



UNIVERSITI PUTRA MALAYSIA

INTEGRATION AND PRICING EFFICIENCY OF RICE MARKET

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**INTEGRATION AND PRICING EFFICIENCY OF RICE MARKET
IN NEPAL**

By

BISHWA BANDHU RAJ SINGH

**Dissertation Submitted in Fulfilment of Requirements for the Degree of
Doctor of Philosophy in the Faculty of Economics and Management
Universiti Putra Malaysia**

December 1999



DEDICATION

To my parents,

**Shree Indra Raj Singh
&
Shreemati Ram Devi**



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of requirements for the degree of Doctor of Philosophy

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December 1999

Chairperson: Professor Fatimah Mohd. Arshad, Ph.D.

Faculty: Economics and Management

This study investigated performance of rice market in Nepal by analysing interdependence of prices (market integration) and efficiency of arbitrage (pricing efficiency) among the regional wholesale markets

An integrated approach to the analysis of performance of the market system was adopted. The cointegration-based Johansen's Vector Error Correction Model (VECM) was used for analysis of nature of interdependence of prices in the regional markets to infer on integration.

Switching Regimes Model (SRM) was used to evaluate efficiency of arbitrage between market regions related in direct trade to infer on pricing efficiency of the market system. The analysis results for market integration and pricing efficiency were interpreted in relation to the structural and behavioural characteristics of the market system being investigated through the rapid appraisal market survey.



The evaluation of results from estimation of the VECM lend support to the hypothesis that regional markets for rice in Nepal are integrated to form a single market area with Kathmandu as the central market. Price shocks in the central market gets quickly transmitted to the regional markets. However, the results from estimation of the SRM for the five market pairs provided statistical evidence of violation of efficient arbitrage conditions. This supports the hypothesis that the integrated rice market in the country is not efficient in arbitrage sense. Consideration of behavioural characteristics of the market indicated inefficient integration of the market regions could be due to lack of adequate institutional infrastructure in the market that provided the large millers and traders to enjoy some degree of market power.

The study indicates that physical facilities in the market are necessary for integration of the market, but these alone are not sufficient for a market system to be efficient. With expansion of the market through economic integration, need for provision of appropriate institutional infrastructure in the form of public and private order institutions arises. The government needs to play a crucial role in providing institutional infrastructures to make the market more competitive, efficient and equitable.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

INTEGRASI DAN KECEKAPAN MELETAK HARGA PASARAN BERAS DI NEPAL

Oleh

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Kajian ini meneliti prestasi pasaran beras di Nepal daripada segi saling pergantungan antara harga (integrasi pasaran) dan kecekapan arbitraj (kecekapan letak harga) di dalam pasaran borong tempatan.

Pendekatan integrasi telah digunakan ke atas analisis prestasi sistem pemasaran. Model Pembetulan Ralat Vector Johansen yang berlandaskan kointegrasi (atau *Vector Error Correction Model* (VECM)) telah diterima pakai untuk menganalisis pola saling pergantungan harga di pasaran tempatan untuk mencapai rumusan tentang integrasi sistem pemasaran. Model Regim Alihan (atau *Switching Regimes Model* (SRM)) yang berlandaskan kepada fungsi sempadan telah digunakan untuk menilai kecekapan arbitraj antara pasaran tempatan yang terlibat dalam perdagangan untuk merumus kecekapan harga sistem pemasaran. Penemuan daripada analisis integrasi pasaran dan kecekapan harga telah ditakrifkan mengambil kira ciri struktur dan gelagat sistem pasaran yang diteliti melalui kajiselidik penilaian pasaran pantas.

Penelitian penemuan anggaran daripada model VECM menyokong hipotesis bahawa pasaran beras tempatan adalah berintegrasi sehingga terbentuk satu kawasan pasaran di mana Kathmandu sebagai pasaran pusat. Kejutan harga dalam pasaran pusat akan disalurkan dengan pantas ke pasaran tempatan. Bagaimanapun, penemuan anggaran SRM bagi kelima-lima pasangan pasaran memberi bukti statistik bahawa syarat kecekapan arbitraj tidak diakuri. Penemuan ini menyokong hipotesis bahawa pasaran beras adalah tidak cekap dari segi arbitraj. Mengambil kira ciri-ciri gelagat pasaran (yang dikumpul melalui kajiselidik penilaian pantas), didapati bahawa ketidakcekapan integrasi pasaran tempatan adalah disebabkan oleh kekurangan institusi infrastruktur yang disediakan oleh pengilang dan peniaga besar yang memiliki kuasa pasaran.

