A Regional Econometric Study of the Interactions Among Climate Changes,
Agricultural Supply & Demand, and AgriEnvironmental policy

Kick-off Meeting

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1. Research Objectives

The purpose of this study is to conduct a research on relation between the farming activities and environmental resource factors such as irrigation, climate change, green-house-gas emission etc. The impacts on technical efficiency in agriculture of irrigation project is also conducted.

2. Research Topics and methodologies, < examples based on my works in other areas>

<1>As for the impacts of water resource conservation regulations, I have conducted the input-output analysis on the environmental resource conservation in rice growing area in Australia, where 4 regulations are imposed. i.e. (1) regulation of rice farming location, under this regulations, rice farming is allowed only in the districts whose underground clay soil is more than 1.5 meters in depth (2) water allocation regulation, (maximum available water is 600～1400 megalitre per farm), (3)regulation on farm land ownership, (maximum area of farm holding is 140% of the home maintenance areas), (4) rice production regulation. (Depending on rice market situations, rice production quota is allocated to each producer every year) These regulations are imposed in order to alleviate the serious water shortage and salinity problems. In this research, the impacts of irrigation investment and the change of these regulations on each sectors is analyzed. This regionalized IO model consists of 23 sectors for intermediate demand/inputs, 3 sectors for final demand and 3 sectors for value added. One part of results is shown in Table 1 for Australian rice sector case.

Regional Agricultural Sector based I-O Analysis

$$A \cdot X + F = X \qquad \cdots\cdots ①$$

$$X = (I - A)^{-1} \cdot F \qquad \cdots\cdots ②$$

<enfluence degree coefficient> $E_j = \Sigma_i b_{ij} / (\Sigma_j \Sigma_i b_{ij} / n)$ $(i,j=1,2,\cdots,n)$ ···③

<renponsive degree coefficient> $K_i = \Sigma_j b_{ij} / (\Sigma_i \Sigma_j b_{ij} / n)$ $(i,j=1,2,\cdots,n)$ ···④

$$P = [(I - A)^{-1}]' V \qquad \cdots\cdots ⑤$$

$$\Delta P = [(I - A)^{-1}]' \Delta V \qquad \cdots\cdots ⑥$$

<2> I have conducted a research on the global warming and methane emission from rice growing by simultaneous equation model. According to EPA report[3], the methane emission from paddy field is 60 to 170 million tons and those from livestock grazing is 65 to 85 million tons per year. The methane emission coefficients are 5 to 120 g per 1 km^2 of paddy field, 64 kg per dairy cow, and 41kg per beef cattle [4].

According to IPCC report[], it is known that the contribution of methane on the global warming is 21 times bigger than CO_2 although the methane density in the air is 1.72 ppm, much less than CO_2 density (353 ppm). The 1 ppm increase of CO_2 density makes temperature by 0.0038 but the 1 ppm increase of methane density makes temperature by 0.1 degree, 26 times bigger effect than CO_2.

This prediction model consists of 8 structural equations and 2 identities. The flowchart of model structure is shown in Fig 1 and the predicted results of methane emission are shown in the figures 2.

<3> As for the regional level study. I am interested in analysis on the effects of the irrigation projects and climate related variables on technical-efficiency and allocation efficiency in agriculture in Turkey. The stochastic frontier production function can be estimated for this analysis. i.e.

$$\ln Y = \alpha_0 + \Sigma_k \alpha_k \ln X_{ki} + \Sigma_k \Sigma_k \beta_{kj} \ln X_{ki} \ln X_{kj} + \Sigma_n c_n D_n + V_i - U_I \quad \cdots\cdots\cdots\cdots\cdots ⑦$$

$$TE = [1 + \exp(-b_0 - \Sigma_f b_f d_f - \mu)]^{-1} = f(Ir, Cl, \cdots\cdots) \quad \cdots\cdots\cdots\cdots\cdots ⑧$$

$$AE = (\partial Y / \partial X) / R_k = g(Ir, Cl, \cdots\cdots) \quad \cdots\cdots\cdots\cdots\cdots ⑨$$

The frontier function can be cost function or profit function instead of the production function. Also the specification of these functions can be either of Cobb-Douglas, CES ot Translog form.

