Chapter 4
Development of the Rice Econometric Model with Endogenous Water in Thailand (REMEW-THAI)

4-1. Introduction

The world's leading rice exporter is Thailand, and this country exported 7.43 million metric tons (mMT) in 2006 and followed by India, Vietnam, Pakistan, and the USA, with rice exports of 3.30 mMT, 4.74 mMT, 4.64 mMT, 3.69 mMT, and 3.30 mMT respectively. Thailand's world rice trade was 24.3% in 2006; therefore, production trends affects the world food market. The variance of rice production depends in part on water supply changes and domestic policies.

There is an extensive body of existing literature on rice production and policies in Thailand. Siamwalla & Setboonsarng (1989) analyzed the effects of export taxes and price supports for rice, sugar, maize, and rubber by using a comparative static model. Kagatsume (1988) analyzed the impacts of a rice-premium policy on the market of rice in Thailand using a supply and demand model of rice, and found that this policy has a price stabilizing effect. O'Mara & Le-Si (1985) analyzed impacts of price changes of rice on agricultural income and production using an income classification model, and they shed light on the problem that farmers lost their incentives to produce through the rice-premium policy. Choeun, Godo, & Hayami (2006) used a comparative static model and clarified the issue that the export tax was higher than the optimum value in the low-income era by politicians' lead.

Tax revenue in Thailand increased due to the growth of the industrial sector, and the rice-premium policy was abolished in 1986. However, the policy had another function, the stabilization of domestic price of rice. The paddy mortgage scheme was started 1984 for the purpose of price stabilization.

The model developed in this chapter focuses on the analyses of impacts of water supply changes on the regional rice market; thus, analyses of the impacts of policy change is reserved for other articles. However, the understanding of the paddy mortgage scheme is quite important to understand the background of the supply and demand of rice in Thailand. The outline of the policy is described in the next section.

4-2. Paddy mortgage scheme

The paddy mortgage scheme allows the farmer to obtain financing from the Bank of Agricultural Cooperatives (BAAC) when the farmer pledges their paddy to the Public Warehouse Organization (PWO). If the market price is higher than the loan rate plus interest rate, the farmer will be able to buy back their paddy at this lower adjusted loan price. Conversely, if the market price is lower than the loan rate plus interest rate, pledged paddy of farmers will be confiscated by the government and the farmer retains the original payment.

Let's examine the workflow in more detail. First, farmers applies to participate in the scheme to the office of the Ministry of Agriculture and Cooperatives (MOAC), and if the office affirms that the farmer cultivates his or her land, they will get a certificate of registration in the scheme. The farmers bring their paddy to a miller who is also a member of the scheme. The farmers will get a certificate of shipment after the examination of the water content of the paddy by the PWO. Farmers who get the certificate present it to the BAAC and obtain the bank loan. The paddy is milled by directive of the government and is brought to the warehouse of the PWO. Furthermore, the interest rate of the BAAC for the scheme in the wet season in 2008 was 3%, and the upper limit of the loan provision to an individual farm was 500,000 Baht.

If a farmer participates in the scheme and sells his or her paddy to the government at the loan rate, the farmer gets the revenue which is loan rate times sales quantity. The paddy mortgage scheme forms a floor revenue when the market price is lower than the loan rate. However, the percentage of paddy production enrolled in the scheme has varied between 2.89% in 1999 and 25.23% in 2005. Clearly, the loan rate is not the floor price for all farmers in Thailand.

Academic and business experts pointed out some problems of the scheme in our interviews in Bangkok and its suburb. The problems raised are as follows; (1) The scheme mainly assists rich farmers who cultivate rice in the dry season. (2) The scheme diminishes the function of price formation in the central market. (3) The scheme expands the budget deficit. (4) The price of the milled rice sold by the government is higher than the market price, and it lowers the competitive edge of Thai rice in the global market.

The loan rate in dry season has been higher than the average farm price from 2004 to 2008; however, the loan rate in wet season has been lower than the average farm price from 2002 to 2007. The

fluctuations in price of dry season rice is wider than that of wet season rice, so, the government may have set the loan rate at a relatively high level for dry season rice.

The price stabilization effect of the paddy mortgage scheme is one of the mitigation policies for reducing impacts of the water supply changes on producers.

4-3. Model

The supply and demand model of rice in Thailand is more detailed in the North-East region because of its location in the critical Mekong River basin. Yield and planted area functions are estimated for each province in the North-East region and those in the North, Central, and South regions are estimated at the regional aggregate. There are nineteen provinces in the North-East region. There are two cultivation types, i.e., major rice or rainy season rice and second rice or dry season rice. The generalized forms of the model are as follows:

Yield function of major rice:

$$YW^i = f_{YWi}(T, ET_{MAR\,t}^{\ i}, \ldots, ET_{DEC\,t}^{\ i}), \quad (4\text{-}1)$$

Planted Area function of major rice:

$$APW^i_t = f_{APWi}(APW^i_{t-1}, FP_{t-1}, ET_{MAR\,t-1}^{\ i}, \ldots, ET_{DEC\,t-1}^{\ i}) \quad (4\text{-}2)$$

Harvested area of major rice:

$$AHW^i_t = APW^i_t - ABW^i_t = APW^i_t(1\text{-}RABW^i_t) \quad (4\text{-}3)$$

Production of major rice:

$$QW^i = YW^i AHW^i, \; QW = \sum_i QW^i, \quad (4\text{-}4)$$

Yield function of second rice:

$$YD^i = f_{YDi}(T, ET_{NOV\,t-1}^{\ i}, \ldots, ETJUN^i_t), \quad (4\text{-}5)$$

Planted Area function of second rice:

$$APD^i_t = f_{APDi}(APD^i_{t-1}, FP_{t-1}, ETNOV^i_{t-2}, \ldots, ET_{JUN\,t-1}^{\ i}) \quad (4\text{-}6)$$

Harvested area of second rice:

$$AHD^i_t = APD^i_t - ABD^i_t = APD^i_t(1\text{-}RABD^i_t) \quad (4\text{-}7)$$

Production of second rice:

$$QD^i = YD^i AHD^i, \; QD = \sum_i QD^i, \quad (4\text{-}8)$$

Total production:

$$Q = 0.667(QW + QD), \quad (4\text{-}9)$$

Export function:

$$EXP = f_{EXP}(T, Q), \quad (4\text{-}10)$$

Stock change function:

$$STC = f_{STC}(T, FP_{t,t-1}, Q_{t,t-1}), \quad (11)$$

Total supply:

$$QS = Q + IMP - EXP - STC, \quad (12)$$

Demand function:

$$QS/POP = f_{QS}(RP, GDP/POP), \quad (13)$$

Price linkage function:

$$FP = f_{FP}(RP), \quad (14)$$

where i is the province in the North-East region and in the regional aggregate elsewhere, t denotes that the data are measured at time t, T is a time trend, $ET_{JAN}^{\ i}$ through $ET_{DEC}^{\ i}$ are evapotranspiration values for January through December, *YW*, *APW*, *AHW*, *ABW*, *RABW*, and *QW* are yield, planted area, harvested area, abandoned area, abandoned area ratio, and production of main season rice, *YD*, *APD*, *AHD*, *ABD*, *RABD*, and *QD* are yield, planted area, harvested area, abandoned area, abandoned area ratio, and production of second season rice, *Q* is total production, *IMP* is imports, *EXP* is exports, STC is the annual change of stocks, i.e., ending stock minus beginning stock, *QS* is total supply, *POP* is population, *GDP* is gross domestic products, *EXR* is exchange rate, FP is the producer price, *RP* is the retail price. The retail price is fed to the other three countries' models through price linkage functions. The retail price of the Bangkok 5% broken is used to Laotian and Cambodian rice models, and that of the Bangkok 35% broken is used for Vietnamese rice model. All functions are specified as linear functions.

The planted area functions are based on the adaptive expectation model in which the ET is expected variable for farmers. There are a total of 80 functions in the Thai rice model and an additional 45 identities. Figure 4-1 and Figure 4-2 show flowcharts of the model for the production and the supply and demand sector.

4-4. Data

The source of the data of evapotranspiration (ET) is same as that of the Lao and Cambodian rice models.

The time series data for production and planted area of the two types of rice cultivations for each province are provided by the Center for Agricultural Information at the Office of Agricultural Economics of the Ministry of Agriculture and Co-operatives of Thailand. The farm price for rice is obtained from FAO-STAT and the retail price of rice is obtained from the IRRI, which is available from 1961 to 1997 and is held constant after 1997. These prices are a national average price for Thailand. CPI, GDP, and population are from the Asian Development Bank (ADB) and the exchange rate and the world price of rice are numbers from the International Monetary Fund (IMF). The estimation period for yield and planted area functions for each province in the North-East region and aggregated other regions, and import, stock change, and demand functions for the country as a whole are from 1982 to 2000 which starts in the earliest available year for statistics of production and ends in the last year of available ET values.

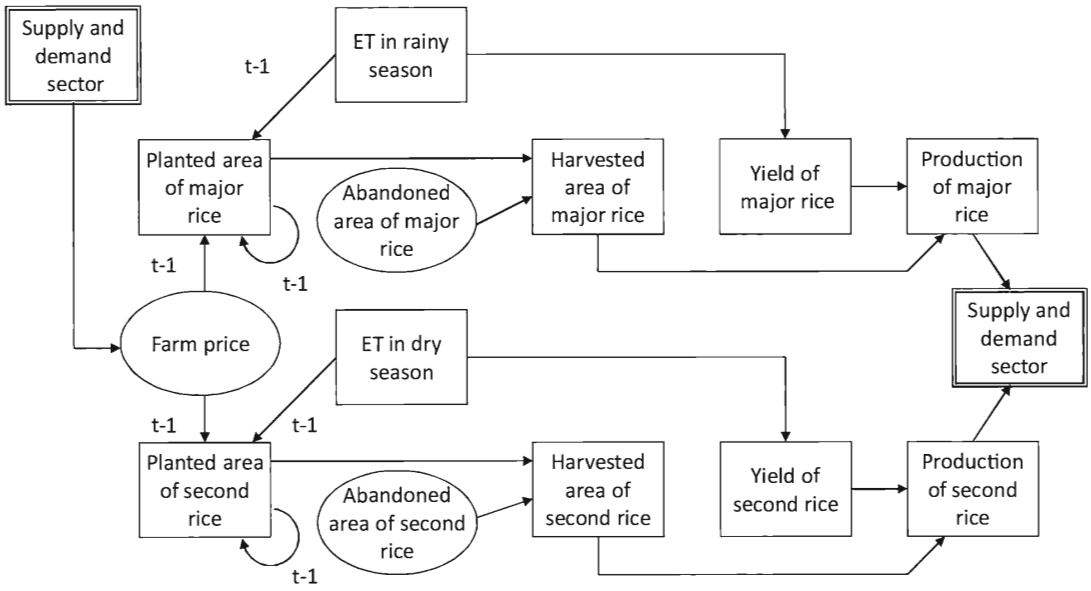

Fig. 4-1. Flowchart of the rice production sector of Thai rice model

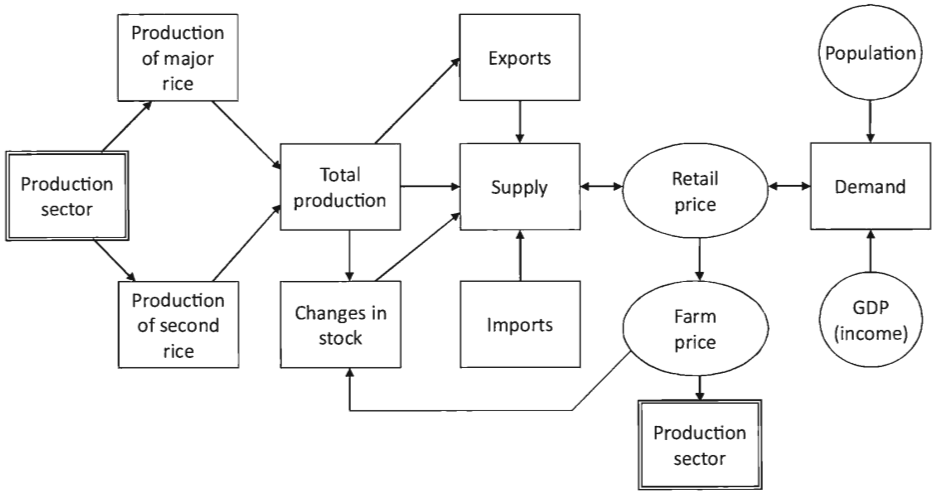

Fig. 4-2. Flowchart of the supply and demand sector of Thai rice model

4-5. Estimation results of all functions

The estimation method of all functions is OLS, and the estimation period is from 1982 to 2000. First, yield functions of major rice in North East region for each province are shown, and yield functions of major rice in the other three aggregate regions, i.e., North, South, and Central regions follow them. Second, yield functions of second rice in these regions are shown. Third, planted area functions of major and second rice in these regions are shown. Finally, estimated results of export, stock change, demand, and price linkage function are shown.

4-5-1. Yield functions

4-5-1-1. Yield function of major rice

4-5-1-1-1. Yield function of major rice in North East region

4-5-1-1-1-1. Yield function of major rice in Nakhon Phanom

YMH01 = + 0.62083
(1.58)
+ 0.04878*TREND
(12.03)
- 0.00823*ET01MAY

(-7.06) [-0.431]
+ 0.01179*ET01JLY
(3.90) [0.668]
- 0.00768*ET01AUG
(-3.79) [-0.404]
+ 0.00761*ET01OCT
(3.85) [0.500]
- 0.23554*D97
(-3.22)
- 0.22855*D989
(-3.90)

$AdjR^2$=0.9089 D.W.=1.559

YMH01 Yield of Major Rice in Nakhon Phanom
TREND Time Trend from 1982 to 2000
ET01MAY Evapotranspiration of May in Nakhon Phanom
ET01JLY Evapotranspiration of July in Nakhon Phanom
ET01AUG Evapotranspiration of August in Nakhon Phanom
ET01OCT Evapotranspiration of October in Nakhon Phanom
D97 Dummy Variable, 1 in 1997, 0 otherwise
D989 Dummy Variable, 1 in 1998 to 1999, 0 otherwise

4-5-1-1-1-2. Yield function of major rice in Sakon Nakhon

YMH02 = + 1.63175
(2.82)
+ 0.04597*T8298)
(8.19)
+ 0.00806*ET02APR
(6.19) [0.252]
- 0.01782*ET02MAY
(-7.52) [-0.922]
- 0.02310*ET02JUN
(-3.96) [-1.173]
+ 0.02406*ET02JLY
(4.76) [1.274]
+ 0.00724*ET02AUG
(2.88) [0.360]
- 0.00583*ET02SEP
(-2.35) [-0.313]
+ 0.00668*ET02NOV
(1.89) [0.302]
+ 0.31891*D84
(4.23)
+ 0.34969*D93
(4.27)
- 0.39614*D94
(-3.77)

$AdjR^2$=0.8474 D.W.=1.992

YMH02 Yield of Major Rice in Sakon Nakhon
T8298 Time Trend from 1982 to 1998, 0 before 1982, 0 after 1998
ET02APR Evapotranspiration of April in Sakon Nakhon
ET02MAY Evapotranspiration of May in Sakon Nakhon
ET02JUN Evapotranspiration of June in Sakon Nakhon
ET02JLY Evapotranspiration of July in Sakon Nakhon
ET02AUG Evapotranspiration of August in Sakon Nakhon
ET02SEP Evapotranspiration of September in Sakon Nakhon
ET02NOV Evapotranspiration of November in Sakon Nakhon
D84 Dummy Variable, 1 in 1984, 0 otherwise
D93 Dummy Variable, 1 in 1993, 0 otherwise
D94 Dummy Variable, 1 in 1994, 0 otherwise

4-5-1-1-1-3. Yield function of major rice in Nong Khai

YMH03 = + 0.46487
(1.65)
+ 0.01231*TREND
(3.40)
+ 0.00369*ET03APR
(3.83) [0.112]
- 0.00935*ET03MAY
(-4.99) [-0.484]
+ 0.01476*ET03AUG
(5.95) [0.705]
+ 0.00633*ET03OCT
(2.34) [0.355]
- 0.36983*D86
(-4.47)
- 0.37117*D90
(-4.42)
- 0.14839*D967
(-2.33)

$AdjR^2$=0.8657 D.W.=2.057

YMH03 Yield of Major Rice in Nong Khai
TREND Time Trend from 1982 to 2000
ET03APR Evapotranspiration of April in Nong Khai
ET03MAY Evapotranspiration of May in Nong Khai
ET03AUG Evapotranspiration of August in Nong Khai
ET03OCT Evapotranspiration of October in Nong Khai
D86 Dummy Variable, 1 in 1986, 0 otherwise
D90 Dummy Variable, 1 in 1990, 0 otherwise
D967 Dummy Variable, 1 in 1996 to 1997, 0 otherwise

4-5-1-1-1-4. Yield function of major rice in Udon Thani

YMH04 = + 2.53763
(4.18)
+ 0.00379*ET04APR
(2.78) [0.111]
- 0.00543*ET04JUN
(-1.53) [-0.288]
+ 0.00745*ET04SEP
(1.74) [0.391]
- 0.01589*ET04NOV
(-2.62) [-0.717]
- 0.39942*D87
(-3.33)
- 1.45489*D88
(-12.02)
- 0.43588*D93
(-2.43)

$AdjR^2$= 0.8953 D.W.= 2.066

YMH04 Yield of Major Rice in Udon Thani
ET04APR Evapotranspiration of April in Udon Thani
ET04JUN Evapotranspiration of June in Udon Thani

