments. There was a possibility that the difference didn't appear because the plot was too small, there was a difference in the amount of ammonia volatilization between the nitrogen treatments.

Pre-experiment in CIAT

Experimental site: experimental field in CIAT, Cali, Colombia

Duration: 27 November 2015~4 December 2015

Purpose: ①to measure the amount of nitrogen loss under the environment of CIAT, ② to compare the amount of nitrogen loss between water treatments.

Contents: monitoring of the amount of ammonia volatilization, nitrogen leaching, soil water content and soil pH before and after the fertilization under flooded, water saving irrigation and upland condition.

Treatment: water treatment (flooded, water saving irrigation, upland)

Plot: figure14

Sampling: same with pre-experiment in Ibague

Results: the amount of ammonia volatilization in CIAT was lower than Ibague. The difference of water treatment affected on the amount of ammonia volatilization.

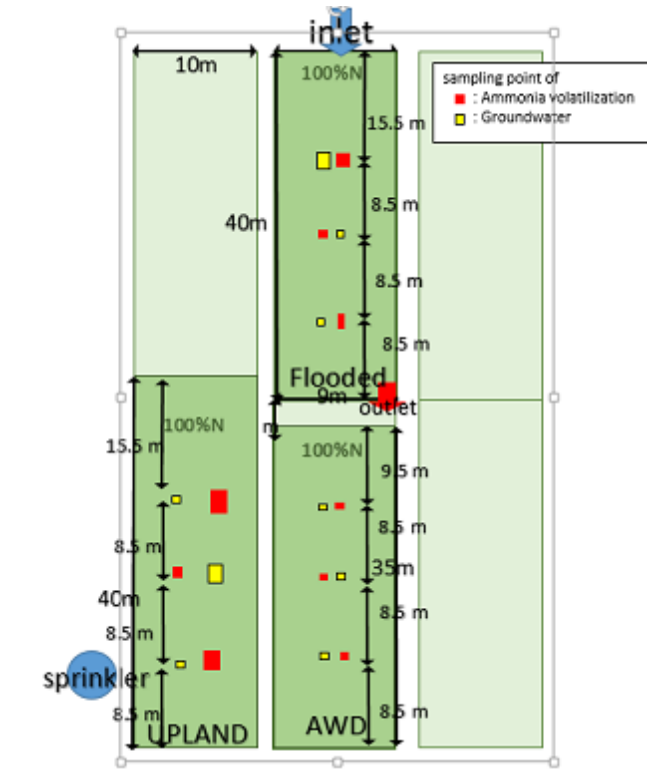


Fig 14. Eperimental plot in CIAT

Future schedule

December	Analyzing date of pre-experiments
January	Preparation for main experiment
February to May	Main experiment
June to September	Analyzing data, writing thesis, Activity to get knowledge about agriculture in Latin America