By comparison of these relations among different regions in Turkey, we can find regional pattern of significance of irrigation and environmental resource factors on agricultural efficiencies.

<Reference>

[1]Masaru KAGATSUME, “Input Output Analysis on the Environmental Resources Conservation in Rice Growing Areas in Australia”,Journal of Oceania Economy Studies], No.7, October, 1993, Association of Oceanian Economic Studies

[2]Masaru KAGATSUME, “Global warming and methane emission from the rice growing”, The Farm Accounting Studies, No.24, December 1991

[3]Lashof, D & Tirpak, D., “Policy options for stabilizing global climate” (draft), US. EPA, Washington, DC., 1989

[4]Yuzuru MATSUOKA, “Effects estimation model of global warming alleviation measures”, Environmental Research, No.77, 1990

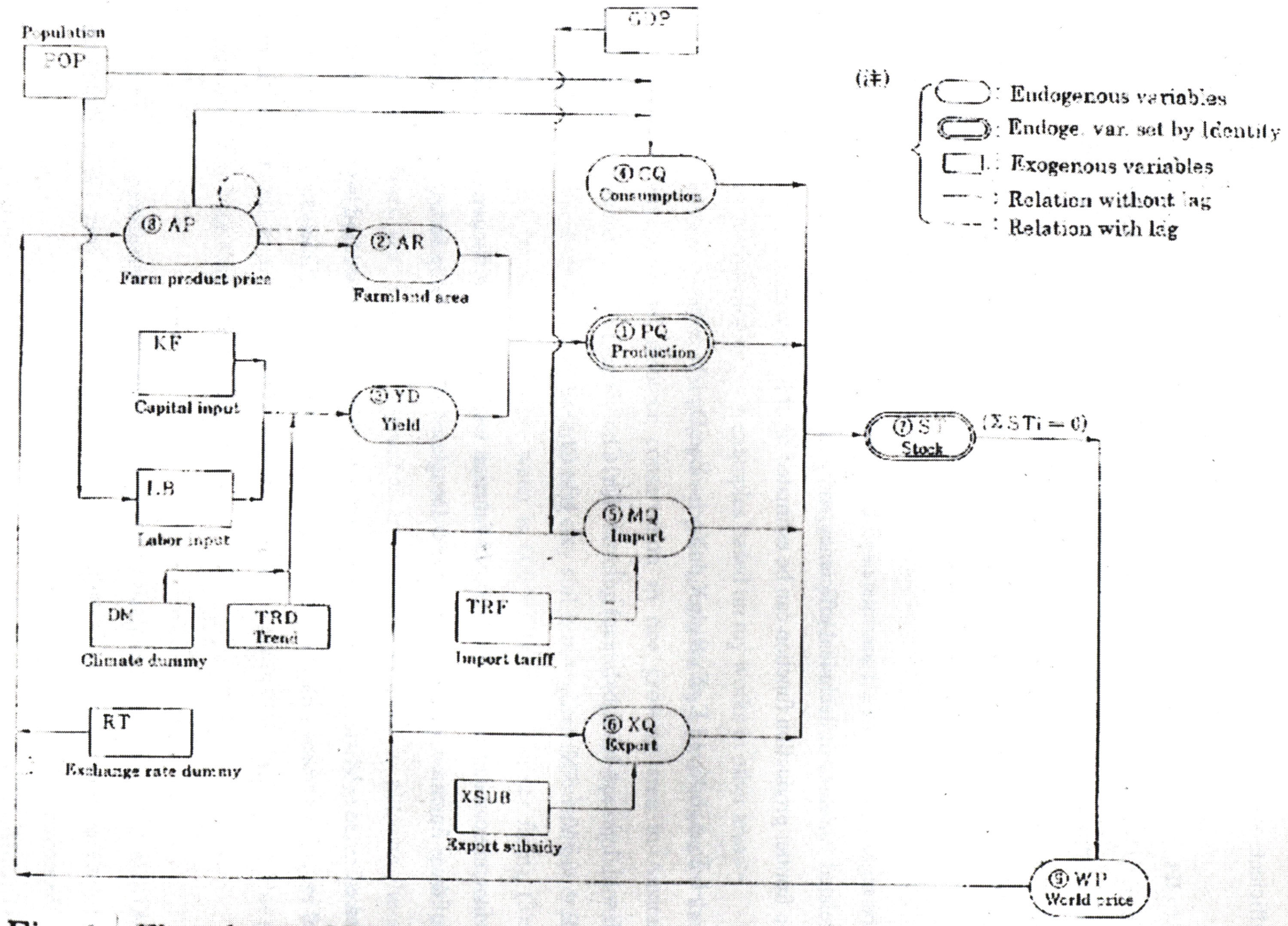

Fig. 1 Flowchart of Rice Sector-Methane Emission model

Simultaneous Equation System of the Rice-Sector Methane Emission model

< Explanation of variables >

① PQ=AR・YD
② AR=f (AP(-1), QT)
③ YD=f (LB, KF, DM, TRD)