ET04SEP Evapotranspiration of Septemer in Udon Thani
ET04NOV Evapotranspiration of November in Udon Thani
D87 Dummy Variable, 1 in 1987, 0 otherwise
D88 Dummy Variable, 1 in 1988, 0 otherwise
D93 Dummy Variable, 1 in 1993, 0 otherwise

4-5-1-1-1-5. Yield function of major rice in Loei

YMH06 = - 1.17177
(-1.41)
- 0.01282*ET06MAY
(-7.00) [-0.426]
+ 0.02831*ET06JLY
(4.96) [0.965]
+ 0.03165*ET06NOV
(5.48) [0.925]
- 0.46734*D82
(-3.77)
+ 0.59201*D00
(4.81)

$Adj R^2$=0.8507 D.W.=1.817

YMH06 Yield of Major Rice in Loei
ET06MAY Evapotranspiration of May in Loei
ET06JLY Evapotranspiration of July in Loei
ET06NOV Evapotranspiration of November in Loei
D82 Dummy Variable, 1 in 1982, 0 otherwise
D00 Dummy Variable, 1 in 2000, 0 otherwise

4-5-1-1-1-6. Yield function of major rice in Yasothon

YMH08 = + 2.53918
(4.07)
+ 0.02670*TREND
(7.64)
+ 0.00466*ET08MAY
(3.03) [0.248]
- 0.00698*ET08JUN
(-2.06) [-0.385]
+ 0.00786*ET08JLY
(2.40) [0.454]
+ 0.00712*ET08SEP
(2.41) [0.407]
- 0.01154*ET08OCT
(-3.80) [-0.795]
- 0.01385*ET08NOV
(-2.89) [-0.428]
- 0.56166*D88
(-5.27)

$Adj R^2$=0.8911 D.W.=2.097

YMH08 Yield of Major Rice in Yasothon
TREND Time Trend from 1982 to 2000
ET08MAY Evapotranspiration of May in Yasothon
ET08JUN Evapotranspiration of June in Yasothon
ET08JLY Evapotranspiration of July in Yasothon
ET08SEP Evapotranspiration of September in Yasothon
ET08OCT Evapotranspiration of October in Yasothon
ET08NOV Evapotranspiration of November in Yasothon
D88 Dummy Variable, 1 in 1988, 0 otherwise

4-5-1-1-1-7. Yield function of major rice in Ubon Ratchathani

YMH09= + 1.16657
(3.07)
+ 0.01449*TREND
(2.63)
- 0.00327*ET09APR
(-2.07) [-0.091]
+ 0.00583*ET09MAY
(3.25) [0.338]
- 0.00972*ET09JLY
(-2.82) [-0.616]
+ 0.00747*ET09AUG
(2.38) [0.457]
+ 0.46127*D85
(5.45)

$Adj R^2$=0.8828 D.W.=2.237

YMH09 Yield of Major Rice in Ubon Ratchathani
TREND Time Trend from 1982 to 2000
ET09APR Evapotranspiration of April in Ubon Ratchathani
ET09MAY Evapotranspiration of May in Ubon Ratchathani
ET09JLY Evapotranspiration of July in Ubon Ratchathani
ET09AUG Evapotranspiration of August in Ubon Ratchathani
D85 Dummy Variable, 1 in 1985, 0 otherwise

4-5-1-1-1-8. Yield function of major rice in Kalasin

YMH11= + 4.15186
(5.08)
+ 0.03328*TREND
(8.92)
- 0.00205*ET11APR
(-2.01) [-0.052]
+ 0.00282*ET11MAY
(1.48) [0.121]
- 0.00970*ET11JLY
(-2.04) [-0.462]
- 0.00802*ET11AUG
(-2.76) [-0.361]
- 0.00380*ET11OCT
(-1.52) [-0.201]
- 0.01067*ET11NOV
(-2.66) [-0.428]
+ 0.57323*D83
(4.85)
- 0.21475*D934
(-2.61)
- 0.33656*D989
(-5.64)

$Adj R^2$=0.8450 D.W.=1.933

YMH11 Yield of Major Rice in Kalasin
TREND Time Trend from 1982 to 2000
ET11APR Evapotranspiration of April in Kalasin
ET11MAY Evapotranspiration of May in Kalasin
ET11JLY Evapotranspiration of July in Kalasin
ET11AUG Evapotranspiration of August in Kalasin
ET11OCT Evapotranspiration of October in Kalasin

ET11NOV Evapotranspiration of November in Kalasin
D83 Dummy Variable, 1 in 1983, 0 otherwise
D934 Dummy Variable, 1 in 1993 to 1994, 0 otherwise
D989 Dummy Variable, 1 in 1998 to 1999, 0 otherwise

4-5-1-1-1-9. Yield function of major rice in Khon Kaen

YMH12 = + 2.51256
(10.08)
+ 0.00532*ET12JUN
(3.23) [0.278]
- 0.00463*ET12JLY
(-2.66) [-0.253]
- 0.00577*ET12SEP
(-2.57) [-0.279]
- 0.00401*ET12OCT
(-3.01) [-0.227]
- 0.22654*D82
(-3.92)
- 0.40232*D87
(-8.41)
- 0.09938*D95
(-1.91)

$Adj R^2$=0.8619 D.W.=2.095

YMH12 Yield of Major Rice in Khon Kaen
TREND Time Trend from 1982 to 2000
ET12JUN Evapotranspiration of June in Khon Kaen
ET12JLY Evapotranspiration of July in Khon Kaen
ET12SEP Evapotranspiration of September in Khon Kaen
ET12OCT Evapotranspiration of October in Khon Kaen
D82 Dummy Variable, 1 in 1982, 0 otherwise
D87 Dummy Variable, 1 in 1987, 0 otherwise
D95 Dummy Variable, 1 in 1995, 0 otherwise

4-5-1-1-1-10. Yield function of major rice in Maha Sarakham

YMH13 = + 1.51352
(7.76)
+ 0.04631*TREND
(13.34)
- 0.00509*ET13JUN
(-2.10) [-0.262]
+ 0.44242*D834
(7.78)
- 0.30566*D99
(-4.06)

$Adj R^2$=0.9083 D.W.=2.112

YMH13 Yield of Major Rice in Maha Sarakham
TREND Time Trend from 1982 to 2000
ET13JUN Evapotranspiration of June in Maha Sarakham
D834 Dummy Variable, 1 in 1983 to 1984, 0 otherwise
D99 Dummy Variable, 1 in 1999, 0 otherwise

4-5-1-1-1-11. Yield function of major rice in Roi Et

YMH14= + 1.35644
(3.80)
+ 0.04313*TREND
(9.43)
- 0.01191*ET14JUN
(-3.67) [-0.633]
+ 0.00947*ET14JLY
(2.43) [0.532]
- 0.32715*D82
(-3.51)
- 0.35764*D989
(-4.91)

$Adj R^2$=0.8900 D.W.=2.119

YMH14 Yield of Major Rice in Roi Et
TREND Time Trend from 1982 to 2000
ET14JUN Evapotranspiration of June in Roi Et
ET14JLY Evapotranspiration of July in Roi Et
D82 Dummy Variable, 1 in 1982, 0 otherwise
D989 Dummy Variable, 1 in 1998 to 1999, 0 otherwise

4-5-1-1-1-12. Yield function of major rice in Buri Ram

YMH15 = + 1.93605
(8.40)
+ 0.03313*TREND
(8.82)
- 0.00382*ET15APR
(-3.30) [-0.110]
- 0.00489*ET15OCT
(-2.30) [-0.281]
+ 0.56244*D835
(9.94)
- 0.22791*D912
(-3.71)

$Adj R^2$=0.8882 D.W.=1.763

YMH15 Yield of Major Rice in Buri Ram
TREND Time Trend from 1982 to 2000
ET15APR Evapotranspiration of April in Buri Ram
ET15OCT Evapotranspiration of October in Surin
D835 Dummy Variable, 1 in 1983 to 1985, 0 otherwise
D912 Dummy Variable, 1 in 1991 to 1992, 0 otherwise

4-5-1-1-1-13. Yield function of major rice in Surin

YMH16= + 0.60350
(1.12)
+ 0.00411*ET16APR
(2.27) [0.109]
+ 0.00744*ET16JLY
(2.06) [0.390]
+ 0.00764*ET16AUG
(2.48) [0.407]
+ 0.00664*ET16SEP
(1.97) [0.325]
- 0.01085*ET16OCT
(-3.50) [-0.628]
+ 0.43567*D88
(3.17)
+ 0.68427*D94
(6.34)
+ 0.33107*D97

(3.50)

$AdjR^2$= 0.9041 D.W.=2.053

YMH16 Yield of Major Rice in Surin
ET16APR Evapotranspiration of April in Surin
ET16JLY Evapotranspiration of July in Surin
ET16AUG Evapotranspiration of August in Surin
ET16SEP Evapotranspiration of September in Surin
ET16OCT Evapotranspiration of October in Surin
D88 Dummy Variable, 1 in 1988, 0 otherwise
D94 Dummy Variable, 1 in 1994, 0 otherwise
D97 Dummy Variable, 1 in 1997, 0 otherwise

4-5-1-1-1-14. Yield function of major rice in Si Sa Ket

YMH17 = - 0.58471
(-1.19)
+ 0.04291*TREND
(8.18)
+ 0.00461*ET17MAY
(3.14) [0.232]
- 0.01698*ET17JUN
(-4.91) [-0.870]
+ 0.01026*ET17JLY
(2.41) [0.554]
+ 0.01248*ET17SEP
(3.31) [0.639]
+ 0.01103*ET17NOV
(2.32) [0.582]
- 0.31936*D923
(-4.54)
- 0.39813*D989
(-5.32)

$AdjR^2$=0.8637 D.W.=2.222

YMH17 Yield of Major Rice in Si Sa Ket
TREND Time Trend from 1982 to 2000
ET17MAY Evapotranspiration of May in Si Sa Ket
ET17JUN Evapotranspiration of June in Si Sa Ket
ET17JLY Evapotranspiration of July in Si Sa Ket
ET17SEP Evapotranspiration of September in Si Sa Ket
ET17NOV Evapotranspiration of November in Si Sa Ket
D923 Dummy Variable, 1 in 1992 to 1993, 0 otherwise
D989 Dummy Variable, 1 in 1998 to 1999, 0 otherwise

4-5-1-1-1-15. Yield function of major rice in Chaiyaphum

YMH18 = + 4.09209
(4.54)
- 0.01267*ET18MAY
(-4.11) [-0.573]
- 0.01186*ET18JUN
(-2.63) [-0.571]
- 0.00952*ET18AUG
(-2.03) [-0.458]
+ 0.01531*ET18SEP
(2.66) [0.673]
+ 0.00780*ET18OCT
(1.73) [0.405]
- 0.01677*ET18NOV
(-3.54) [-0.774]
+ 0.46670*D83
(3.03)
+ 0.59224*D96
(4.08)
+ 0.82541*D00
(5.68)

$AdjR^2$=0.8812 D.W.=1.895

YMH18 Yield of Major Rice in Chaiyaphum
ET18MAY Evapotranspiration of May in Chaiyaphum
ET18JUN Evapotranspiration of June in Chaiyaphum
ET18AUG Evapotranspiration of August in Chaiyaphum
ET18SEP Evapotranspiration of September in Chaiyaphum
ET18OCT Evapotranspiration of October in Chaiyaphum
ET18NOV Evapotranspiration of November in Chaiyaphum
D83 Dummy Variable, 1 in 1983, 0 otherwise
D96 Dummy Variable, 1 in 1996, 0 otherwise
D00 Dummy Variable, 1 in 2000, 0 otherwise

4-5-1-1-1-16. Yield function of major rice in Nakhon Ratchasima

YMH19 = + 4.97683
(6.96)
+ 0.05049*TREND
(9.31)
- 0.00997*ET19APR
(-7.57) [-0.320]
+ 0.00394*ET19MAY
(2.48) [0.202]
- 0.00376*ET19JLY
(-1.54) [-0.204]
+ 0.00984*ET19SEP
(2.90) [0.483]
- 0.01299*ET19OCT
(-5.40) [-0.747]
- 0.03524*ET19NOV
(-6.06) [-1.925]
+ 0.64573*D825
(7.78)
+ 0.26546*D89
(3.50)
+ 0.35398*D98
(3.75)

$AdjR^2$= 0.8924 D.W.=1.686

YMH19 Yield of Major Rice in Nakhon Ratchasima
TREND Time Trend from 1982 to 2000
ET19APR Evapotranspiration of April in Nakhon Ratchasima
ET19MAY Evapotranspiration of May in Nakhon Ratchasima
ET19JLY Evapotranspiration of July in Nakhon Ratchasima
ET19SEP Evapotranspiration of September in Nakhon Ratchasima
ET19OCT Evapotranspiration of October in Nakhon Ratchasima
ET19NOV Evapotranspiration of November in Nakhon Ratchasima
D825 Dummy Variable, 1 in 1982 to 1985, 0 otherwise
D89 Dummy Variable, 1 in 1989, 0 otherwise

D98 Dummy Variable, 1 in 1998, 0 otherwise

4-5-1-1-2. Yield function of major rice in North region

YMH_N= - 0.30514
(-0.51)
+ 0.02299*TREND
(5.53)
+ 0.00734*ETNJUN
(3.23) [0.212]
- 0.00838*ETNAUG
(-3.35) [-0.230]
+ 0.01499*ETNSEP
(3.36) [0.395]
- 0.01050*ETNOCT
(-3.43) [-0.295]
+ 0.02736*ETNNOV
(4.47) [0.711]
+ 0.00876*ETNDEC
(3.87) [0.164]
- 0.29898*D90
(-3.52)
- 0.20411*D979
(-3.50)
+ 0.33102*SHIFT00
(3.32)

$AdjR^2$=0.8611 D.W.=2.626

YMH_N Yield of Major Rice in North region
ETNJUN Evapotranspiration of June in North region
ETNAUG Evapotranspiration of August in North region
ETNSEP Evapotranspiration of September in North region
ETNOCT Evapotranspiration of October in North region
ETNNOV Evapotranspiration of November in North region
ETNDEC Evapotranspiration of December in North region
D90 Dummy Variable, 1 in 1990, 0 otherwise
D979 Dummy Variable, 1 in 1997 to 1999, 0 otherwise
SHIFT00 Dummy Variable, 1 after 2000, 0 otherwise

4-5-1-1-3. Yield function of major rice in South region

YMH_S = - 0.62642
(-1.63)
+ 0.03423*TREND
(10.98)
+ 0.01348*ETSJUN
(4.32) [0.509]
+ 0.01658*ETSOCT
(5.47) [0.609]
- 0.00532*ETSDEC
(-3.13) [-0.251]
- 0.32229*D90
(-4.92)
- 0.21043*D92
(2.95)

AdjR2=0.9200 D.W.=1.631

YMH_S Yield of Major Rice in South region
TREND Time Trend from 1982 to 2000
ETSJUN Evapotranspiration of June in South region
ETSOCT Evapotranspiration of October in South region
ETSDEC Evapotranspiration of December in South region
D90 Dummy Variable, 1 in 1990, 0 otherwise
D92 Dummy Variable, 1 in 1992, 0 otherwise

4-5-1-1-4. Yield function of major rice in Central region

YMH_C = + 0.95407
(3.69)
+ 0.04902*TREND
(19.18)
+ 0.01224*ETCNOV
(4.53) [0.306]
- 0.74002*D90
(-12.03)

$AdjR^2$=0.9709 D.W.=2.695

YMH_C Yield of Major Rice in Central region
TREND Time Trend from 1982 to 2000
ETCNOV Evapotranspiration of November in Central region
D90 Dummy Variable, 1 in 1990, 0 otherwise

4-5-1-2. Yield function of second rice

4-5-1-2-1. Yield function of second rice in North East region

4-5-1-2-1-1. Yield function of second rice in Nakhon Phanom

YSH01 = + 1.76190
(11.59)
+ 0.01774*TREND
(2.80)
- 0.00912*ET01MAR
(-2.61) [-0.105]
+ 0.01272*ET01APR
(5.48) [0.259]
- 0.40577*D91
(-2.38)
+ 0.59741*D97
(3.44)

$AdjR^2$=0.8456 D.W.=1.772

YSH01 Yield of Second Rice in Nakhon Phanom
TREND Time Trend from 1982 to 2000
ET01MAR Evapotranspiration of March in Nakhon Phanom
ET01APR Evapotranspiration of April in Nakhon Phanom
D91 Dummy Variable, 1 in 1991, 0 otherwise
D97 Dummy Variable, 1 in 1997, 0 otherwise

4-5-1-2-1-2. Yield function of second rice in Sakon Nakhon

YSH02 = - 1.14095
(-1.74)
- 0.01760*TREND
(-2.26)
+ 0.02715*ET02NOV(t-1)
(3.32) [0.955]
- 0.04772*ET02DEC(t-1)

(-4.54) [-0.815]
+ 0.03309*ET02JAN
(2.44) [0.255]
+ 0.01097*ET02MAR
(3.40) [0.154]
- 0.00430*ET02APR
(-2.27) [-0.104]
+ 0.02966*ET02MAY
(7.30) [1.195]
+ 1.03905*D86
(6.14)
- 0.72469*D90
(-4.22)
+ 1.24464*D91
(6.79)

$Adj R^2$=0.8683 D.W.=2.534

YSH02 Yield of Second Rice in Sakon Nakhon
ET02NOV Evapotranspiration of November in Sakon Nakhon
ET02DEC Evapotranspiration of December in Sakon Nakhon
ET02JAN Evapotranspiration of January in Sakon Nakhon
ET02MAR Evapotranspiration of March in Sakon Nakhon
ET02APR Evapotranspiration of April in Sakon Nakhon
ET02MAY Evapotranspiration of May in Sakon Nakhon
D86 Dummy Variable, 1 in 1986, 0 otherwise
D90 Dummy Variable, 1 in 1990, 0 otherwise
D91 Dummy Variable, 1 in 1991, 0 otherwise

