



Total Factor Productivity in Thai Agriculture: Measurement and Determinants

**Waleerat Suphannachart
Kasetsart University
Bangkok, Thailand**

**Peter Warr
The Australian National University
Canberra, Australia**

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Outline

- 1 Introduction
- 2 TFP Measurement: Method, Data
- 3 TFP Determinants: Model, Data
- 4 Results and Discussion
- 5 Conclusion

1. Introduction

- ❖ **TFP in Thai Agriculture: Findings from previous studies**
 - **TFP growth was relatively high in Thai agricultural sector**
 - **Over recent decades, TFP has accounted for between one fifth and three fifth of total output growth**
 - **Growth Accounting is the commonly used method**
 - **Number of studies investigating TFP determinants is limited**

1. Introduction (2)

- ❖ **Objectives and scope of this study**
 - **To measure TFP in Thai agriculture**
 - **Focus on crop and livestock sectors**
 - **To investigate factors affecting TFP in Thai agriculture**
 - **Account for all potential causes of TFP growth**
 - **Period of study: 1970-2006**

1. Introduction (3)

❖ Research questions:

1

TFP Measurement

- To what extent TFP have contributed to agricultural growth?

2

TFP Determinants

- What are causes of TFP?
- Does agricultural research contribute to TFP growth?

2. TFP Measurement

❖ Method

- **Growth Accounting**
- **Reasons:**
 - **Aggregate-level study**
 - **Data availability: Time series**
 - **Comparable with previous Thai studies**
 - **Underlying assumptions are applicable with Thai agriculture context**

Growth Accounting Framework

Output Growth



```
graph BT; Labor((Labor)) --> Arrow[ ]; Land((Land)) --> Arrow; Capital((Capital)) --> Arrow; TFP((TFP)) --> Arrow; Arrow --> OutputGrowth[Output Growth]
```

TFP growth (TFPG) is a residual of output growth that cannot be explained by growth in conventional inputs.

2. TFP Measurement (2)

❖ Growth Accounting

- TFPG = Output (Q) growth – Input growth weighted by factor income shares (S)
- 3 conventional inputs: labor (L), land (N), capital (K)

$$\begin{aligned}TFPG_t &= \ln TFP_t - \ln TFP_{t-1} \\ &= (\ln Q_t - \ln Q_{t-1}) - \frac{1}{2}(S_{L_t} + S_{L_{t-1}})(\ln L_t - \ln L_{t-1}) \\ &\quad - \frac{1}{2}(S_{N_t} + S_{N_{t-1}})(\ln N_t - \ln N_{t-1}) - \frac{1}{2}(S_{K_t} + S_{K_{t-1}})(\ln K_t - \ln K_{t-1})\end{aligned}$$

2. TFP Measurement (3)

❖ Factor Input Adjustment:

➤ Labor quality: age, sex, education

- Using quality-adjusted index developed by Thailand Development Research Institute (TDRI) to adjust number of workers
- The index incorporates the changing composition of labor in terms of age, sex and education

➤ Land quality: irrigation

- Using proportion of irrigated areas to adjust stock of crop land area to reflect multiple cropping

2. TFP Measurement: Data

(annual data: 1970-2006)