Kajian ini menyarankan bahawa kemudahan fizikal dalam pasaran adalah penting ke arah pasaran yang berintegrasi. Namun situasi ini masih tidak mencukupi untuk mewujudkan pasaran yang cekap. Pasaran yang berkembang melalui integrasi ekonomi memerlukan infrastruktur institusi seperti institusi awam dan swasta. Kerajaan perlu memainkan peranan yang penting dalam menyediakan infrastruktur institusi untuk mewujudkan pasaran yang bersaing, cekap dan saksama.

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I certify that an Examination Committee met on 22 December, 1999 to conduct the final examination of Bishwa Bandhu Raj Singh on his Doctor of Philosophy thesis entitled "Integration and Pricing Efficiency of Rice Market in Nepal" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination are as follows:

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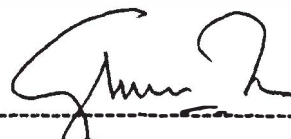
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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations that have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

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LIST OF ABBREVIATIONS

ADB/M	Asian Development Bank, Manila
ADB/N	Agricultural Development Bank, Nepal
ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criteria
AMC	Agricultural Marketing Corporation
APP	Agricultural Perspective Plan
APROSC	Agricultural Projects Services Centre
ARCH	Auto-Regressive Conditional Heteroskedasticity
CBS	Central Bureau of Statistics
CUSUMSQ	Cumulative Sum of Squares
EASD	Economic Analysis and Statistics Division
FMC	Food Management Corporation
I(0)	Integrated of Order Zero
I(1)	Integrated of Order One
JMA	John Mellor Associates
LM	Lagrange Multiplier
LOP	Law of One Price
AMDD	Agricultural Marketing Development Division
MMA	Morang Merchants' Association
MOA	Ministry of Agriculture
MOF	Ministry of Finance
MSP	Minimum Support Price
NFC	Nepal Food Corporation
NPC	National Planning Commission
NRB	Nepal Rastra Bank
OLS	Ordinary Least Squares
PP	Philips-Perron
RECs	Rice Exporting Companies
RLSC	Recursive Least Squares Coefficients
Rs	Rupees (1 US\$ = Rs 56.75, as of July 1997)
SBC	Schwartz Bayesian Criteria
SCP	Structure Conduct Performance
SEE	Standard Error of Equations
SPE	Spatial Price Equilibrium
SRM	Switching Regimes Model
VAR	Vector Autoregression
VECM	Vector Error Correction Model