4-5-1-2-1-3. Yield function of second rice in Nong Khai

YSH03 = + 3.76808
(6.19)
+ 0.02507*TREND
(3.61)
- 0.04723*ET03NOV(t-1)
(-7.19) [-1.232]
+ 0.03150*ET03JAN
(3.84) [0.245]
- 0.01500*ET03FEB
(-2.76) [-0.112]
+ 0.01446*ET03MAR
(4.34) [0.173]
- 0.00870*ET03APR
(-3.62) [-0.162]
+ 0.01958*ET03MAY
(5.00) [0.622]
- 0.85520*D87
(-5.27)
- 0.93102*D934
(-5.98)
- 0.82979*D00
(-4.42)

$Adj R^2$=0.9031 D.W.=2.060

YSH03 Yield of Second Rice in Nong Khai
TREND Time Trend from 1982 to 2000
ET03JAN Evapotranspiration of January in Nong Khai
ET03FEB Evapotranspiration of February in Nong Khai
ET03MAR Evapotranspiration of March in Nong Khai
ET03APR Evapotranspiration of April in Nong Khai
ET03MAY Evapotranspiration of May in Nong Khai
ET03NOV Evapotranspiration of November in Nong Khai
D87 Dummy Variable, 1 in 1987, 0 otherwise
D934 Dummy Variable, 1 in 1993 to 1994, 0 otherwise
D00 Dummy Variable, 1 in 2000, 0 otherwise

4-5-1-2-1-4. Yield function of second rice in Udon Thani

YSH04 = + 0.20609
(0.41)
+ 0.01645*TREND
(2.35)
+ 0.05106*ET04NOV(t-1)
(5.45) [1.563]
- 0.04324*ET04DEC(t-1)
(-4.73) [-0.666]
- 0.01080*ET04FEB
(-1.94) [-0.078]
+ 0.33744*D889
(2.73)
+ 0.90961*D90
(5.58)
+ 0.88404*D99
(4.97)

$Adj R^2$=0.8657 D.W.=2.216

YSH04 Yield of Second Rice in Udon Thani
TREND Time Trend from 1982 to 2000
ET04FEB Evapotranspiration of February in Udon Thani
ET04NOV Evapotranspiration of November in Udon Thani
ET04DEC Evapotranspiration of December in Udon Thani
D889 Dummy Variable, 1 in 1988 to 1989, 0 otherwise
D90 Dummy Variable, 1 in 1990, 0 otherwise
D99 Dummy Variable, 1 in 1999, 0 otherwise

4-5-1-2-1-5. Yield function of second rice in Loei

YSH06 = + 3.00217
(5.07)
- 0.03449*ET06NOV(t-1)
(-3.38) [-0.953]
+ 0.03746*ET06DEC(t-1)
(5.08) [0.649]
+ 0.01461*ET06MAR
(4.06) [0.165]
+ 0.89519*D92
(4.24)
+ 1.03827*D96
(4.76)
- 0.43222*D989
(-2.49)

$Adj R^2$=0.8740 D.W.=2.306

YSH06 Yield of Second Rice in Loei
ET06MAR Evapotranspiration of March in Loei
ET06NOV Evapotranspiration of November in Loei
ET06DEC Evapotranspiration of December in Loei
D92 Dummy Variable, 1 in 1992, 0 otherwise
D96 Dummy Variable, 1 in 1996, 0 otherwise

D989 Dummy Variable, 1 in 1998 to 1999, 0 otherwise

4-5-1-2-1-6. Yield function of second rice in Yasothon

YSH08 = + 4.03983
(3.37)
- 0.04115*ET08NOV(t-1)
(-3.05) [-1.262]
+ 0.05793*ET08DEC(t-1)
(4.22) [0.757]
- 0.01455*ET08FEB
(-2.29) [-0.070]
+ 0.02063*ET08MAY
(7.06) [0.627]
- 0.02036*ET08JUN
(-2.90) [-0.641]
+ 1.02254*D92
(6.32)
+ 0.99383*D96
(7.03)
+ 0.86071*D98
(6.10)

$Adj R^2$=0.8998 D.W.=1.968

YSH08 Yield of Second Rice in Yasothon
ET08FEB Evapotranspiration of February in Yasothon
ET08MAY Evapotranspiration of May in Yasothon
ET08JUN Evapotranspiration of June in Yasothon
ET08NOV Evapotranspiration of November in Yasothon
ET08DEC Evapotranspiration of December in Yasothon
D92 Dummy Variable, 1 in 1992, 0 otherwise
D96 Dummy Variable, 1 in 1996, 0 otherwise
D98 Dummy Variable, 1 in 1998, 0 otherwise

4-5-1-2-1-7. Yield function of second rice in Ubon Ratchathani

YSH09 = + 2.79164
(4.91)
+ 0.04823*T8292
(6.86)
- 0.01509*ET09NOV(t-1)
(-2.93) [-0.705]
- 0.01497*ET09JAN
(-3.36) [-0.175]
+ 0.01133*ET09MAR
(3.01) [0.118]
+ 0.00717*ET09JUN
(2.12) [0.317]
- 0.73377*D91
(-7.01)
- 0.61404*D98
(-4.81)

$Adj R^2$=0.8744 D.W.=2.070

YSH09 Yield of Second Rice in Ubon Ratchathani
T8292 Time Trend from 1982 to 1992, 0 before 1982, 0 after 1992
ET09JAN Evapotranspiration of January in Ubon Ratchathani
ET09MAR Evapotranspiration of March in Ubon Ratchathani
ET09JUN Evapotranspiration of June in Ubon Ratchathani
ET09NOV Evapotranspiration of November in Ubon Ratchathani
D91 Dummy Variable, 1 in 1991, 0 otherwise
D98 Dummy Variable, 1 in 1998, 0 otherwise

4-5-1-2-1-8. Yield function of second rice in Kalasin

YSH11 = + 4.85052
(6.95)
+ 0.04600*TREND
(5.18)
+ 0.03074*ET11DEC(t-1)
(3.01) [0.308]
- 0.01383*ET11FEB
(-1.87) [-0.056]
- 0.03550*ET11JUN
(-5.08) [-0.924]
+ 0.34197*D890
(2.46)
- 1.06759*D94
(-4.20)

$Adj R^2$=0.8742 D.W.=1.958

YSH11 Yield of Second Rice in Kalasin
TREND Time Trend from 1982 to 2000
ET11FEB Evapotranspiration of February in Kalasin
ET11JUN Evapotranspiration of June in Kalasin
ET11DEC Evapotranspiration of December in Kalasin
D890 Dummy Variable, 1 in 1989 to 1990, 0 otherwise
D94 Dummy Variable, 1 in 1994, 0 otherwise

4-5-1-2-1-9. Yield function of second rice in Khon Kaen

YSH12 = + 1.09285
(1.66)
+ 0.07713*TREND
(8.45)
- 0.01717*ET12NOV(t-1)
(-2.33) [-0.421]
+ 0.06347*ET12JAN
(4.54) [0.294]
- 0.01858*ET12MAR
(-4.79) [-0.163]
- 0.00643*ET12APR
(-2.38) [-0.092]
+ 0.02822*ET12JUN
(4.65) [0.747]
+ 0.78400*D85
(4.40)
- 1.51149*D93
(-7.50)
- 0.89488*D956
(-5.96)

$Adj R^2$=0.8636 D.W.=1.640

YSH12 Yield of Second Rice in Khon Kaen
TREND Time Trend from 1982 to 2000
ET12JAN Evapotranspiration of January in Khon Kaen
ET12MAR Evapotranspiration of March in Khon Kaen
ET12APR Evapotranspiration of April in Khon Kaen
ET12JUN Evapotranspiration of June in Khon Kaen

ET12NOV Evapotranspiration of November in Khon Kaen
D85 Dummy Variable, 1 in 1985, 0 otherwise
D93 Dummy Variable, 1 in 1993, 0 otherwise
D956 Dummy Variable, 1 in 1995 to 1996, 0 otherwise

4-5-1-2-1-10. Yield function of second rice in Maha Sarakham

YSH13 = + 4.50255
(6.80)
+ 0.0775*TREND
(9.13)
- 0.02489*ET13MAR
(-4.23) [-0.188]
+ 0.00807*ET13APR
(2.12) [0.107]
- 0.00468*ET13MAY
(-1.30) [0.100]
- 0.02173*ET13JUN
(-2.97) [-0.514]
+ 0.88063*D890
(6.18)
+ 1.03944*D98
(3.99)

$AdjR^2$=0.8735 D.W.=2.057

YSH13 Yield of Second Rice in Maha Sarakham
TREND Time Trend from 1982 to 2000
ET13MAR Evapotranspiration of March in Maha Sarakham
ET13APR Evapotranspiration of April in Maha Sarakham
ET13MAY Evapotranspiration of May in Maha Sarakham
ET13JUN Evapotranspiration of June in Maha Sarakham
D890 Dummy Variable, 1 in 1989 to 1990, 0 otherwise
D98 Dummy Variable, 1 in 1998, 0 otherwise

4-5-1-2-1-11. Yield function of second rice in Roi Et

YSH14 = - 2.87485
(-4.49)
+ 0.06625*ET14NOV(t-1)
(8.24) [1.714]
+ 0.02756*ET14MAR
(6.59) [0.224]
- 1.1150*D82
(-7.71)
- 1.15959*D87
(-7.51)
+ 0.58066*D912
(5.09)

$AdjR^2$=0.9177 D.W.=2.361

YSH14 Yield of Second Rice in Roi Et
ET14MAR Evapotranspiration of March in Roi Et
ET14NOV Evapotranspiration of November in Roi Et
D82 Dummy Variable, 1 in 1982, 0 otherwise
D87 Dummy Variable, 1 in 1987, 0 otherwise
D912 Dummy Variable, 1 in 1991 to 1992, 0 otherwise

4-5-1-2-1-12. Yield function of second rice in Buri Ram

YSH15 = + 3.88415
(5.20)
- 0.03807*ET15DEC(t-1)
(-3.50) [-0.634]
+ 0.12514*ET15JAN
(5.02) [0.796]
- 0.03341*ET15FEB
(-2.53) [-0.195]
- 0.01729*ET15MAR
(-2.64) [-0.150]
+ 0.02078*ET15MAY
(3.79) [0.651]
- 0.03028*ET15JUN
(-3.24) [-0.998]
- 0.86525*D87
(-3.45)
- 0.92406*D89
(-3.57)
+ 0.79307*D93
(3.12)

$AdjR^2$=0.8071 D.W.=1.876

YSH15 Yield of Second Rice in Buri Ram
ET15JAN Evapotranspiration of January in Buri Ram
ET15FEB Evapotranspiration of February in Buri Ram
ET15MAR Evapotranspiration of March in Buri Ram
ET15MAY Evapotranspiration of May in Buri Ram
ET15JUN Evapotranspiration of June in Buri Ram
ET15DEC Evapotranspiration of December in Buri Ram
D87 Dummy Variable, 1 in 1987, 0 otherwise
D89 Dummy Variable, 1 in 1989, 0 otherwise
D93 Dummy Variable, 1 in 1993, 0 otherwise

4-5-1-2-1-13. Yield function of second rice in Surin

YSH16 = + 5.49422
(3.74)
+ 0.03696*TREND
(2.99)
- 0.05185*ET16NOV(t-1)
(-3.02) [-1.950]
+ 0.02561*ET16DEC(t-1)
(3.88) [0.431]
+ 0.03191*ET16FEB
(3.85) [0.209]
- 0.01606*ET16MAR
(-2.62) [-0.151]
- 0.56121*D82
(-3.10)
+ 0.65824*D91
(4.35)
- 1.31875*D96
(-7.69)
- 1.07867*SHIFT98
(-7.17)

$AdjR^2$=0.9110 D.W.=1.784

YSH16 Yield of Second Rice in Surin
TREND Time Trend from 1982 to 2000
ET16FEB Evapotranspiration of January in Surin
ET16MAR Evapotranspiration of January in Surin

ET16NOV	Evapotranspiration of January in Surin
ET16DEC	Evapotranspiration of January in Surin
D82	Dummy Variable, 1 in 1982, 0 otherwise
D91	Dummy Variable, 1 in 1991, 0 otherwise
D96	Dummy Variable, 1 in 1996, 0 otherwise
SHIFT98	Dummy Variable, 1 after 1998, 0 otherwise

4-5-1-2-1-14. Yield function of second rice in Si Sa Ket

YSH17 = - 0.89927
(-1.83)
+ 0.05499*ET17DEC(t-1)
(4.94) [0.966]
- 0.04007*ET17JAN
(-2.24) [-0.296]
- 0.04265*ET17FEB
(-3.80) [-0.245]
+ 0.04484*ET17MAR
(9.11) [0.372]
+ 0.00801*ET17APR
(4.55) [0.156]
+ 0.01193*ET17JUN
(2.99) [0.463]
- 0.63630*D87
(-5.27)
+ 0.30943*D91
(2.87)
- 0.52736*D989
(-6.38)

$Adj R^2$=0.9356 D.W.=2.224

YSH17	Yield of Second Rice in Si Sa Ket
ET17JAN	Evapotranspiration of January in Si Sa Ket
ET17FEB	Evapotranspiration of February in Si Sa Ket
ET17MAR	Evapotranspiration of March in Si Sa Ket
ET17APR	Evapotranspiration of April in Si Sa Ket
ET17JUN	Evapotranspiration of June in Si Sa Ket
ET17DEC	Evapotranspiration of December in Si Sa Ket
D87	Dummy Variable, 1 in 1987, 0 otherwise
D91	Dummy Variable, 1 in 1991, 0 otherwise
D989	Dummy Variable, 1 in 1998 to 1999, 0 otherwise

4-5-1-2-1-15. Yield function of second rice in Chaiyaphum

YSH18 = + 6.00024
(9.81)
+ 0.06028*T8292
(4.73)
- 0.02309*ET18DEC(t-1)
(-2.26) [-0.358]
+ 0.05427*ET18JAN
(2.88) [0.314]
- 0.02342*ET18FEB
(-3.17) [-0.155]
- 0.00850*ET18MAR
(-2.18) [-0.092]
- 0.00648*ET18MAY
(-1.48) [-0.192]
- 0.02481*ET18JUN
(-3.65) [-0.784]
+ 0.36519*D856
(2.30)
+ 0.98348*D93
(4.22)
+ 0.80015*D97
(3.78)

$Adj R^2$=0.8592 D.W.=2.380

YSH18	Yield of Second Rice in Chaiyaphum
T8292	Time Trend from 1982 to 1992, 0 before 1982, 0 after 1992
ET18JAN	Evapotranspiration of January in Chaiyaphum
ET18FEB	Evapotranspiration of February in Chaiyaphum
ET18MAR	Evapotranspiration of March in Chaiyaphum
ET18MAY	Evapotranspiration of May in Chaiyaphum
ET18JUN	Evapotranspiration of June in Chaiyaphum
ET18DEC	Evapotranspiration of December in Chaiyaphum
D856	Dummy Variable, 1 in 1985 to 1986, 0 otherwise
D93	Dummy Variable, 1 in 1993, 0 otherwise
D97	Dummy Variable, 1 in 1997, 0 otherwise

4-5-1-2-1-16. Yield function of second rice in Nakhon Ratchasima

YSH19 = + 1.50479
(6.27)
+ 0.00871*ET19DEC(t-1)
(2.37) [0.143]
+ 0.00491*ET19APR
(2.28) [0.089]
+ 0.00752*ET19MAY
(2.57) [0.217]
+ 0.72592*D89
(5.30)
+ 1.09139*D92
(7.40)
- 0.33658*D96
(-2.41)

$Adj R^2$=0.8578 D.W.=2.631

YSH19	Yield of Second Rice in Nakhon Ratchasima
ET19APR	Evapotranspiration of April in Nakhon Ratchasima
ET19MAY	Evapotranspiration of May in Nakhon Ratchasima
ET19DEC	Evapotranspiration of December in Nakhon Ratchasima
D89	Dummy Variable, 1 in 1989, 0 otherwise
D92	Dummy Variable, 1 in 1992, 0 otherwise
D96	Dummy Variable, 1 in 1996, 0 otherwise

4-5-1-2-2. Yield function of second rice in North region

YSH_N = + 2.26145
(12.89)
+ 0.14069*T8292
(19.72)
- 0.14707*T9600
(-7.21)
+ 0.00790*ETNJAN
(1.95) [0.063]

+ 0.02075*ETNFEB
(3.26) [0.119]
+ 0.005186*ln(ETNMAR)
(2.08) [0.029]
- 0.573257*D87(-6.14)

$Adj R^2$=0.9669 D.W.=2.064

YSH_N	Yield of Second Rice in North region
T8292	Time Trend from 1982 to 1992, 1 before 1982, 11 after 1992
T9600	Time Trend from 1996 to 2000, 1 before 1996
ETNJAN	Evapotranspiration of January in North region
ETNFEB	Evapotranspiration of February in North region
ETNMAR	Evapotranspiration of March in North region
D87	Dummy Variable, 1 in 1987, 0 otherwise