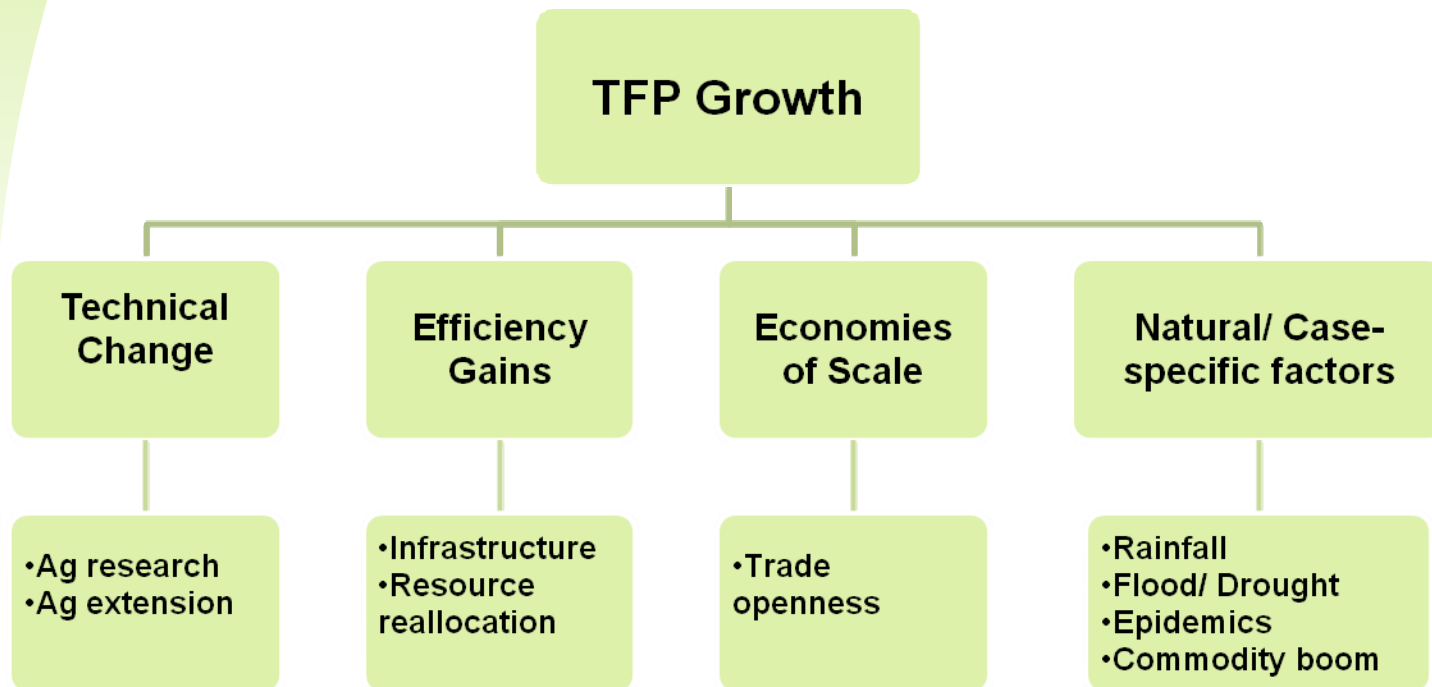
Variables	Definitions	Sources
Output	Ag GDP at 1988 prices (value added)	National Accounts, NESDB
Labor	Number of workers age 15 and above	Labor Force Survey, NSO
Land	Land used in agriculture	Office of AgEcon
Capital	Net capital stock at 1988 prices	National Accounts, NESDB
Wage	Yearly wage of all workers	Labor Force Survey, NSO and TDRI
Land rent	Actual and imputed rent	NESDB

3. TFP Determinants

- ❖ Investigating factors affecting TFP is largely a matter of empirical study
- ❖ The TFP determinants model incorporates factors affecting the residual TFP or the non-conventional inputs such as agricultural research, extension services, and other economic and non-economic factors

3. TFP Determinants (2)

❖ Key Factors Determining TFP Growth in Thai Agriculture



3. TFP Determinants (3)

❖ TFP Determinant Model

$$TFP = f(R^p, E, R^f, I, RR, TO, W, D^c)$$

where TFP = total factor productivity,

R^p = real public agricultural research expenditure,

E = real public agricultural extension expenditure,

R^f = international agricultural research spillovers,

I = infrastructure (rural roads and irrigation),

RR = resource reallocation,

TO = trade openness,

W = weather or climate factor,

D^c = case-specific dummy variable comprising:

D^{boom} = dummy variable capturing the world agricultural commodity boom from 1972-1974,

D^{bird} = dummy variable capturing the Avian Influenza outbreak took place in 2004.