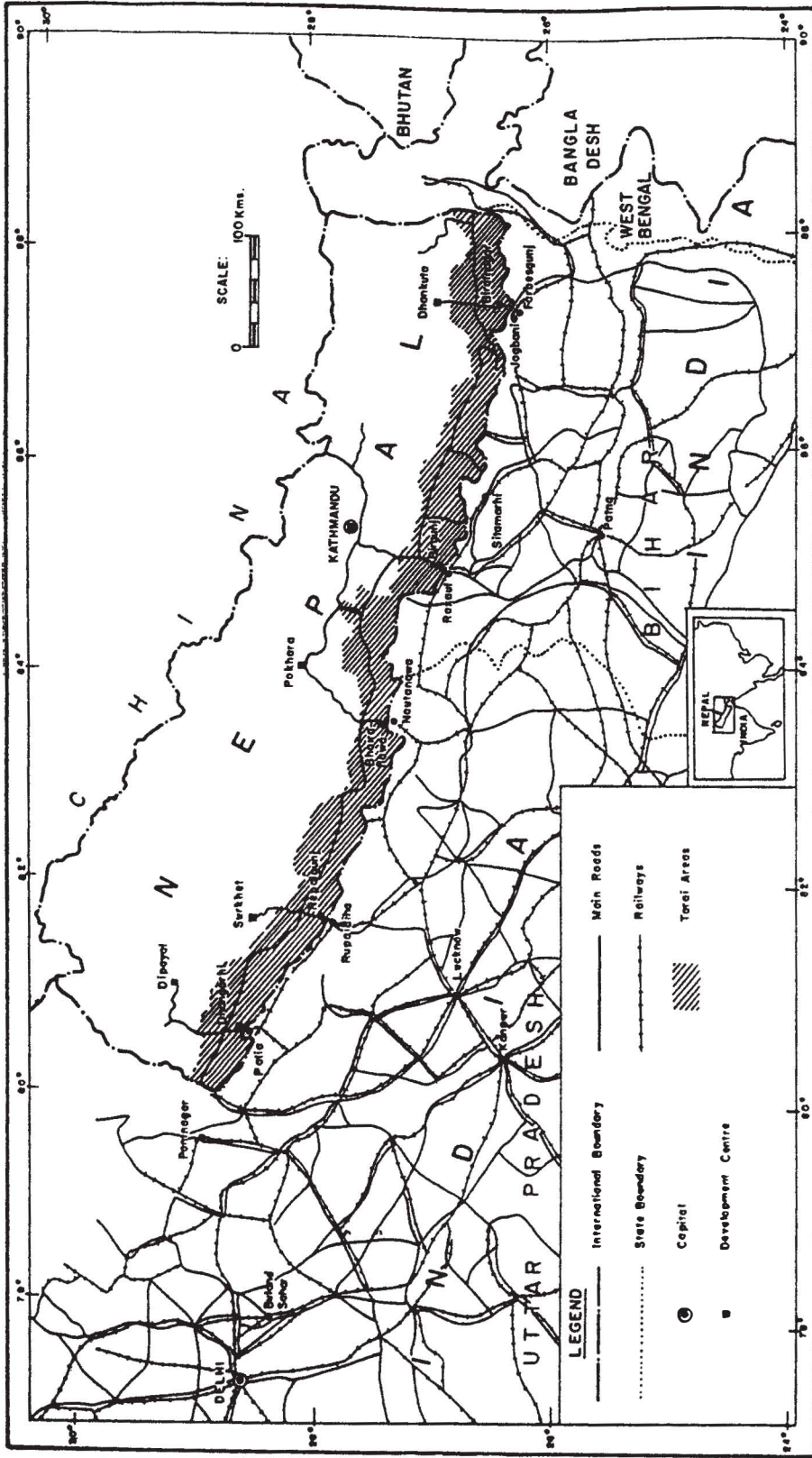
CHAPTER I

INTRODUCTION

Country Background

Nepal is a land-locked country between India and China, with a physical area of 147,181 square kilometre and a population of 21 million. The country is broadly classified into three ecological regions, running parallel from east to west – the *Tarai* (plain area), the hills, and the mountains respectively covering 23, 42 and 35 percent of the total land area. The *Tarai* (75 to 300 meters from sea level) lies on the southern part of the country bordering with Indian states of West Bengal, Bihar and Uttar Pradesh (from east to west). The hills (300 to 3000 meters from sea level) are in the middle and the mountains (above 3000 meters from sea level) form the northern strip bordering with Tibet region of China. Further, the country has been divided into five development regions, viz. eastern region, central region, western region, mid-western region and far-western region. Each of the five development regions is comprised of *Tarai*, hills and mountains. The regional headquarters are Dhankuta (eastern region), Kathmandu (central region), Pokhara (western region), Surkhet (mid-western region) and Dipayal (far-western region).

The country map in Figure 1.1 shows location of the *Tarai* region, regional headquarters, major *Tarai* market centres, major road network within the country, and bordering market centres and transportation network on the Indian side.



Source: G. J. Gill (1996).

Figure 1.1: The Country Map



The distributions of land area and population of the country by development regions and by ecological regions are provided in Appendix A1 and Appendix A2, respectively. In terms of physical size, mid-western region (28.8 percent of the total area) is the largest of the five, followed by western region (20 percent), eastern region (19.3 percent), central region (18.6 percent) and far-western region (13.3 percent). Population concentration is highest in the central region (33 percent), followed by eastern region (24 percent), western region (20 percent), mid-western region (13 percent) and far-western region (9 percent). Population distribution by ecological region is 47 percent in *Tarai*, 45 percent in hills and 8 percent in mountains.

Rice Production and Supply Situation

Agriculture is the mainstay of Nepal's economy, generating 41 percent of the GDP and employing 80 percent of the workforce (MOF, 1997a). Being mountainous, cultivated land in the country is limited to 16 percent of its geographical area, of which 55 percent lies in the *Tarai* region (Appendix A1). Foodgrain, comprising paddy, maize, wheat, millet and barley, cover about 80 percent of the cropped area under all crops. Paddy is the main food crop accounting for 46 percent of the cropped area under food crops. Area under paddy in 1995/96 was 1,497 thousand hectares and its production for the same year was 3,579 thousand metric tons. The annual statistics of area and production of major food crops for 1974/75 – 1995/96 are provided in Appendix A3 and Appendix A4, respectively.

The *Tarai* region, considered the granary of the country, accounts for about three-fourth of the country's paddy output; the hills produce 23 per cent, and the mountain about 2 percent. In 1995/96, out of the total paddy production of 3,579 thousand metric tons in the country, 2,682 thousand metric tons was from the *Tarai* region alone. The estimates of annual production of paddy in *Tarai*, hill and mountain regions for 1974/75 to 1995/96 are provided in Appendix A5. During the period, paddy production grew by 1.04 per cent annually (1.53 percent for *Tarai*, and - 0.20 percent for hills and mountains), whereas annual population growth for the same period was 2.39 percent, resulting in a decline in per capita average annual paddy production by 1.25 percent (Table 1.1).