4-5-1-2-3. Yield function of second rice in South region

YSH_S = + 2.82790
(9.35)
+ 0.19791*T8789
(9.99)
- 0.00471*ETSDEC(t-1)
(-2.59) [-0.172]
- 0.00411*ETSFEB
(-3.47) [-0.101]
+ 0.00316*ETSMAR
(2.70) [0.070]
- 0.00287*ETSAPR
(-2.81) [-0.080]
+ 0.00672*ETSMAY
(3.46) [0.233]
- 0.00383*ETSJUN
(-1.14) [-0.136]
+ 0.382326*D82
(4.69)
- 0.57866*D90
(-9.50)
- 0.34906*D926
(-9.98)

$Adj R^2$=0.9629 D.W.=2.302

YSH_S	Yield of Second Rice in South region
T8789	Time Trend from 1987 to 1989, 1 before 1987, 3 after 1989
ETSFEB	Evapotranspiration of February in South region
ETSMAR	Evapotranspiration of March in South region
ETSAPR	Evapotranspiration of April in South region
ETSMAY	Evapotranspiration of May in South region
ETSJUN	Evapotranspiration of June in South region
ETSDEC	Evapotranspiration of December in South region
D82	Dummy Variable, 1 in 1982, 0 otherwise
D90	Dummy Variable, 1 in 1990, 0 otherwise
D926	Dummy Variable, 1 in 1992 to 1996, 0 otherwise

4-5-1-2-4. Yield function of second rice in Central region

YSH_C = + 3.46934
(48.39)
+ 0.05174*TREND
(11.15)
+ 0.00581*ETCMAR
(2.36) [-0.040]
- 0.33076*D87
(-3.18)
- 1.87457*D90
(16.68)
+ 0.35704*D96
(3.34)

$Adj R^2$=0.9699 D.W.=2.094

YSH_C	Yield of Second Rice in Central region
TREND	Time Trend from 1982 to 2000
ETCMAR	Evapotranspiration of March in Central region
D87	Dummy Variable, 1 in 1987, 0 otherwise
D90	Dummy Variable, 1 in 1990, 0 otherwise
D96	Dummy Variable, 1 in 1996, 0 otherwise

4-5-2. Planted area functions

4-5-2-1. Planted area function of major rice

4-5-2-1-1. Planted area function of major rice in North East region

4-5-2-1-1-1. Planted area function of major rice in Nakhon Phanom

APM01= - 57036
(-0.80)
+ 0.49673*APM01(t-1)
(3.34)
+ 5.66909*[FPR(t-1)/CPI(t-1)/100]
(2.06) [0.153]
- 460.38753* ET01MAY(t-1)
(-4.10) [-0.189]
+ 751.20376* ET01JLY(t-1)
(2.13) [0.331]
+ 1223.51665* ET01OCT(t-1)
(3.71) [0.631]
- 1336.95339*ET01NOV(t-1)
(-3.02) [-0.529]
+ 2137.33188*ET01DEC(t-1)
(2.84) [0.410]
- 30740*D823
(-4.98)
- 23189*D92
(-3.88)

$Adj R^2$=0.9016 D.W.=2.246

APM01	Planted Area of Major Rice in Nakhon Phanom
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET01MAY	Evapotranspiration of May in Nakhon Phanom
ET01JLY	Evapotranspiration of July in Nakhon Phanom
ET01OCT	Evapotranspiration of October in Nakhon Phanom
ET01NOV	Evapotranspiration of November in Nakhon Phanom
ET01DEC	Evapotranspiration of December in Nakhon Phanom
D823	Dummy Variable, 1 in 1982 to 1983, 0 otherwise
D92	Dummy Variable, 1 in 1992, 0 otherwise

4-5-2-1-1-2. Planted area function of major rice in Sakon Nakhon

APM02= + 325123
(2.72)
+ 0.59106*APM02(t-1)
(3.28)
+ 21.16978*[FPR(t-1)/CPI(t-1)/100]
(3.88) [0.457]
+ 981.21360*ET02APR(t-1)
(3.25) [0.192]
- 1636.77096*ET02MAY(t-1)
(-2.87) [-0.545]
- 2858.21242*ET02AUG(t-1)
(-4.47) [-0.913]
+ 3884.42246*ET02SEP(t-1)
(6.48) [1.355]
- 4901.40208*ET02NOV(t-1)
(-4.53) [-1.434]
+ 37671*D88
(2.19)
+ 46493*D91
(2.30)
+ 69480*D95
(3.78)

$Adj R^2$=0.7443 D.W.=1.812

APM02	Planted Area of Major Rice in Sakon Nakhon
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET02APR	Evapotranspiration of April in Sakon Nakhon
ET02MAY	Evapotranspiration of May in Sakon Nakhon
ET02AUG	Evapotranspiration of August in Sakon Nakhon
ET02SEP	Evapotranspiration of September in Sakon Nakhon
ET02NOV	Evapotranspiration of November in Sakon Nakhon
D88	Dummy Variable, 1 in 1988, 0 otherwise
D91	Dummy Variable, 1 in 1991, 0 otherwise
D95	Dummy Variable, 1 in 1995, 0 otherwise

4-5-2-1-1-3. Planted area function of major rice in Nong Khai

APM03= + 230472
(4.87)
+ 0.21182*APM03(t-1)
(2.40)
+ 13.68872*[FPR(t-1)/CPI(t-1)/100]
(6.51) [0.446]
- 882.44676*ET03MAY(t-1)
(-6.89) [-0.460]
+ 1683.74236*ET03JUN(t-1)
(5.90) [0.840]
- 2526.12207*ET03SEP(t-1)
(-8.41) [-1.316]
+ 1680.74831*ET03OCT(t-1)
(7.80) [0.948]
- 4733.56802*ET03NOV(t-1)
(-11.53) [-2.030]
+ 4137.42883*ET03DEC(t-1)
(11.30) [1.022]
+ 52651*D90
(8.70)
- 18520*D93
(-2.82)
- 92658*D97
(-12.21)

$Adj R^2$=0.9438 D.W.=2.397

APM03	Planted Area of Major Rice in Nong Khai
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET03MAY	Evapotranspiration of May in Nong Khai
ET03JUN	Evapotranspiration of June in Nong Khai
ET03SEP	Evapotranspiration of September in Nong Khai
ET03OCT	Evapotranspiration of October in Nong Khai
ET03NOV	Evapotranspiration of November in Nong Khai
ET03DEC	Evapotranspiration of December in Nong Khai
D90	Dummy Variable, 1 in 1990, 0 otherwise
D93	Dummy Variable, 1 in 1993, 0 otherwise
D97	Dummy Variable, 1 in 1997, 0 otherwise

4-5-2-1-1-4. Planted area function of major rice in Udon Thani

APM04 = + 257903
(4.48)
+ 0.20507*APM04(t-1)
(2.03)
+ 10.00143*[FPR(t-1)/CPI(t-1)/100]
(1.84) [0.127]
+ 1017.70684*ET04MAR(t-1)
(3.29) [-0.070]
- 1255.39328*ET04APR(t-1)
(-5.17) [-0.132]
+ 1621.82874*ET04MAY(t-1)
(5.73) [0.316]
- 855.06144*ET04JUN(t-1)
(-1.99) [-0.168]
- 122204*D82
(-7.59)
+ 38527*D00
(2.32)

$Adj R^2$=0.8748 D.W.=2.270

APM04	Planted Area of Major Rice in Udon Thani
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET04MAR	Evapotranspiration of March in Udon Thani
ET04APR	Evapotranspiration of April in Udon Thani
ET04MAY	Evapotranspiration of May in Udon Thani
ET04JUN	Evapotranspiration of June in Udon Thani
D82	Dummy Variable, 1 in 1982, 0 otherwise
D00	Dummy Variable, 1 in 2000, 0 otherwise

4-5-2-1-1-5. Planted area function of major rice in Loei

APM06 = - 94713
(-3.97)
+ 0.62760*APM06(t-1)
(5.50)
+ 4.77205*[FPR(t-1)/CPI(t-1)/100]

(3.23) [0.436]
+ 589.44534*ET06SEP(t-1)
(3.84) [0.767]
+ 505.59908*ET06OCT(t-1)
(3.33) [0.721]
+ 18958*D85
(4.86)
+ 7332*D93
(2.10)
+ 9301*SHIFT00
(2.23)

$AdjR^2$=0.8869 D.W.=2.078

APM06	Planted Area of Major Rice in Loei
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET06SEP	Evapotranspiration of September in Loei
ET06OCT	Evapotranspiration of October in Loei
D85	Dummy Variable, 1 in 1985, 0 otherwise
D93	Dummy Variable, 1 in 1993, 0 otherwise
SHIFT00	Dummy Variable, 1 after 2000, 0 otherwise

4-5-2-1-1-6. Planted area function of major rice in Yasothon

APM08 = + 200244
(6.45)
+ 0.16365*APM08(t-1)
(1.56)
+ 6.05595*[FPR(t-1)/CPI(t-1)/100]
(2.98) [0.203]
+ 243.19072*ET08APR(t-1)
(2.19) [0.061]
- 452.47485*ET08MAY(t-1)
(-3.24) [-0.223]
- 1022.97716*ET08JLY(t-1)
(-4.80) [-0.543]
- 400.05764*ET08AUG(t-1)
(-1.81) [-0.206]
+ 635.83002*ET08SEP(t-1)
(3.12) [0.339]
- 71917*D82
(-11.14)
+ 34551*D94
(5.05)
+ 18432*D99
(2.47)

$AdjR^2$=0.8991 D.W.=1.609

APM08	Planted Area of Major Rice in Yasothon
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET08APR	Evapotranspiration of April in Yasothon
ET08MAY	Evapotranspiration of May in Yasothon
ET08JLY	Evapotranspiration of July in Yasothon
ET08AUG	Evapotranspiration of August in Yasothon
ET08SEP	Evapotranspiration of September in Yasothon
D82	Dummy Variable, 1 in 1982, 0 otherwise
D94	Dummy Variable, 1 in 1994, 0 otherwise
D99	Dummy Variable, 1 in 1999, 0 otherwise

4-5-2-1-1-7. Planted area function of major rice in Ubon Ratchathani

APM09 = - 76398
(-1.03)
+ 0.89135*APM09 (t-1)
(8.71)
+ 15.51384*[FPR(t-1)/CPI(t-1)/100]
(3.69) [0.144]
- 403.52314*ET09MAY(t-1)
(-1.90) [-0.057]
- 958.50868*ET09AUG(t-1)
(-2.38) [-0.143]
+ 2583.35305*ET09SEP(t-1)
(5.07) [0.389]
+ 863.17759*ET09OCT(t-1)
(2.41) [0.154]
- 1521.19193*ET09NOV(t-1)
(-2.68) [-0.236]
- 63632*D82
(-6.03)
- 26533*D913
(-4.58)
+ 76450*D94
(5.51)

$AdjR^2$=0.9446 D.W.=2.095

APM09	Planted Area of Major Rice in Ubon Ratchathani
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET09MAY	Evapotranspiration of May in Ubon Ratchathani
ET09AUG	Evapotranspiration of August in Ubon Ratchathani
ET09SEP	Evapotranspiration of September in Ubon Ratchathani
ET09OCT	Evapotranspiration of October in Ubon Ratchathani
ET09NOV	Evapotranspiration of November in Ubon Ratchathani
D82	Dummy Variable, 1 in 1982, 0 otherwise
D913	Dummy Variable, 1 in 1991 to 1993, 0 otherwise
D94	Dummy Variable, 1 in 1994, 0 otherwise

4-5-2-1-1-8. Planted area function of major rice in Kalasin

APM11 = + 56220
(0.98)
+ 0.24723*APM11(t-1)
(2.24)
+ 21.91551*[FPR(t-1)/CPI(t-1)/100]
(3.97) [0.678]
- 1706.00635*ET11JUN(t-1)
(-3.45) [-0.832]
+ 1313.66003*ET11SEP(t-1)
(2.54) [0.625]
+ 810.50056*ET11OCT(t-1)
(2.28) [0.448]
- 2465.92084*ET11DEC(t-1)
(-3.74) [-0.465]
- 95808*D82
(-8.65)
+ 35211*D87
(2.92)

$Adj R^2$=0.8977 D.W.=1.894

APM11	Planted Area of Major Rice in Kalasin
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET11JUN	Evapotranspiration of June in Kalasin
ET11SEP	Evapotranspiration of September in Kalasin
ET11OCT	Evapotranspiration of October in Kalasin
ET11DEC	Evapotranspiration of December in Kalasin
D82	Dummy Variable, 1 in 1982, 0 otherwise
D87	Dummy Variable, 1 in 1987, 0 otherwise

4-5-2-1-1-9. Planted area function of major rice in Khon Kaen

APM12 = - 134423
(-1.46)
+ 0.23600*APM12(t-1)
(1.54)
+ 17.43296*[FPR(t-1)/CPI(t-1)/100]
(3.14) [0.328]
+ 1394.37618*TREND
(1.70)
+ 2484.46307*ET12OCT(t-1)
(3.85) [0.800]
+ 76341*D834
(6.81)
+ 41616*D89
(2.16)
+ 69709*D00
(4.35)

$Adj R^2$=0.8562 D.W.=2.366

APM12	Planted Area of Major Rice in Khon Kaen
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
TREND	Time Trend from 1982 to 2000
ET12OCT	Evapotranspiration of October in Khon Kaen
D834	Dummy Variable, 1 in 1983 to 1984, 0 otherwise
D89	Dummy Variable, 1 in 1989, 0 otherwise
D00	Dummy Variable, 1 in 2000, 0 otherwise

4-5-2-1-1-10. Planted area function of major rice in Maha Sarakham

APM13 = + 687180
(7.08)
+ 0.23836*APM13(t-1)
(2.33)
+ 10.82375*[FPR(t-1)/CPI(t-1)/100]
(2.03) [0.238]
- 723.13962*ET13APR(t-1)
(-2.10) [-0.130]
+ 1334.35315*ET13MAY(t-1)
(3.63) [0.389]
+ 2536.51034*ET13JUN(t-1)
(3.60) [0.821]
- 1202.71922*ET13JLY(t-1)
(-2.19) [-0.417]
- 4285.68386*ET13AUG(t-1)
(-5.71) [-1.465]
- 4291.66920*ET13SEP(t-1)
(-7.29) [-1.399]
- 84962*D86
(-4.62)
+ 37388*D990
(2.90)

$Adj R^2$=0.8695 D.W.=2.192

APM13	Planted Area of Major Rice in Maha Sarakham
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET13APR	Evapotranspiration of April in Maha Sarakham
ET13MAY	Evapotranspiration of May in Maha Sarakham
ET13JUN	Evapotranspiration of June in Maha Sarakham
ET13JLY	Evapotranspiration of July in Maha Sarakham
ET13AUG	Evapotranspiration of August in Maha Sarakham
ET13SEP	Evapotranspiration of September in Maha Sarakham
D86	Dummy Variable, 1 in 1989, 0 otherwise
D990	Dummy Variable, 1 in 1999 to 2000, 0 otherwise

4-5-2-1-1-11. Planted area function of major rice in Roi Et

APM14 = - 59874
(-0.70)
+ 0.40904*APM14(t-1)
(3.40)
+ 40.80481*[FPR(t-1)/CPI(t-1)/100]
(7.20) [0.575]
- 1060.27586*ET14MAY(t-1)
(-3.56) [-0.210]
+ 2232.47525*ET14JLY(t-1)
(3.98) [0.498]
- 1505.74858*ET14AUG(t-1)
(-2.14) [-0.326]
+ 796.79684*ET14OCT(t-1)
(1.66) [0.207]
- 92498*D84
(-4.76)
+ 39365*D85
(2.42)
+ 71147*D88
(3.49)

$Adj R^2$=0.8423 D.W.=1.926

APM14	Planted Area of Major Rice in Roi Et
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET14MAY	Evapotranspiration of May in Roi Et
ET14JLY	Evapotranspiration of July in Roi Et
ET14AUG	Evapotranspiration of August in Roi Et
ET14OCT	Evapotranspiration of October in Roi Et
D84	Dummy Variable, 1 in 1984, 0 otherwise
D85	Dummy Variable, 1 in 1985, 0 otherwise
D88	Dummy Variable, 1 in 1988, 0 otherwise

4-5-2-1-1-12. Planted area function of major rice in Buri Ram

APM15 = - 336450
(-1.81)
+ 0.52159*APM15(t-1)

(3.97)
+ 54.86962*[FPR(t-1)/CPI(t-1)/100]
(6.27) [0.715]
+ 3133.80343*TREND
(3.72)
- 854.62530*ET15APR(t-1)
(-2.92) [-0.094]
+ 6822.75234*ET15MAY(t-1)
(10.20) [1.270]
- 9528.72585*ET15AUG(t-1)
(-7.63) [-2.075]
- 7128.03099*ET15SEP(t-1)
(-9.60) [-1.399]
+ 6507.67104*ET15OCT(t-1)
(5.20) [1.481]
+ 2904.03314*ET15NOV(t-1)
(4.40) [0.590]
+ 6919.87444*ET15DEC(t-1)
(6.11) [0.690]
+ 216618*D84
(8.97)
- 78318*D86
(-3.49)
+ 50616*D93
(2.93)

$Adj R^2$=0.9299 D.W.=2.336

APM15	Planted Area of Major Rice in Buri Ram
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
TREND	Time Trend from 1982 to 2000
ET15APR	Evapotranspiration of April in Buri Ram
ET15MAY	Evapotranspiration of May in Buri Ram
ET15AUG	Evapotranspiration of August in Buri Ram
ET15SEP	Evapotranspiration of September in Buri Ram
ET15OCT	Evapotranspiration of October in Buri Ram
ET15NOV	Evapotranspiration of November in Buri Ram
ET15DEC	Evapotranspiration of December in Buri Ram
D84	Dummy Variable, 1 in 1984, 0 otherwise
D86	Dummy Variable, 1 in 1986, 0 otherwise
D93	Dummy Variable, 1 in 1993, 0 otherwise