3. TFP Determinants (4)

- ❖ Estimation method: ECM (Hendry, 1995)
 - Variables are a mixture of $I(0)$ and $I(1)$
 - Minimize spurious relationships while retaining long-run information without restricting lag structure
 - Included variables are in both level and rate-of-change terms
 - capturing both SR and LR information
 - Dynamic and flexible form of lags
 - no need to pre-specify length and shape of lags

3. TFP Determinants: Data

List of potential factors affecting TFP in Thai agriculture

Variables	Definitions	Sources
Public R&D	Real agricultural research budget expenditure	Bureau of budget
Extension	Real agricultural extension budget expenditure	Bureau of budget
Foreign R&D spillovers	CGIAR funding to IRRI, CIAT, CIMMYT in USD Livestock breeders imports	CGIAR financial reports, Office of Ag Econ
Irrigation	Proportion of irrigated area	Office of Ag Econ

3. TFP Determinants: Data

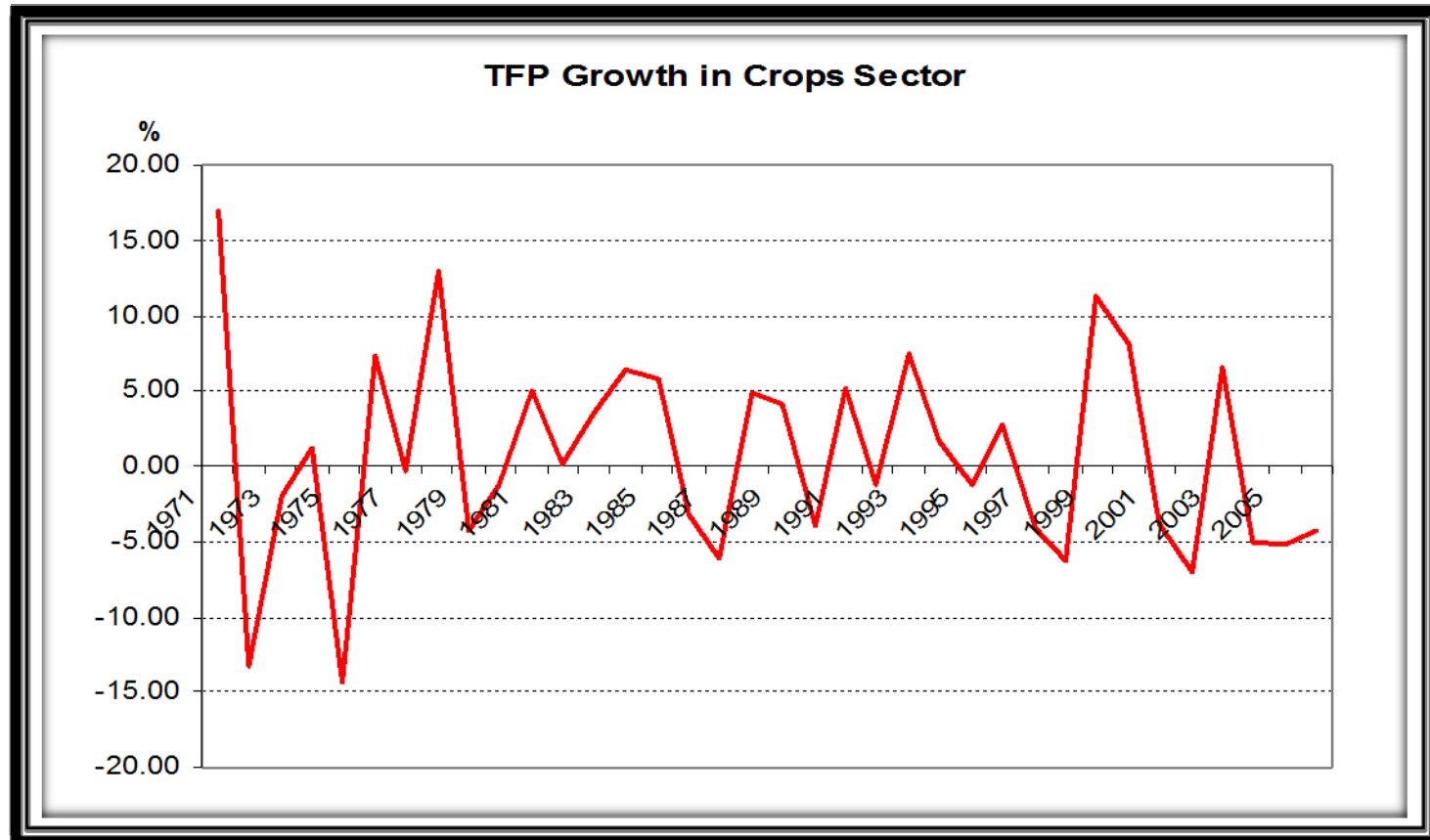
Variables	Definitions	Sources
Rainfall	Amount of rainfall in millimeter	Office of Ag Economics (OAE)
Weather (drought or flooding)	Ratio of rice harvested to rice planted area	OAE
Resource reallocation	Non-crops and non-rice employment shares	OAE, National Statistical Office
Trade openness	Import and export share in agricultural output	OAE
Ag commodity boom	Dummy = 1 for year 1972-1974	
Bird Flu	Dummy = 1 from year 2004	