④ CQ=f (AP, GDP, POP)
⑤ MQ=f (WP, GDP, TRF)
⑥ XQ=f (WP, XSUB)
⑦ ST=PQ+MQ-CQ-XQ
⑧ AP=f (RT・WP, AP(-1))
⑨ WP=f (ΣST)

<endogenous variables>

①PQ=Production
②AR=Farmland area
③YD=Yield
④CQ=Consumption
⑤MQ=Import
⑥XQ=Export
⑦ST=Stock
⑧AP=Domestic price
⑨WP=International price

<exogenous variables>

GDP=Gross domestic product
POP=Population
KF=Capital input
LB=Labor input
DM=Climate dummy
TRD=Trend
RT=Exchange rate dummy
TRF=Import tariff
XSUB=Export subsidy
QT=Quota

Fig .2
Methane Emission from Rice Growing (million tons)

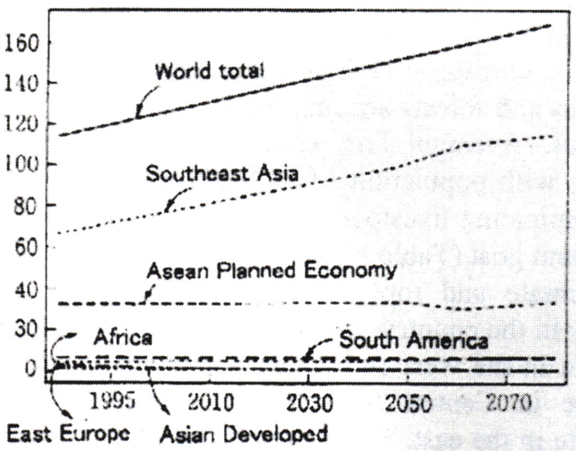

Table 1
Results of IO analysis in Australian rice sector model

(sectors)	Multiplier Effects of Irrigation Projects
Animal Products	0.05
Rice growing	0.61
Other Agric	0.08
Forestry/Fishery	0.00
Mining	0.00
Food	0.02
Rice Milling/processing	0.33
Wood/paper	0.00
Machine/equipment	0.00
Other manufacturing	0.00
Electricity/gas/water	0.00
Irrigation	-
Construction	0.00
Commerce	0.00
Transportation	0.00
Rice distribution	0.00
Finance	0.00
Administration	0.00
Community service	0.00
R&D	0.00
Personal services	0.00