4-5-2-1-1-13. Planted area function of major rice in Surin

APM16= + 266712
(1.92)
+ 0.69840*APM16(t-1)
(8.81)
+ 36.19530*[FPR(t-1)/CPI(t-1)/100]
(5.12) [0.481]
- 3403.65471*ET16APR(t-1)
(-6.77) [-0.360]
+ 5495.16008*ET16MAY(t-1)
(9.23) [1.060]
- 4382.96428*ET16JUN(t-1)
(-5.15) [-0.862]
+ 3222.46877*ET16JLY(t-1)
(3.48) [0.692]
+ 2837.27333*ET16AUG(t-1)
(3.42) [0.619]
- 3201.25189*ET16OCT(t-1)
(-3.58) [-0.764]
- 3482.64124*ET16NOV(t-1)
(-2.28) [-0.708]
- 5804.47477*ET16DEC(t-1)
(-5.05) [-0.528]
+ 118036*D823
(8.51)
- 78289*D93
(-4.06)
+ 123196*D00
(6.78)

$Adj R^2$=0.9623 D.W.=2.366

APM16	Planted Area of Major Rice in Surin
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET16APR	Evapotranspiration of April in Surin
ET16MAY	Evapotranspiration of May in Surin
ET16JUN	Evapotranspiration of June in Surin
ET16JLY	Evapotranspiration of July in Surin
ET16AUG	Evapotranspiration of August in Surin
ET16OCT	Evapotranspiration of October in Surin
ET16NOV	Evapotranspiration of November in Surin
ET16DEC	Evapotranspiration of December in Surin
D823	Dummy Variable, 1 in 1982 to 1983, 0 otherwise
D93	Dummy Variable, 1 in 1993, 0 otherwise
D00	Dummy Variable, 1 in 2000, 0 otherwise

4-5-2-1-1-14. Planted area function of major rice in Si Sa Ket

APM17= - 665675
(-2.71)
+ 0.22264*APM17(t-1)
(1.31)
+ 36.97384*[FPR(t-1)/CPI(t-1)/100]
(4.28) [0.481]
+ 4041.36742*TREND
(2.98)
- 472.37718*ET17MAY(t-1)
(-1.54) [-0.110]
- 2872.11128*ET17JUN(t-1)
(-3.06) [-0.682]
+ 4017.48029*ET17JLY(t-1)
(3.76) [1.005]
+ 1658.21640*ET17AUG(t-1)
(1.61) [0.408]
+ 4533.44519*ET17SEP(t-1)
(4.58) [1.089]
+ 3749.95561*ET17OCT(t-1)
(3.97) [1.068]
- 5086.39557*ET17NOV(t-1)
(-3.44) [-1.253]
+ 3902.32737*ET17DEC(t-1)
(3.25) [0.421]
+ 59252*D85
(2.94)
+ 171277*D92

(6.21)
- 85476*D980
(-5.65)

AdjR^2=0.8454 D.W.=2.385

APM17	Planted Area of Major Rice in Si Sa Ket
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
TREND	Time Trend from 1982 to 2000
ET17MAY	Evapotranspiration of May in Si Sa Ket
ET17JUN	Evapotranspiration of June in Si Sa Ket
ET17JLY	Evapotranspiration of July in Si Sa Ket
ET17AUG	Evapotranspiration of August in Si Sa Ket
ET17SEP	Evapotranspiration of September in Si Sa Ket
ET17OCT	Evapotranspiration of Ocober in Si Sa Ket
ET17NOV	Evapotranspiration of November in Si Sa Ket
ET17DEC	Evapotranspiration of December in Si Sa Ket
D85	Dummy Variable, 1 in 1985, 0 otherwise
D92	Dummy Variable, 1 in 1992, 0 otherwise
D980	Dummy Variable, 1 in 1998 to 2000, 0 otherwise

4-5-2-1-1-15. Planted area function of major rice in Chaiyaphum

APM18= - 93877
(-0.94)
+ 0.39721*APM18(t-1)
(4.49)
+ 26.42655*[FPR(t-1)/CPI(t-1)/100]
(3.68) [0.744]
- 5940.53421*T9299
(-4.23)
- 900.92307*ET18APR(t-1)
(-2.87) [-0.205]
+ 891.39063*ET18MAY(t-1)
(3.07) [0.373]
- 803.50716*ET18AUG(t-1)
(-1.63) [-0.359]
+ 1293.83482*ET18OCT(t-1)
(2.34) [0.624]
+ 51111*D83
(3.88)
- 54500*D845
(-5.77)
- 39337**D90
(-2.35)

AdjR^2=0.8516 D.W.=1.385

APM18	Planted Area of Major Rice in Chaiyaphum
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
T9299	Time Trend from 1992 to 1999, 0 before 1992, 0 after 1999
ET18APR	Evapotranspiration of April in Chaiyaphum
ET18MAY	Evapotranspiration of May in Chaiyaphum
ET18AUG	Evapotranspiration of August in Chaiyaphum
ET18OCT	Evapotranspiration of Ocotober in Chaiyaphum
D83	Dummy Variable, 1 in 1983, 0 otherwise
D845	Dummy Variable, 1 in 1984 to 1985, 0 otherwise
D90	Dummy Variable, 1 in 1990, 0 otherwise

4-5-2-1-1-16. Planted area function of major rice in Nakhon Ratchasima

APM19= - 894888
(-3.46)
+ 0.70340*APM19(t-1)
(7.81)
+ 32.87640*[FPR(t-1)/CPI(t-1)/100]
(3.53) [0.396]
- 999.44193*ET19MAY(t-1)
(-2.12) [-0.180]
+ 4430.01488*ET19JUN(t-1)
(3.74) [0.806]
+ 2052.08192*ET19OCT(t-1)
(2.25) [0.414]
+ 4289.62393*ET19NOV(t-1)
(3.05) [0.821]
+ 95151*D88
(3.77)
- 119257*D90
(-3.97)
+ 96474*D93
(3.47)

AdjR^2=0.8760 D.W.=1.903

APM19	Planted Area of Major Rice in Nakhon Ratchasima
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET19MAY	Evapotranspiration of May in Nakhon Ratchasima
ET19JUN	Evapotranspiration of June in Nakhon Ratchasima
ET19OCT	Evapotranspiration of October in Nakhon Ratchasima
ET19NOV	Evapotranspiration of November in Nakhon Ratchasima
D88	Dummy Variable, 1 in 1988, 0 otherwise
D90	Dummy Variable, 1 in 1990, 0 otherwise
D93	Dummy Variable, 1 in 1993, 0 otherwise

4-5-2-1-2. Planted area function of major rice in North region

APM_N= + 344051
(0.87)
+ 0.72682*LAG(APM_N)
(4.83)
+ 29.84673*[(FPR/(CPI/100)](t-1)
(1.60) [0.083]
- 1979.04416*ETNAPR(t-1)
(-2.65) [-0.043]
- 6466.43149*ETNAUG(t-1)
(-3.71) [-0.247]
+ 8486.67984*ETNSEP(t-1)
(2.70) [0.314]
+ 319584 *D88
(6.14)
- 195605 *D89
(-2.76)
- 122122 *D92
(-2.67)

$AdjR^2$=0.7873 D.W.=1.247

APM_N	Harvested Area of Major Rice in North region
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ETNAPR	Evapotranspiration of April in North region
ETNAUG	Evapotranspiration of August in North region
ETNSEP	Evapotranspiration of September in North region
D88	Dummy Variable, 1 in 1988, 0 otherwise
D89	Dummy Variable, 1 in 1989, 0 otherwise
D92	Dummy Variable, 1 in 1992, 0 otherwise

4-5-2-1-3. Planted area function of major rice in South region

APM_S = - 70160
(-0.49)
+ 0.89397*APM_S(t-1)
(16.15)
+ 11.96174*[FPR/(CPI/100)](t-1)
(1.86) [0.151]
- 1361.18163*ETSMAY(t-1)
(-3.28) [-0.297]
+ 2187.11507*ETSJUN(t-1)
(2.37) [0.492]
+ 875.51807*ETSJUL(t-1)
(1.48) [0.205]
- 1888.96266*ETSOCT(t-1)
(-2.63) [-0.373]
- 967.83482*ETSNOV(t-1)
(-1.41) [-0.187]
+ 1195.89685*ETSDEC(t-1)
(2.94) [0.276]
+ 58243*D85
(3.06)
- 80662*D890
(-4.70)

$AdjR^2$=0.9703 D.W.=2.489

APM_S	Harvested Area of Major Rice in North region
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ETSMAY	Evapotranspiration of May in South region
ETSJUN	Evapotranspiration of JUNE in South region
ETSJLY	Evapotranspiration of JULY in South region
ETSOCT	Evapotranspiration of October in South region
ETSNOV	Evapotranspiration of November in South region
ETSDEC	Evapotranspiration of December in South region
D85	Dummy Variable, 1 in 1985, 0 otherwise
D890	Dummy Variable, 1 from 1989 to 1990, 0 otherwise

4-5-2-1-4. Planted area function of major rice in Central region

APM_C = + 1281911
(4.15)
- 50080*T8892
(-4.66)
+ 0.52558*APM_C(t-1)
(3.84)
+ 28.85434*[FPR/(CPI/100)](t-1)
(2.00) [0.089]
- 809.59811*ETCAPR(t-1)
(-1.50) [-0.026]
- 2721.19394*ETCMAY(t-1)
(-3.23) [-0.153]
+ 2021.77212*ETCOCT(t-1)
(1.82) [0.111]
- 3889.93395*ETCNOV(t-1)
(-2.85) [-0.172]
- 85669 *D834
(-2.73)
- 186982*D90
(-4.01)
- 196237*SHIFT93
(-3.30)

$AdjR^2$=0.9778 D.W.=2.448

APM_C	Harvested Area of Major Rice in Central region
T8892	Time Trend from 1988 to 1992, 0 before 1988, 0 after 1992
FPR	Farm Price of Thai Rice (baht per kg)
CPI	Consumer Price Index (1998=100)
ETCAPR	Evapotranspiration of April in Central region
ETCMAY	Evapotranspiration of May in Central region
ETCOCT	Evapotranspiration of October in Central region
ETCNOV	Evapotranspiration of November in Central region
D834	Dummy Variable, 1 from 1983 to 1984, 0 otherwise
D90	Dummy Variable, 1 in 1990, 0 otherwise
SHIFT93	Dummy Variable, 1 after 1993, 0 otherwise

4-5-2-2. Planted area function of second rice

4-5-2-2-1. Planted area function of second rice in North East region

4-5-2-2-1-1. Planted area function of second rice in Nakhon Phanom

APS01 = + 10674
(5.28)
+ 0.74477*APS01(t-1)
(7.00)
+ 0.12905*[FPR(t-1)/CPI(t-1)/100]
(0.73) [0.356]
- 109.04618*ET01NOV(t-2)
(-4.30) [-4.407]
+ 115.41304*ET01DEC(t-2)
(3.63) [2.253]
+ 20.11001*ET01APR(t-1)
(2.56) [0.484]
- 20.87385*ET01MAY(t-1)
(-2.33) [-0.875]
- 66.52683*ET01JUN(t-1)
(-3.62) [-2.899]
+ 1645.15186*D989
(3.96)

$AdjR^2$=0.8956 D.W.=2.247

APS01	Planted Area of Second Rice in Nakhon Phanom

FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET01APR	Evapotranspiration of April in Nakhon Phanom
ET01MAY	Evapotranspiration of May in Nakhon Phanom
ET01JUN	Evapotranspiration of June in Nakhon Phanom
ET01NOV	Evapotranspiration of November in Nakhon Phanom
ET01DEC	Evapotranspiration of December in Nakhon Phanom
D989	Dummy Variable, 1 in 1998 to 1999, 0 otherwise

4-5-2-2-1-2. Planted are function of second rice in Sakon Nakhon

APS02 = - 7991.74998
(-8.34)
+ 0.47788*APS02(t-1)
(6.94)
+ 0.49060*[FPR(t-1)/CPI(t-1)/100]
(4.52) [1.984]
+ 51.00659*ET02FEB(t-1)
(5.91) [0.667]
+ 12.73450*ET02MAR(t-1)
(2.30) [0.285]
- 19.01202*ET02MAY(t-1)
(-2.79) [-1.185]
+ 76.76855*ET02JUN(t-1)
(7.10) [4.687]
- 1393.70226*D834
(-5.09)
+ 1911.31585*D88
(6.92)

$Adj R^2$=0.9530 D.W.=2.456

APS02	Planted Area of Second Rice in Sakon Nakhon
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET02FEB	Evapotranspiration of February in Sakon Nakhon
ET02MAR	Evapotranspiration of March in Sakon Nakhon
ET02JUN	Evapotranspiration of June in Sakon Nakhon
D834	Dummy Variable, 1 in 1983 to 1984, 0 otherwise
D88	Dummy Variable, 1 in 1988, 0 otherwise

4-5-2-2-1-3. Planted area function of second rice in Nong Khai

APS03 = - 1987.90745
(-1.24)
+ 0.40458*APS03(t-1)
(7.04)
+ 0.36758*[FPR(t-1)/CPI(t-1)/100]
(2.35) [0.671]
- 71.48689*ET03NOV(t-2)
(-3.05) [-1.714]
+ 66.07381*ET03DEC(t-2)
(3.34) [0.902]
+ 48.04893*ET03JUN(t-1)
(2.56) [1.343]
+ 632.34656*T9499
(10.82)
- 1008.27611*D901
(-3.10)
- 2518.71811*D94
(-4.93)
- 4752.70048*D97
(-9.82)

$Adj R^2$=0.9637 D.W.=1.633

APS03	Planted Area of Second Rice in Nong Khai
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET03JUN	Evapotranspiration of June in Nong Khai
ET03NOV	Evapotranspiration of November in Nong Khai
ET03DEC	Evapotranspiration of December in Nong Khai
T9499	Time trend from 1994 to 1999, 0 otherwise
D901	Dummy Variable, 1 in 1990 to 1991, 0 otherwise
D94	Dummy Variable, 1 in 1994, 0 otherwise
D97	Dummy Variable, 1 in 1997, 0 otherwise

4-5-2-2-1-4. Planted area function of second rice in Udon Thani

APS04 = - 8197.84994
(-7.36)
+ 0.02368*APS04(t-1)
(0.27)
+ 0.22650*[FPR(t-1)/CPI(t-1)/100]
(1.78) [0.603]
+ 196.94825*ET04NOV(t-2)
(9.37) [6.897]
- 283.71352*ET04DEC(t-2)
(-9.19) [-5.176]
+ 275.26268*ET04JAN(t-1)
(5.03) [2.146]
+ 25.11571*ET04APR(t-1)
(5.00) [0.554]
- 2445.32646*D82
(-6.47)
+ 989.09254*D96
(2.34)
- 2320.75745*D00
(-4.04)

$Adj R^2$=0.8994 D.W.=2.365

APS04	Planted Area of Second Rice in Udon Thani
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET04JAN	Evapotranspiration of January in Udon Thani
ET04APR	Evapotranspiration of April in Udon Thani
ET04NOV	Evapotranspiration of November in Udon Thani
ET04DEC	Evapotranspiration of December in Udon Thani
D82	Dummy Variable, 1 in 1982, 0 otherwise
D96	Dummy Variable, 1 in 1996, 0 otherwise
D00	Dummy Variable, 1 in 2000, 0 otherwise

4-5-2-2-1-5. Planted area function of second rice in Loei

APS06 = - 1298.89276
(-5.27)
+ 0.22751*APS06(t-1)
(1.95)
+ 0.04119*[FPR(t-1)/CPI(t-1)/100]
(1.58) [0.879]
- 23.54613*ET06DEC(t-2)

(-4.99) [-4.089]
+ 46.82898*ET06JAN(t-1)
(6.17) [4.132]
+ 5.26211*ET06MAR(t-1)
(2.89) [0.626]
- 2.65433*ET06APR(t-1)
(-1.84) [-0.490]
+ 14.62046*ET06JUN(t-1)
(5.73) [4.833]
+ 154.75145*D92
(1.74)
- 324.02005*D98
(-3.44)

$AdjR^2$=0.8850 D.W.=2.376

APS06	Planted Area of Second Rice in Loei
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET06JAN	Evapotranspiration of January in Loei
ET06MAR	Evapotranspiration of March in Loei
ET06APR	Evapotranspiration of April in Loei
ET06JUN	Evapotranspiration of June in Loei
ET06DEC	Evapotranspiration of December in Loei
D92	Dummy Variable, 1 in 1992, 0 otherwise
D98	Dummy Variable, 1 in 1998, 0 otherwise

4-5-2-2-1-6. Planted area function of second rice in Yasothon

APS08 = - 3094.03126
(-6.80)
+ 0.53993*APS08(t-1)
(10.97)
+ 0.30103*[FPR(t-1)/CPI(t-1)/100]
(5.15) [1.491]
+ 113.08309*ET08DEC(t-2)
(6.02) [3.509]
- 88.84498*ET08JAN(t-1)
(-2.92) [-1.004]
- 26.81450*ET08APR(t-1)
(-9.27) [-0.999]
+ 1251.20415*D84
(7.74)
+ 724.62758*D92
(3.85)
+ 1697.19520*D98
(8.50)

$AdjR^2$=0.9633 D.W.=1.504

APS08	Planted Area of Second Rice in Yasothon
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET08JAN	Evapotranspiration of January in Yasothon
ET08APR	Evapotranspiration of April in Yasothon
ET08DEC	Evapotranspiration of December in Yasothon
D84	Dummy Variable, 1 in 1984, 0 otherwise
D92	Dummy Variable, 1 in 1992, 0 otherwise
D98	Dummy Variable, 1 in 1998, 0 otherwise