4. Results: TFP Measure

- ❖ TFP makes an important contribution to agricultural growth in Thailand during 1970-2006
- ❖ TFP has been the second most important source of output growth in both crop and livestock sectors
- ❖ The results are comparable with previous study (Poapongsakorn, 2006)

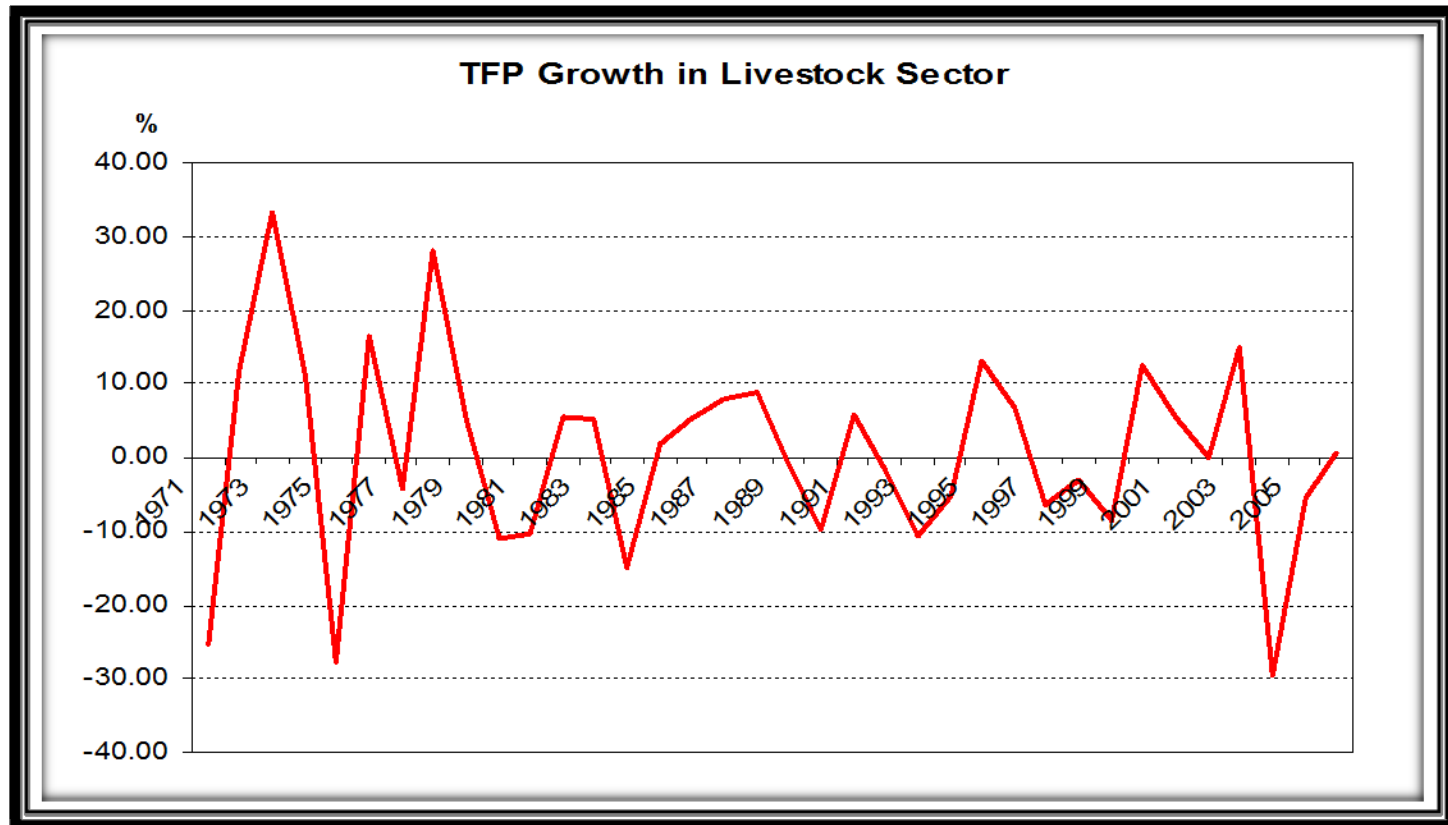
4. Results

- ❖ Crop TFP increases at an average rate of 0.68% per year, accounting for 20.82% of crop output growth



4. Results

- ❖ Livestock TFP grows at an average rate of 0.67% per year, accounting for 17.49% of livestock output growth



4. Results: TFP Determinants in crop sector

Dependent Variable: $\Delta \ln TFP_t^{crop}$		
	Estimated coefficients (t-ratios)	Long-run elasticity
Constant	-1.056 (-6.460)***	
$\Delta \ln R^p_{t-3}$	0.155 (4.423)***	
$\Delta \ln E_{t-1}$	0.137 (3.665)***	
$\ln R^p_{t-3}$	0.059 (1.876)*	0.067 (2.117)**
$\ln R^f_{t-1}$	0.092 (2.955)***	0.105 (3.045)***
$\ln I^{roads}_{t-1}$	0.033 (1.977)**	0.038 (1.962)**
D^{boom}	0.127 (3.104)***	0.145 (3.189)***
$\ln TFP_{t-1}$	-0.873 (-6.664)***	