4-5-2-2-1-7. Planted area function of second rice in Ubon Ratchathani

APS09 = -16778
(2.93)
+ 0.35528*APS09(t-1)
(4.27)
+ 0.50425*[FPR(t-1)/CPI(t-1)/100]
(1.37) [0.473]
+ 310.01829*ET09NOV(t-2)
(6.02) [4.850]
-350.56930*ET09DEC(t-2)
(-7.61) [-2.751]
- 134.94665*ET09MAR(t-1)
(-5.07) [-0.467]
+156.76263*ET09APR(t-1)
(7.95) [1.097]
-188.37162*ET09MAY(t-1)
(-7.96) [-2.694]
+ 214.92390*ET09JUN(t-1)
(9.74) [3.176]
-4067.13257*D83
(-4.16)
-9466.71777*D87
(-8.21)
-3062.02409*D890
(-3.91)

$AdjR^2$=0.9248 D.W.=1.521

APS09	Planted Area of Second Rice in Ubon Ratchathani
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET09M AR	Evapotranspiration of March in Ubon Ratchathani
ET09APR	Evapotranspiration of April in Ubon Ratchathani
ET09MAY	Evapotranspiration of May in Ubon Ratchathani
ET09JUN	Evapotranspiration of June in Ubon Ratchathani
ET09NOV	Evapotranspiration of November in Ubon Ratchathani
ET09DEC	Evapotranspiration of December in Ubon Ratchathani
D83	Dummy Variable, 1 in 1983, 0 otherwise
D87	Dummy Variable, 1 in 1987, 0 otherwise
D890	Dummy Variable, 1 in 1989 to 1990, 0 otherwise

4-5-2-2-1-8. Planted area function of second rice in Kalasin

APS11 = + 24807
(5.41)
+ 0.85267*APS11(t-1)
(18.04)
+ 0.51460*[FPR(t-1)/CPI(t-1)/100]
(0.87) [0.309]
+ 3189.24007*ln(T87)
(12.91)
- 859.78676*ET11DEC(t-2)
(-9.00) [-3.147]
+ 1640.72617*ET11JAN(t-1)
(11.63) [2.119]
- 31.31688*ET11MAR(t-1)
(-1.34) [-0.095]
+ 77.12215*ET11APR(t-1)
(2.90) [0.392]
- 161.89174*ET11MAY(t-1)

(-6.43) [-1.410]
- 126.64582*ET11JUN(t-1)
(-3.14) [-1.199]
+ 4640.36286*D86
(3.21)
- 19145*D94
(-11.82)
- 23325*D99
(-14.24)

$Adj R^2$=0.9906 D.W.=2.527

APS11	Planted Area of Second Rice in Kalasin
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
LT87	Logarithm of time trend from 1987, 0 otherwise
ET11JAN	Evapotranspiration of January in Kalasin
ET11MAR	Evapotranspiration of March in Kalasin
ET11APR	Evapotranspiration of April in Kalasin
ET11MAY	Evapotranspiration of May in Kalasin
ET11JUN	Evapotranspiration of June in Kalasin
ET11DEC	Evapotranspiration of December in Kalasin
D86	Dummy Variable, 1 in 1986, 0 otherwise
D94	Dummy Variable, 1 in 1994, 0 otherwise
D99	Dummy Variable, 1 in 1999, 0 otherwise

4-5-2-2-1-9. Planted area function of second rice in Khon Kaen

APS12 = - 72551
(-6.79)
+ 0.48354*APS12(t-1)
(3.97)
+ 0.50818*[FPR(t-1)/CPI(t-1)/100]
(0.48) [0.273]
+ 921.53020*ET12NOV(t-2)
(7.66) [7.216]
+ 261.11113*ET12MAR(t-1)
(4.48) [0.753]
- 156.80801*ET12APR(t-1)
(-3.68) [-0.689]
- 7614.73365*D85
(-3.64)
- 8553.49095*D87
(-3.49)
+ 7360.77399*D89
(2.81)
+ 14057*D95
(3.91)

$Adj R^2$=0.8795 D.W.=1.847

APS12	Planted Area of Second Rice in Khon Kaen
FPR	Farm Price of Thai Rice (baht per kg)
CPI	Consumer Price Index (1998=100)
ET12MAR	Evapotranspiration of March in Khon Kaen
ET12APR	Evapotranspiration of April in Khon Kaen
ET12NOV	Evapotranspiration of November in Khon Kaen
D85	Dummy Variable, 1 in 1985, 0 otherwise
D87	Dummy Variable, 1 in 1987, 0 otherwise
D89	Dummy Variable, 1 in 1989, 0 otherwise

4-5-2-2-1-10. Planted area function of second rice in Maha Sarakham

APS13 = - 37565
(-3.83)
+ 0.91330*APS13(t-1)
(10.15)
+ 0.83544*[FPR(t-1)/CPI(t-1)/100]
(0.77) [0.609]
+ 294.81708*ET13NOV(t-2)
(2.78) [3.077]
+ 382.10238*ET13JAN(t-1)
(2.04) [0.667]
- 298.89046*ET13FEB(t-1)
(-3.32) [-0.614]
+ 193.01579*ET13MAR(t-1)
(3.11) [0.666]
- 138.52959*ET13APR(t-1)
(-3.39) [-0.828]
+ 164.15449*ET13MAY(t-1)
(3.34) [1.590]
+ 3654.77905*D89
(1.36)
-12115*D94
(-4.25)

$Adj R^2$=0.9299 D.W.=2.006

APS13	Planted Area of Second Rice in Maha Sarakham
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET13JAN	Evapotranspiration of January in Maha Sarakham
ET13FEB	Evapotranspiration of February in Maha Sarakham
ET13MAR	Evapotranspiration of March in Maha Sarakham
ET13APR	Evapotranspiration of April in Maha Sarakham
ET13MAY	Evapotranspiration of May in Maha Sarakham
ET13NOV	Evapotranspiration of November in Maha Sarakham
D89	Dummy Variable, 1 in 1989, 0 otherwise
D94	Dummy Variable, 1 in 1994, 0 otherwise

4-5-2-2-1-11. Planted area function of second rice in Roi Et

APS14 = -30287
(-3.57)
+ 0.36316*APS14(t-1)
(3.36)
+ 0.19654*[FPR(t-1)/CPI(t-1)/100]
(0.40) [0.225]
+ 468.41894*ET14NOV(t-2)
(3.37) [7.661]
- 818.83755*ET14DEC(t-2)
(-2.85) [-5.635]
+ 663.14523*ET14JAN(t-1)
(1.85) [1.824]
+ 144.23248*ET14FEB(t-1)
(2.07) [0.473]
+ 132.33002*ET14JUN(t-1)
(2.93) [2.286]
+ 2923.10947*D89
(2.27)
+ 10046*D92

(6.97)
- 3821.74466*D94
(-2.67)
$AdjR^2$=0.9309 D.W.=1.983

APS14	Planted Area of Second Rice in Roi Et
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET14JAN	Evapotranspiration of January in Roi Et
ET14FEB	Evapotranspiration of February in Roi Et
ET14JUN	Evapotranspiration of June in Roi Et
ET14NOV	Evapotranspiration of November in Roi Et
ET14DEC	Evapotranspiration of Necember in Roi Et
D89	Dummy Variable, 1 in 1989, 0 otherwise
D92	Dummy Variable, 1 in 1992, 0 otherwise
D94	Dummy Variable, 1 in 1994, 0 otherwise

4-5-2-2-1-12. Planted area function of second rice in Buri Ram

APS15 = -3238.14066
(-4.23)
+ 0.52715*APS15(t-1)
(8.18)
+ 0.13450*[FPR(t-1)/CPI(t-1)/100]
(2.18) [1.217]
+ 26.50944*ET15NOV(t-2)
(3.57) [3.721]
+ 9.74792*ET15FEB(t-1)
(1.53) [0.236]
+ 9.10498*ET15MAR(t-1)
(1.74) [9.105]
+ 1024.55174*D889
(8.48)
+ 989.19506*D92
(5.96)
$AdjR^2$=0.8414 D.W.=2.258

APS15	Planted Area of Second Rice in Buri Ram
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET15FEB	Evapotranspiration of February in Buri Ram
ET15MAR	Evapotranspiration of March in Buri Ram
ET15NOV	Evapotranspiration of November in Buri Ram
D889	Dummy Variable, 1 in 1988 to 1989, 0 otherwise
D92	Dummy Variable, 1 in 1992, 0 otherwise

4-5-2-2-1-13. Planted area function of second rice in Surin

APS16 = - 6780.14533
(-5.81)
+ 0.63350*APS16(t-1)
(9.98)
+ 0.07752*[FPR(t-1)/CPI(t-1)/100]
(1.23) [0.533]
+ 145.56050*T8289
(7.36)
+ 133.81691*ln(T95)
(3.42)
+ 40.50127*ET16NOV(t-2)
(3.48) [4.241]
+ 36.22501*ET16JAN(t-1)
(3.18) [0.663]
+ 6.78879*ET16APR(t-1)
(2.07) [0.371]
+ 23.46808*ET16JUN(t-1)
(5.32) [2.385]
- 243.75092*D89
(-1.05)
+ 1096.64935*D923
(8.41)
$AdjR^2$=0.9594 D.W.=2.731

APS16	Planted Area of Second Rice in Surin
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
T8289	Time Trend from 1982 to 1989, 0 otherwise
LT95	Logarithm of Time Trend from 1995, 0 otherwise
ET16JAN	Evapotranspiration of January in Surin
ET16APR	Evapotranspiration of April in Surin
ET16JUN	Evapotranspiration of June in Surin
ET16NOV	Evapotranspiration of November in Surin
D89	Dummy Variable, 1 in 1989, 0 otherwise
D923	Dummy Variable, 1 in 1992 to 1993, 0 otherwise

4-5-2-2-1-14. Planted area function of second rice in Si Sa Ket

APS17 = - 5854.12296
(-3.77)
+ 0.26837*APS17(t-1)
(3.12)
+ 0.59373*[FPR(t-1)/CPI(t-1)/100]
(3.94) [1.746]
- 43.96068*ET17JAN(t-1)
(-1.71) [-0.385]
- 20.39977*ET17MAY(t-1)
(-2.46) [-0.911]
+ 66.11579*ET17JUN(t-1)
(4.37) [3.016]
+ 3220.64128*D846
(10.76)
+ 2240.93639*D88
(4.72)
+ 2035.05366*D92
(4.77)
$AdjR^2$=0.9199 D.W.=1.823

APS17	Planted Area of Second Rice in Si Sa Ket
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET17JAN	Evapotranspiration of January in Si Sa Ket
ET17MAY	Evapotranspiration of May in Si Sa Ket
ET17JUN	Evapotranspiration of June in Si Sa Ket
D846	Dummy Variable, 1 in 1984 to 1986, 0 otherwise
D88	Dummy Variable, 1 in 1988, 0 otherwise
D92	Dummy Variable, 1 in 1992, 0 otherwise

4-5-2-2-1-15. Planted area function of second rice in Chaiyaphum

APS18 = - 4934.88547

(-3.10)
+ 0.33270*APS18(t-1)
(2.69)
+ 0.16210*[FPR(t-1)/CPI(t-1)/100]
(0.91) [0.720]
+ 21.48022*ET18NOV(t-2)
(1.43) [1.448]
- 88.04848*ET18JAN(t-1)
(-3.22) [-1.107]
+ 18.41744*ET18MAR(t-1)
(2.24) [0.455]
+ 24.49043*ET18APR(t-1)
(2.03) [0.880]
- 21.38045*ET18MAY(t-1)
(-2.06) [-1.412]
+ 49.12046*ET18JUN(t-1)
(3.25) [3.473]
+ 877.22287*D889
(3.16)
+ 2747.09344*D92
(5.79)

$Adj R^2$=0.8797 D.W.=1.921

APS18	Planted Area of Second Rice in Chaiyaphum
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET18JAN	Evapotranspiration of January in Chaiyaphum
ET18MAR	Evapotranspiration of March in Chaiyaphum
ET18APR	Evapotranspiration of April in Chaiyaphum
ET18MAY	Evapotranspiration of May in Chaiyaphum
ET18JUN	Evapotranspiration of June in Chaiyaphum
ET18NOV	Evapotranspiration of November in Chaiyaphum
D889	Dummy Variable, 1 in 1988 to 1989, 0 otherwise
D92	Dummy Variable, 1 in 1992, 0 otherwise

4-5-2-2-1-16. Planted area function of second rice in Nakhon Ratchasima

APS19 = - 32297
(-8.74)
+ 0.61102*APS19(t-1)
(8.11)
+ 0.35556*[FPR(t-1)/CPI(t-1)/100]
(1.43) [0.456]
+ 282.85892*ET19NOV(t-2)
(9.06) [5.737]
+ 80.58050*ET19DEC(t-2)
(-11.22) [0.868]
- 358.38272*ET19FEB(t-1)
(-11.82) [-1.432]
+ 241.14504*ET19MAR(t-1)
(10.40) [1.495]
+ 43.31809*ET19APR(t-1)
(3.23) [0.500]
- 125.50027*ET19MAY(t-1)
(-9.02) [-2.398]
+ 149.99681*ET19JUN(t-1)
(4.49) [2.903]
- 8996.55486*D90
(-11.22)
- 8920.60848*D98
(8.97)
+ 5938.94675*D00
(8.97)

$Adj R^2$=0.9880 D.W.=1.971

APS19	Planted Area of Second Rice in Nakhon Ratchasima
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ET19FEB	Evapotranspiration of February in Nakhon Ratchasima
ET19MAR	Evapotranspiration of March in Nakhon Ratchasima
ET19APR	Evapotranspiration of April in Nakhon Ratchasima
ET19MAY	Evapotranspiration of May in Nakhon Ratchasima
ET19JUN	Evapotranspiration of June in Nakhon Ratchasima
ET19NOV	Evapotranspiration of November in Nakhon Ratchasima
ET19DEC	Evapotranspiration of December in Nakhon Ratchasima
D90	Dummy Variable, 1 in 1990, 0 otherwise
D98	Dummy Variable, 1 in 1998, 0 otherwise
D00	Dummy Variable, 1 in 2000, 0 otherwise

4-5-2-2-2. Planted area function of second rice in North region

APS_N = - 190405
(-2.92)
+ 13897.4*TREND
(7.50)
+ 0.53896*APS_N(t-1)
(5.25)
+ 15.6997*[FPR/(CPI/100)](t-1)
(2.13) [0.257]
+ 15656.5*ETNJAN(t-1)
(11.48) [1.540]
- 15033.5*ETNFEB(t-1)
(-7.48) [-1.058]
+ 4129.81*ETNMAR(t-1)
(6.43) [0.290]
- 2378.73*ETNMAY(t-1)
(-5.74) [-0.579]
+ 194653 *D86
(7.05)
- 138917 *D912
(-8.67)

$Adj R^2$=0.9839 D.W.=1.615

APS_N	Harvested Area of Second Rice in North region
TREND	Time Trend from 1982 to 2000
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ETNJAN	Evapotranspiration of January in North region
ETNFEB	Evapotranspiration of February in North region
ETNMAR	Evapotranspiration of March in North region
ETNMAY	Evapotranspiration of May in North region
D86	Dummy Variable, 1 in 1986, 0 otherwise
D912	Dummy Variable, 1 in 1991 to 1992, 0 otherwise

4-5-2-2-3. Planted area function of second rice in South region

APS_S = + 38495.4
(2.85)
+ 0.52253*APS_S(t-1)
(5.20)
+ 2.59221*[FPR/(CPI/100)](t-1)
(2.05) [0.490]
- 354.600*ETSJAN(t-1)
(-3.13) [-1.293]
- 8558.75*D82
(-2.25)
- 15921.4*D902
(-5.58)
+ 17528.6*D99
(4.54)

$Adj R^2$=0.8531 D.W.=2.167

APS_S	Harvested Area of Second Rice in South region
FPR	Farm Price of Thai Rice (baht per KG)
CPI	Consumer Price Index (1998=100)
ETSJAN	Evapotranspiration of January in South region
D82	Dummy Variable, 1 in 1982, 0 otherwise
D902	Dummy Variable, 1 in 1990 to 1992, 0 otherwise
D99	Dummy Variable, 1 in 1999, 0 otherwise

4-5-2-2-4. Planted area function of second rice in Central region

APS_C = + 370279
(4.14)
+ 41541.3*ln(T94)
(4.51)
+ 0.32570*APS_C(t-1)
(2.36)
+ 23.7520*[FPR/(CPI/100)](t-1)
(2.06) [0.239]
+ 8489.08*ETCDEC(t-2)
(5.55) [1.055]
- 13446 *ETCJAN(t-1)
(-4.66) [-0.763]
+ 5303.54*ETCFEB(t-1)
(2.66) [0.211]
+ 1230.38*ETCAPR(t-1)
(2.07) [0.114]
- 5619.69*ETCMAY(t-1)
(-5.62) [-0.933]
+ 65595.8*D89
(1.70)
- 181487 *D91
(-5.30)

$Adj R^2$=0.8844 D.W.=2.331

APS_C	Harvested Area of Second Rice in Central region
LT94	Log Time Trend from 1994, 0 before 1994
FPR	Farm Price of Thai Rice (baht per kg)
CPI	Consumer Price Index (1998=100)
ETCJAN	Evapotranspiration of January in Central region
ETCFEB	Evapotranspiration of February in Central region
ETCAPR	Evapotranspiration of April in Central region
ETCMAY	Evapotranspiration of May in Central region
ETCDEC	Evapotranspiration of May in December region
D89	Dummy Variable, 1 in 1989, 0 otherwise
D91	Dummy Variable, 1 in 1991, 0 otherwise

4-5-3. Production

4-5-3-1. Production of major rice

4-5-3-1-1. Production of major rice in North East region

4-5-3-1-1-1. Production identity of major rice in Nakhon Phanom

QM01=	YMH01*(APM01-LM01)
QM01	Production of major rice in Nakhon Phanom (MT)
YMH01	Yield of major rice in Nakhon Phanom (MT/HA)
APM01	Planted area of major rice in Nakhon Phanom (HA)
LM01	Abandoned area of major rice in Nakhom Phanom (HA)

4-5-3-1-1-2. Production identity of major rice in Sakon Nakhon

QM02=	YMH02*(APM02-LM02)
QM02	Production of major rice in Sakon Nakhon (MT)
YMH02	Yield of major rice in Sakon Nakhon (MT/HA)
APM02	Planted area of major rice in Sakon Nakhon (HA)
LM02	Abandoned area of major rice in Sakon Nakhon (HA)

4-5-3-1-1-3. Production identity of major rice in Nong Khai

QM03=	YMH03*(APM03-LM03)
QM03	Production of major rice in Nong Khai (MT)
YMH03	Yield of major rice in Nong Khai (MT/HA)
APM03	Planted area of major rice in Nong Khai (HA)
LM03	Abandoned area of major rice in Nong Khai (HA)

4-5-3-1-1-4. Production identity of major rice in Udon Thani

QM04=	YMH04*(APM04-LM04)
QM04	Production of major rice in Udon Thani (MT)
YMH04	Yield of major rice in Udon Thani (MT/HA)
APM04	Planted area of major rice in Udon Thani (HA)
LM04	Abandoned area of major rice in Udon Thani (HA)

4-5-3-1-1-5. Production identity of major rice in Loei

QM06=	YMH06*(APM06-LM06)
QM06	Production of major rice in Loei (MT)
YMH06	Yield of major rice in Loei (MT/HA)
APM06	Planted area of major rice in Loei (HA)
LM06	Abandoned area of major rice in Loei (HA)

4-5-3-1-1-6. Production identity of major rice in Yasothon

QM08=	YMH08*(APM08-LM08)
QM08	Production of major rice in Yasothon (MT)
YMH08	Yield of major rice in Yasothon (MT/HA)
APM08	Planted area of major rice in Yasothon (HA)
LM08	Abandoned area of major rice in Yasothon (HA)

4-5-3-1-1-7. Production identity of major rice in Ubon Ratchathani

QM09= YMH09*(APM09-LM09)
QM09 Production of major rice in Ubon Ratchathani (MT)
YMH09 Yield of major rice in Ubon Ratchathani (MT/HA)
APM09 Planted area of major rice in Ubon Ratchathani (HA)
LM09 Abandoned area of major rice in Ubon Ratchathani (HA)

4-5-3-1-1-8. Production identity of major rice in Kalasin

QM11= YMH11*(APM11-LM11)
QM11 Production of major rice in Kalasin (MT)
YMH11 Yield of major rice in Kalasin (MT/HA)
APM11 Planted area of major rice in Kalasin (HA)
LM11 Abandoned area of major rice in Kalasin (HA)

4-5-3-1-1-9. Production identity of major rice in Khon Kaen

QM12= YMH12*(APM12-LM12)
QM12 Production of major rice in Khon Kaen (MT)
YMH12 Yield of major rice in Khon Kaen (MT/HA)
APM12 Planted area of major rice in Khon Kaen (HA)
LM12 Abandoned area of major rice in Khon Kaen (HA)

4-5-3-1-1-10. Production identity of major rice in Maha Sarakham

QM13= YMH13*(APM13-LM13)
QM13 Production of major rice in Maha Sarakham (MT)
YMH13 Yield of major rice in Maha Sarakham (MT/HA)
APM13 Planted area of major rice in Maha Sarakham (HA)
LM13 Abandoned area of major rice in Maha Sarakham (HA)

4-5-3-1-1-11. Production identity of major rice in Roi Et

QM14= YMH14*(APM14-LM14)
QM14 Production of major rice in Roi Et (MT)
YMH14 Yield of major rice in Roi Et (MT/HA)
APM14 Planted area of major rice in Roi Et (HA)
LM14 Abandoned area of major rice in Roi Et (HA)

4-5-3-1-1-12. Production identity of major rice in Buri Ram

QM15= YMH15*(APM15-LM15)
QM15 Production of major rice in Buri Ram (MT)
YMH15 Yield of major rice in Buri Ram (MT/HA)
APM15 Planted area of major rice in Buri Ram (HA)
LM15 Abandoned area of major rice in Buri Ram (HA)

4-5-3-1-1-13. Production identity of major rice in Surin

QM16= YMH16*(APM16-LM16)
QM16 Production of major rice in Surin (MT)
YMH16 Yield of major rice in Surin (MT/HA)
APM16 Planted area of major rice in Surin (HA)
LM16 Abandoned area of major rice in Surin (HA)

4-5-3-1-1-14. Production identity of major rice in Si Sa Ket

QM17= YMH17*(APM17-LM17)
QM17 Production of major rice in Si Sa Ket (MT)
YMH17 Yield of major rice in Si Sa Ket (MT/HA)
APM17 Planted area of major rice in Si Sa Ket (HA)
LM17 Abandoned area of major rice in Si Sa Ket (HA)

4-5-3-1-1-15. Production identity of major rice in Chaiyaphum

QM18= YMH18*(APM18-LM18)
QM18 Production of major rice in Chaiyaphum (MT)
YMH18 Yield of major rice in Chaiyaphum (MT/HA)
APM18 Planted area of major rice in Chaiyaphum (HA)
LM18 Abandoned area of major rice in Chaiyaphum (HA)

4-5-3-1-1-16. Production identity of major rice in Nakhon Ratchasima

QM19= YMH19*(APM19-LM19)
QM19 Production of major rice in Nakhon Ratchasima (MT)
YMH19 Yield of major rice in Nakhon Ratchasima (MT/HA)
APM19 Planted area of major rice in Nakhon Ratchasima (HA)
LM19 Abandoned area of major rice in Nakhon Ratchasima (HA)

4-5-3-1-1-17. Production identity of major rice for whole North East region

QM_NE= QM01 + QM02 + QM03 + QM04 + QM06 + QM08 + QM09 + QM11+ QM12 + QM13 + QM14 + QM15 + QM16 + QM17 + QM18 + QM19
QM_NE Production of major rice in North East region (MT)
QM01 Production of major rice in Nakhon Phanom (MT)
QM02 Production of major rice in Sakon Nakhon (MT)
QM03 Production of major rice in Nong Khai (MT)
QM04 Production of major rice in Udon Thani (MT)
QM06 Production of major rice in Loei (MT)
QM08 Production of major rice in Yasothon (MT)
QM09 Production of major rice in Ubon Ratchathani (MT)
QM12 Production of major rice in Khon Kaen (MT)
QM13 Production of major rice in Maha Sarakham (MT)
QM14 Production of major rice in Roi Et (MT)
QM15 Production of major rice in Buri Ram (MT)
QM16 Production of major rice in Surin (MT)
QM17 Production of major rice in Si Sa Ket (MT)
QM18 Production of major rice in Chaiyaphum (MT)
QM19 Production of major rice in Nakhon Ratchasima (MT)

4-5-3-1-2. Production of major rice in North region

QM_N= YMH_N*(APM_N - LM_N)
QM_N Production of major rice in North region (MT)
YMH_N Yield of major rice in North region (MT/HA)
APM_N Planted area of major rice in North region (HA)
LM_N Abandoned area of major rice in North region (HA)

4-5-3-1-3. Production of major rice in South region

QM_S= YMH_S*(APM_S - LM_S)
QM_S Production of major rice in South region (MT)
YMH_S Yield of major rice in South region (MT/HA)
APM_S Planted area of major rice in South region (HA)
LM_S Abandoned area of major rice in South region (HA)

4-5-3-1-4. Production of major rice in Central region

QM_C= YMH_C*(APM_C - LM_C)
QM_C Production of major rice in Central region (MT)
YMH_C Yield of major rice in Central region (MT/HA)
APM_C Planted area of major rice in Central region (HA)
LM_C Abandoned area of major rice in Central region (HA)

4-5-3-1-5. Production of major rice for whole country

QM= QM_NE + QM_N + QM_C + QM_S
QM Production of major rice for whole country (MT)
QM_N Production of major rice in North region (MT)
QM_C Production of major rice in Central region (MT)
QM_S Production of major rice in South region (MT)

4-5-3-2. Production of second rice

4-5-3-2-1. Production of second rice in North East region

4-5-3-2-1-1. Production identity of second rice in Nakhon Phanom

QS01= YSH01*(APS01-LS01)
QS01 Production of second rice in Nakhon Phanom (MT)
YSH01 Yield of second rice in Nakhon Phanom (MT/HA)
APS01 Planted area of second rice in Nakhon Phanom (HA)
LS01 Abandoned area of second rice in Nakhom Phanom (HA)

4-5-3-2-1-2. Production identity of second rice in Sakon Nakhon

QS02= YSH02*(APS02-LS02)
QS02 Production of second rice in Sakon Nakhon (MT)
YSH02 Yield of second rice in Sakon Nakhon (MT/HA)
APS02 Planted area of second rice in Sakon Nakhon (HA)
LS02 Abandoned area of second rice in Sakon Nakhon (HA)

4-5-3-2-1-3. Production identity of second rice in Nong Khai

QS03= YSH03*(APS03-LS03)
QS03 Production of second rice in Nong Khai (MT)
YSH03 Yield of second rice in Nong Khai (MT/HA)
APS03 Planted area of second rice in Nong Khai (HA)
LS03 Abandoned area of second rice in Nong Khai (HA)

4-5-3-2-1-4. Production identity of second rice in Udon Thani

QS04= YSH04*(APS04-LS04)
QS04 Production of second rice in Udon Thani (MT)
YSH04 Yield of second rice in Udon Thani (MT/HA)
APS04 Planted area of second rice in Udon Thani (HA)
LS04 Abandoned area of second rice in Udon Thani (HA)

4-5-3-2-1-5. Production identity of second rice in Loei

QS06= YSH06*(APS06-LS06)
QS06 Production of second rice in Loei (MT)
YSH06 Yield of second rice in Loei (MT/HA)
APS06 Planted area of second rice in Loei (HA)
LS06 Abandoned area of second rice in Loei (HA)

4-5-3-2-1-6. Production identity of second rice in Yasothon

QS08= YSH08*(APS08-LS08)
QS08 Production of second rice in Yasothon (MT)
YSH08 Yield of second rice in Yasothon (MT/HA)
APS08 Planted area of second rice in Yasothon (HA)
LS08 Abandoned area of second rice in Yasothon (HA)

4-5-3-2-1-7. Production identity of second rice in Ubon Ratchathani

QS09= YSH09*(APS09-LS09)
QS09 Production of second rice in Ubon Ratchathani (MT)
YSH09 Yield of second rice in Ubon Ratchathani (MT/HA)
APS09 Planted area of second rice in Ubon Ratchathani (HA)
LS09 Abandoned area of second rice in Ubon Ratchathani (HA)

4-5-3-2-1-8. Production identity of second rice in Kalasin

QS11= YSH11*(APS11-LS11)
QS11 Production of second rice in Kalasin (MT)
YSH11 Yield of second rice in Kalasin (MT/HA)
APS11 Planted area of second rice in Kalasin (HA)
LS11 Abandoned area of second rice in Kalasin (HA)

4-5-3-2-1-9. Production identity of second rice in Khon Kaen

QS12= YSH12*(APS12-LS12)
QS12 Production of second rice in Khon Kaen (MT)
YSH12 Yield of second rice in Khon Kaen (MT/HA)
APS12 Planted area of second rice in Khon Kaen (HA)
LS12 Abandoned area of second rice in Khon Kaen (HA)

4-5-3-2-1-10. Production identity of second rice in Maha Sarakham

QS13= YSH13*(APS13-LS13)
QS13 Production of second rice in Maha Sarakham (MT)
YSH13 Yield of second rice in Maha Sarakham (MT/HA)
APS13 Planted area of second rice in Maha Sarakham (HA)
LS13 Abandoned area of second rice in Maha Sarakham (HA)

4-5-3-2-1-11. Production identity of second rice in Roi Et

QS14= YSH14*(APS14-LS14)
QS14 Production of second rice in Roi Et (MT)
YSH14 Yield of second rice in Roi Et (MT/HA)
APS14 Planted area of second rice in Roi Et (HA)
LS14 Abandoned area of second rice in Roi Et (HA)

4-5-3-2-1-12. Production identity of second rice in Buri Ram

QS15= YSH15*(APS15-LS15)
QS15 Production of second rice in Buri Ram (MT)
YSH15 Yield of second rice in Buri Ram (MT/HA)
APS15 Planted area of second rice in Buri Ram (HA)
LS15 Abandoned area of second rice in Buri Ram (HA)

4-5-3-2-1-13. Production identity of second rice in Surin

QS16= YSH16*(APS16-LS16)
QS16 Production of second rice in Surin (MT)
YSH16 Yield of second rice in Surin (MT/HA)
APS16 Planted area of second rice in Surin (HA)
LS16 Abandoned area of second rice in Surin (HA)

4-5-3-2-1-14. Production identity of second rice in Si Sa Ket

QS17= YSH17*(APS17-LS17)
QS17 Production of second rice in Si Sa Ket (MT)
YSH17 Yield of second rice in Si Sa Ket (MT/HA)
APS17 Planted area of second rice in Si Sa Ket (HA)
LS17 Abandoned area of second rice in Si Sa Ket (HA)

4-5-3-2-1-15. Production identity of second rice in Chaiyaphum

QS18= YSH18*(APS18-LS18)
QS18 Production of second rice in Chaiyaphum (MT)
YSH18 Yield of second rice in Chaiyaphum (MT/HA)
APS18 Planted area of second rice in Chaiyaphum (HA)
LS18 Abandoned area of second rice in Chaiyaphum (HA)

4-5-3-2-1-16. Production identity of second rice in Nakhon Ratchasima

QS19= YSH19*(APS19-LS19)
QS19 Production of second rice in Nakhon Ratchasima (MT)
YSH19 Yield of second rice in Nakhon Ratchasima (MT/HA)
APS19 Planted area of second rice in Nakhon Ratchasima (HA)
LS19 Abandoned area of second rice in Nakhon Ratchasima (HA)

4-5-3-2-1-17. Production identity of second rice for whole North East region

Production identity of second rice in North East region

QS_NE= QS01 + QS02 + QS03 + QS04 + QS06 + QS08 + QS09 + QS11+ QS12 + QS13 + QS14 + QS15 + QS16 + QS17 + QS18 + QS19
QS_NE Production of second rice in North East region (MT)
QS01 Production of second rice in Nakhon Phanom (MT)
QS02 Production of second rice in Sakon Nakhon (MT)
QS03 Production of second rice in Nong Khai (MT)
QS04 Production of second rice in Udon Thani (MT)
QS06 Production of second rice in Loei (MT)
QS08 Production of second rice in Yasothon (MT)
QS09 Production of second rice in Ubon Ratchathani (MT)
QS11 Production of second rice in Kalasin (MT)
QS12 Production of second rice in Khon Kaen (MT)
QS13 Production of second rice in Maha Sarakham (MT)
QS14 Production of second rice in Roi Et (MT)
QS15 Production of second rice in Buri Ram (MT)
QS16 Production of second rice in Surin (MT)
QS17 Production of second rice in Si Sa Ket (MT)
QS18 Production of second rice in Chaiyaphum (MT)
QS19 Production of second rice in Nakhon Ratchasima (MT)

4-5-3-2-2. Production of second rice in North region

QS_N= YSH_N*(APS_N - LS_N)
QS_N Production of second rice in North region (MT)
YSH_N Yield of second rice in North region (MT/HA)
APS_N Planted area of second rice in North region (HA)
LS_N Abandoned area of second rice in North region (HA)

4-5-3-2-3. Production of second rice in South region

QS_S= YSH_S*(APS_S - LS_S)
QS_S Production of second rice in South region (MT)
YSH_S Yield of second rice in South region (MT/HA)
APS_S Planted area of second rice in South region (HA)
LS_S Abandoned area of second rice in South region (HA)

4-5-3-2-4. Production of second rice in Central region

QS_C= YSH_C*(APS_C - LS_C)
QS_C Production of second rice in Central region (MT)
YSH_C Yield of second rice in Central region (MT/HA)
APS_C Planted area of second rice in Central region (HA)
LS_C Abandoned area of second rice in Central region (HA)

4-5-3-2-5. Production of second rice for whole country

QS= QS_NE + QS_N + QS_C + QS_S
QS Production of second rice for whole country (MT)
QS_N Production of second rice in North region (MT)
QS_C Production of second rice in Central region (MT)
QS_S Production of second rice in South region (MT)

4-5-3-3. Total production in milled equivalent

Q= QM + QS
Q_ME= 0.667*(QM + QS)
Q Total production in paddy equivalent (MT)
Q_ME Total production in milled equivalent (MT)
QM Production of major rice for whole country (MT)
QS Production of second rice for whole country (MT)

4-5-4. Stock change function

STC = - 1084551
(-5.66)
+ 118669 *T86
(6.39)
- 301.624*[FPR/(CPI/100)-FPR(t-1)/(CPI(t-1)/100)]
(-2.60) [0.121]
+ 0.87899*[(Q_ME ñ Q_ME(t-1)]
(7.26) [1.408]
+ 1209462*D857
(4.10)