N = 34, Adj.R² = 0.69, F = 11.31

* = 10%, **=5%, ***=1% level of significance

4. Results: TFP Determinants in livestock sector

Dependent Variable: $\Delta \ln TFP_t^{livestock}$		
	Estimated coefficients (t-ratios)	Long-run elasticity
Constant	0.386 (2.246)**	
$\Delta \ln R_t^f$	0.012 (0.517)	
$\Delta \ln E_{t-1}$	0.119 (1.728)*	
$\ln R_{t-3}^p$	0.128 (2.074)**	0.173 (2.111)**
$\ln E_{t-1}$	-0.089 (-1.590)	-0.121 (-1.578)
$\ln R_{t-1}^f$	-0.003 (-0.168)	-0.004 (-0.167)
D^{bird}	-0.165 (-2.720)***	-0.224 (-2.593)***
$\ln TFP_{t-1}$	-0.739 (-5.510)***	

N = 35, Adj.R² = 0.50, F = 5.93

* = 10%, **=5%, ***=1% level of significance

5. Conclusion

- ❖ This paper provides empirical evidence on TFP estimates and their determinants in Thai agriculture
- ❖ The findings confirm TFP makes important contribution to agricultural growth in Thailand during 1970-2006
- ❖ Major factors affecting TFP are the public investment in agricultural research, international research spillovers, rural roads and case-specific factors.



Thank You !