- 1529720*D89
(-4.05)
+ 2676806*D90
(4.67)

$AdjR^2$=0.85 D.W.=2.292

STC	Stock change of Rice (MT)
T86	Time Trend from 1986, 0 before 1986
FPR	Farm Price of Thai Rice (baht per kg)
CPI	Consumer Price Index(1998=100)
Q_ME	Total Production in milled equivalent (MT)
D857	Dummy Variable, 1 in 1985 to 1987, 0 otherwise
D89	Dummy Variable, 1 in 1989, 0 otherwise
D90	Dummy Variable, 1 in 1990, 0 otherwise

4-5-5. Export function

EXP = + 1450479
(1.31)
+ 73960*TREND
(2.88)
+ 0.13051*Q
(2.07) [0.526]
+ 1416706*D89
(3.60)
+ 1013411*D95
(2.64)
+ 889253*D989
(2.84)

$AdjR^2$=0.8685 D.W.=2.191

EXP	Exportation of Rice (MT)
TREND	Time Trend from 1982 to 2000
Q	Total Production in paddy equivalent (MT)
D89	Dummy Variable, 1 in 1989, 0 otherwise
D95	Dummy Variable, 1 in 1995, 0 otherwise
D989	Dummy Variable, 1 in 1998 to 1999, 0 otherwise

4-5-6. Domestic supply identity in milled equivalent

QD=	Q_ME + IMP - EXP - STC
QD	Domestic supply in milled equivalent (MT)
Q_ME	Total production in milled equivalent (MT)
IMP	Imports (MT)
EXP	Exports (MT)
STC	Stock change (Ending stock - Beginning stock) (MT)

4-5-7. Per capita consumption

QC=	QD / POP
QC	Per capita consumption (KG)
QD	Domestic supply in milled equivalent (MT)
POP	Population (thousand people)

4-5-8. Demand function

Demand Function of Rice for Average of Thai Rice

QC = + 329.064
(7.65)
- 1.77086*T8295
(-5.12)
- 0.00825*[RPRB/(CPI/100)]
(-2.85) [0.771]
- 1.32549*(GDP/POP)
(-11.22) [-0.320]
- 10.9487*D856
(-1.92)
- 29.8603*D87
(-4.08)
+ 23.7069*D89
(4.01)
+ 16.6143*D97
(2.47)

$AdjR^2$=0.9253 D.W.=2.186

QC	Consumption of Rice per capita (KG)
T8295	Time Trend from 1982 to 1995, 0 before 1982, 0 after 1995
RPRB	Retail Price of Rice (Baht/MT)
CPI	Consumer Price Index(1998=100)
GDP	Realized Gross Domestic Products
POP	Population
D856	Dummy Variable, 1 in 1985 to 1986, 0 otherwise
D87	Dummy Variable, 1 in 1987, 0 otherwise
D89	Dummy Variable, 1 in 1989, 0 otherwise
D97	Dummy Variable, 1 in 1997, 0 otherwise

4-5-9. Price linkage function

FPR = + 308.373
(1.01)
- 624.972*T9800
(-3.20)
+ 0.42693*RPRB
(12.93) [1.116]
- 783.421*D93
(-2.16)

$AdjR^2$=0.9125 D.W.=2.155

FPR	Farm Price of Thai Rice (baht per KG)
T9800	Time Trend from 1998 to 2000, 1 before 1998, 3 after 2000
RPRB	Retail Price of Rice (Baht/MT)
D93	Dummy Variable, 1 in 1993, 0 otherwise

Table 4-1. Elasticities of yield of major rice for evapotranspiration and trend

	Trend	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
NORTH-EAST										
Nakhon Phanon	0.049		-0.431		0.668	-0.404		0.500		
Sakon Nakhon		0.252	-0.922	-1.173	1.274	0.360	-0.313		0.302	
Nong Khai	0.012	0.112	-0.484			0.705		0.355		
Udon Thani		0.111		-0.288			0.391		-0.717	
Loei			-0.426		0.965				0.925	
Yasothon	0.027		0.248	-0.385	0.454		0.407	-0.795	-0.428	
Ubon Ratchathani	0.014	-0.091	0.338		-0.616	0.457				
Kalasin	0.033		0.121		-0.462	-0.361		-0.201	-0.428	
Khon Kaen				0.278	-0.253		-0.279	-0.227		
Maha Sarakham	0.046			-0.262						
Roi Et	0.043			-0.633	0.532					
Buri Ram	0.033	-0.110						-0.281		
Surin		0.109			0.390	0.407	0.325	-0.628		
Si Sa Ket	0.043		0.232	-0.870	0.554		0.639		0.582	
Chaiyaphum			-0.573	-0.571		-0.458	0.673	0.405	-0.774	
Nakhon Ratchasima	0.050	-0.320	0.202		-0.204		0.483	-0.747	-1.925	
NORTH	0.022			0.212		-0.230	0.395	-0.295	0.711	0.164
SOUTH	0.034			0.509				0.609		-0.251
CENTRAL	0.049								0.306	

Table 4-2. Elasticities of yield of second rice for evapotranspiration and trend

	Trend	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.
NORTH-EAST									
Nakhon Phanon	0.018					-0.105	0.259		
Sakon Nakhon	-0.018	0.955	-0.815	0.255		0.154	-0.104	1.195	
Nong Khai	0.025	-1.232		0.245	-0.112	0.173	-0.162	0.622	
Udon Thani	0.016	1.563	-0.666		-0.078				
Loei		-0.953	0.649			0.165			
Yasothon		-1.262	0.757		-0.070			0.627	-0.641
Ubon Ratchathani		-0.705		-0.175		0.118			0.317
Kalasin	0.046		0.308		-0.056				-0.924
Khon Kaen	0.077	-0.421		0.294		-0.163	-0.092		0.747
Maha Sarakham	0.078					-0.188	0.107	0.100	-0.514
Roi Et		1.714				0.224			
Buri Ram			-0.634	0.796	-0.195	-0.150		0.651	-0.998
Surin	0.037	-1.950	0.431		0.209	-0.151			
Si Sa Ket			0.966	-0.296	-0.245	0.372	0.156		0.463
Chaiyaphum			-0.358	0.314	-0.155	-0.092		-0.192	-0.784
Nakhon Ratchasima			0.143				0.089	0.217	
NORTH				0.063	0.119	0.029			
SOUTH			-0.172		-0.101	0.070	-0.080	0.233	-0.136
CENTRAL	0.052					-0.040			

Table 4-3. Elasticities of planted area of major rice for farm price and evapotranspiration

	Trend	Area (t-1)	Price (t-1)	Evapotranspiration (t-1)									
				Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
NORTH-EAST													
Nakhon Phanon		0.497	0.153			-0.189		0.331			0.631	-0.529	0.410
Sakon Nakhon		0.591	0.457		0.192	-0.545			-0.913	1.355		-1.434	
Nong Khai		0.212	0.446			-0.460							
Udon Thani		0.205	0.127	-0.070	-0.132	0.316	-0.168						
Loei		0.628	0.436							0.767	0.721		
Yasothon		0.164	0.203		0.061	-0.223		-0.543	-0.206	0.339			
Ubon Ratchathani		0.891	0.144			-0.057			-0.143	0.389	0.154	-0.236	
Kalasin		0.247	0.678				-0.832			0.625	0.448		-0.465
Khon Kaen	0.047	0.236	0.328								0.800		
Maha Sarakham		0.238	0.238		-0.130	0.389	0.821	-0.417	-1.465	-1.399			
Roi Et		0.409	0.575			-0.210		0.498	-0.326		0.207		
Buri Ram	0.078	0.521	0.715		-0.094	1.270			-2.075	-1.399	1.481	0.590	0.690
Surin		0.698	0.481		-0.360	1.060	-0.862	0.692	0.619		-0.764	-0.708	-0.528
Si Sa Ket	0.112	0.223	0.481			-0.110	-0.682	1.005	0.408	1.089	1.068	-1.253	0.421
Chaiyaphum		0.397	0.744		-0.205	0.373			-0.359		0.624		
Nakhon Ratchasima		0.703	0.396			-0.180	0.806				0.414	0.821	
NORTH		0.727	0.083		-0.043				-0.247	0.314			
SOUTH		0.894	0.151			-0.297	0.492	0.205			-0.373	-0.187	0.276
CENTRAL		0.526	0.089		-0.026	-0.153					0.111	-0.172	

Table 4-4. Elasticities of planted area of second rice for farm price and evapotranspiration

	Trend	Area (t-1)	Price (t-1)	Evapotranspiration (t-1)							
				Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.
NORTH-EAST											
Nakhon Phanon		0.745	0.356	-4.407	2.253				0.484	-0.875	-2.899
Sakon Nakhon		0.478	1.984				0.667	0.285		-1.185	4.687
Nong Khai		0.405	0.671	-1.714	0.902						1.343
Udon Thani		0.024	0.603	6.897	-5.176	2.146			0.554		
Loei		0.228	0.879		-4.089	4.132		0.626	-0.490		4.833
Yasothon		0.540	1.491		3.509	-1.004			-0.999		
Ubon Ratchathani		0.355	0.473	4.850	-2.751			-0.467	1.097	-2.694	3.176
Kalasin		0.853	0.309		-3.147	2.119		-0.095	0.392	-1.410	-1.199
Khon Kaen		0.484	0.273	7.216				0.753	-0.689		
Maha Sarakham		0.913	0.609	3.077		0.667	-0.614	0.666	-0.828	1.590	
Roi Et		0.363	0.225	7.661	-5.635	1.824	0.473				2.286
Buri Ram		0.527	1.217	3.721			0.236	9.105			
Surin	0.150	0.634	0.533	4.241		0.663			0.371		2.385
Si Sa Ket		0.268	1.746			-0.385				-0.911	3.016
Chaiyaphum		0.333	0.720	1.448		-1.107		0.455	0.880	-1.412	3.473
Nakhon Ratchasima		0.611	0.456	5.737	0.868		-1.432	1.495	0.500	-2.398	2.903
NORTH	0.411	0.539	0.257			1.540	-1.058	0.290		-0.579	
SOUTH		0.522	0.490			-1.293					
CENTRAL	0.015	0.326	0.239		1.055	-0.763	0.211		0.114	-0.933	

4-6. Simulation results

4-6-1. Results of estimation of yield functions

Table 4-1 and Table 4-2 show elasticities of yield for ET in wet and dry seasons. In the case of Nakhon Phanon, the elasticity of yield of major rice for ET in July is 0.668, indicating that if ET in July increases 1%; the yield of major rice in the province will increase 0.668%.

The planting period in major rice or rainy season rice is from May to August and the harvest period is from October to December. The planting period in second rice or dry season rice is from January to February and the harvest period is from May to June.

These results for major rice show that higher ET in July leads higher yield in many provinces of the North East region. The results suggest that the water supply available in the planting season is important for the growth of rice. The results of second rice also show that ET in December and January leads to a higher yield in many provinces. Therefore, the available water supply during transplanting season is quite critical for rice production.

4-6-2. Results of estimation of planted area functions

Planted area functions of major rice and second rice are specified as linear functions based on the adaptive expectation model. The explanatory variables are time trend, one-year lagged planted area, one-year lagged farm price, and one-year lagged ETs for each month. The elasticities evaluated on the average are shown in Table 4-3 and Table 4-4.

The planted area elasticities of major rice cultivation for ET in October are positive for many provinces. It suggests that if farmers expect an abundant water supply in the flowering season of major rice, they will increase their planted area for rainy season cultivation. Meanwhile, planted area elasticities of dry season cultivation for ET in November are very high. It suggests that the water supply just before the planting period is quite critical for second rice cultivation.

4-6-3. Simulation results of supply and demand model

The simulation term is from 2001 to 2015. The assumptions of the simulation are as follows; (1) the forecast growth value of CPI is the average annual growth between 1998 and 2002, (2) the growth value of real GDP is the average annual growth between 1998 and 2002, (3) the exchange rate is same as the number in 2002, (4) the growth value of population is the average annual growth between 1992 and 2002, (5) the linear trends of the yield functions are continued, (6) the trends of planted area functions are flat.

Figure 4-3 through Figure 4-6 show the simulation results for the production of major rice in the North East region, second rice in Central region, and two types of rice for Thailand as a whole.

The production of major rice in North East region is expected to stabilize around 9.6 million metric tons (mMT) after 2010. The production of second rice in the Central region will increase 210,000 metric tons (MT) from 2010 to 2015.

The production of major and second rice for whole Thailand will increase 594,000 MT and 378,000 MT respectively from 2010 to 2015. Productions of major rice in North and Central region will increase; however, production in the South region will decrease due to shrinking planted area. The production of second rice will increase in Central and North East regions and remain stable in the other two regions.

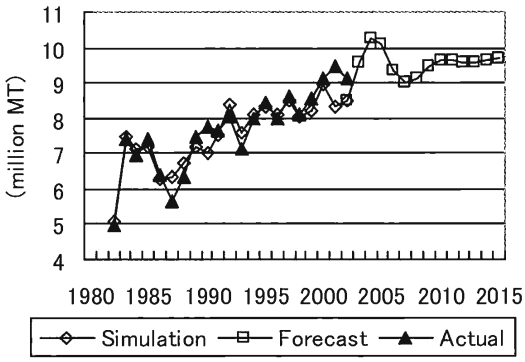

Fig. 4-3. Production of major rice in North East region

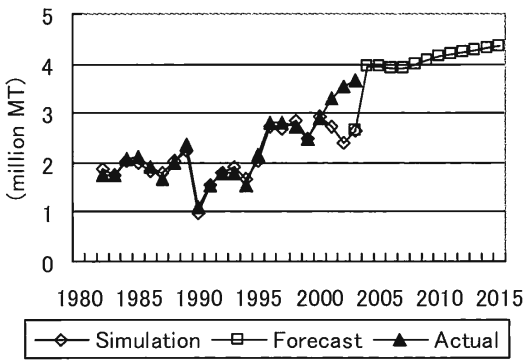

Fig. 4-4. Production of second rice in Central region

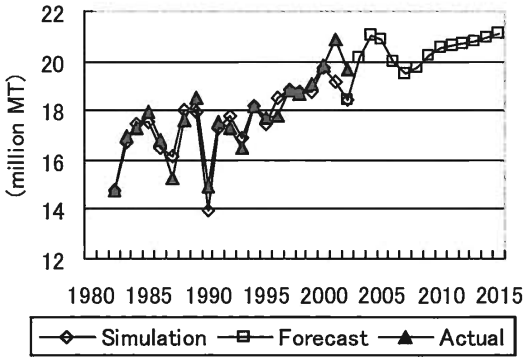

Fig. 4-5. Production of major rice for whole Thailand

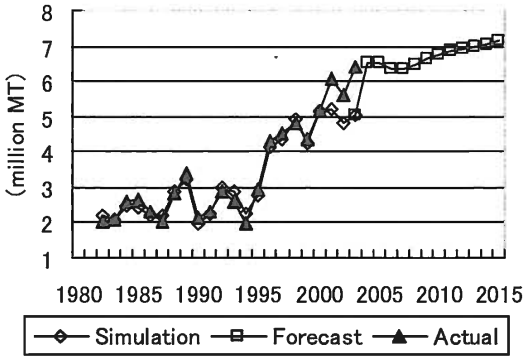

Fig. 4-6. Production of second rice for whole Thailand

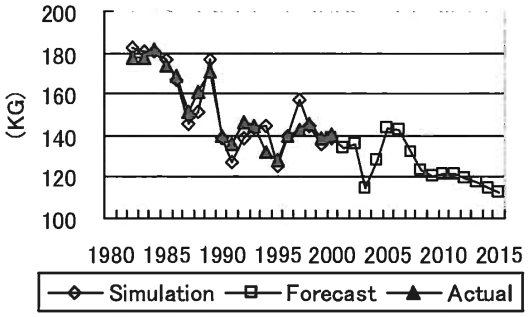

Fig. 4-7. Per capita consumption

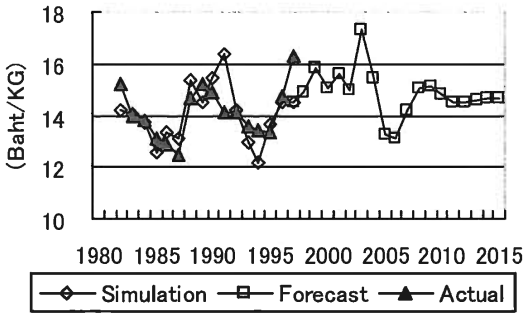

Fig. 4-8. Realized retail price

Figure 4-7 shows per capita rice consumption, which decreases from 121.3 kilogram (KG) in 2010 to 112.8 KG in 2015 due to a negative income elasticity, while total consumption expands with population. Figure 4-8 shows the simulation result of the equilibrium retail price. These prices are realized by CPI which is set to 100 in 1998. The farm price is estimated to be stable at around 14.6 Baht per KG.

4-7. Conclusions

A supply and demand model of rice in Thailand was developed for use in analyzing the impacts of changes in water supply in the provinces of the North East region and three other aggregate regions.

The supply and demand model can analyze changes in yield and planted area independently and consider supply responses and demand changes to the market price while bringing the market into equilibrium. The baseline analysis indicates that production of major rice steadily increases; however, productions in the rainy season in some regions is likely to decrease due to shrinking of planted area. The trends of production of second rice also vary widely for provinces in North East region, and the price elasticity of planted area determines the tendency of the production.

Nationwide per-capita income growth leads to a diversified diet, and rice consumption per capita will decrease as a result. This tendency is consistent with other countries in Indochina region. Stabilization of production is more important than an increase in production, while expansion of the export is also critical issue.