Nepal had higher per hectare yield of paddy than other South-Asian countries in the early 1960's, but the situation got quite reversed by early 1990's (Table 1.2). While Nepal's paddy yield was almost stagnating, the same for other countries in the region was improving. The slow growth of rice yield in the country is attributed to inadequate supply of quality seeds and fertilisers, slow expansion and limited utilisation of irrigation facilities, lack of suitable improved technology for unirrigated farm land, and neglect of development of efficient marketing and pricing system (NPC, 1985; EASD, 1996).

Table 1.1: Total and Per Capita Production of Paddy, 1974/75 - 1995/96

Year	Index of Paddy Production (1974/75=100)			Mid-Year Population (‘000)	Per Capita Paddy Production (kg)
	<i>Tarai</i>	Hill and Mountain	Total		
1974/75	100	100	100	12668	225
1975/76	107	104	106	13005	233
1976/77	96	105	99	13350	210
1977/78	92	94	93	13705	192
1978/79	94	96	95	14069	192
1979/80	83	82	83	14442	163
1980/81	102	88	97	14826	187
1981/82	104	92	100	15178	187
1982/83	69	78	72	15497	132
1983/84	113	89	105	15823	190
1984/85	107	83	100	16155	176
1985/86	112	79	102	16494	175
1986/87	92	77	88	16840	148
1987/88	116	83	105	17194	174
1988/89	126	95	116	17556	188
1989/90	131	95	120	17925	190
1990/91	133	101	123	18301	191
1991/92	122	95	113	18737	172
1992/93	94	83	91	19236	134
1993/94	137	92	123	19747	177
1994/95	107	91	102	20272	143
1995/96	137	101	126	20812	172
Av. Growth Rate (%)	1.53	-0.20	1.04	2.39	-1.25

Note:

- The growth rates have been calculated using the semi-log linear model: $\ln Y = a + bT$, where Y is the dependent variable, T is time variable, b is the growth rate.

Source:

- Production index based on Appendix A4.
- Population estimates are based on the 1971, 1981 and 1991 Census, and the official growth projection for 1991 onwards.

Table 1.2: Per Hectare Yield of Paddy in Nepal and other South-Asian Countries, 1961-63 and 1991-93

Country	1961-63 (kg/ha)	1991-93 (kg/ha)	Annual Growth Rate (%)
Nepal	1940	2277	0.54
India	1504	2648	1.92
Bangladesh	1672	2648	1.55
Pakistan	1386	2448	1.92
Sri Lanka	1921	3077	1.57

Source: Based on Nepal Agricultural Perspective Plan, APROSC/JMA, 1995.

Some general features of rice supply affecting the market are that production fluctuates over years depending on the weather condition, that production at the farm level is seasonal, and that rice is produced in different grade varieties of varying market values. Paddy is transplanted with the onset of the monsoon rain between June and August and harvested from September to December. The monsoon rain first arrives in the eastern part of the country and gradually advances to the west. The planting and production of the crop is very much dependent on timing and intensity of the monsoon rain, which is normally active during mid-June until mid-September. In areas with irrigation facility, farmers manage to get two paddy crops in succession by transplanting the first one little earlier in the season.

The eastern and central *Tarai* regions produce large portion of the country's paddy output. During 1974/75 - 1995/96, the central *Tarai* region accounted for 33.8 percent of the country's paddy output, followed by eastern region (33.2 percent), western region (15.8 percent), mid-western region (8.7 percent) and far-western region (8.5. percent); these closely corresponds to the regional population

distribution (Table 1.3). The estimates of paddy production of *Tarai* in the five development regions during 1974/75 – 1995/96 is provided in Appendix A6.

Table 1.3: Regional Distribution of Paddy Production and Population in the *Tarai* of Nepal (Percent)

	Eastern	Central	Western	Mid-Western	Far-Western	Total
Paddy Production (1974/75 – 1995/96)	33.2	33.8	15.8	8.7	8.5	100
Population (1991)	30.8	35.2	15.4	10.8	7.8	100

Source:

- a. Distribution of paddy production based on Appendix A6.
- b. Population distribution is based on 1991 Census data.

The per capita annual rice consumption in the country is estimated to be 107.1 kg (Table 1.4); this comes to about 184 kg in paddy equivalent after allowing for seed, post harvest losses and milling recovery¹. Relating consumption requirement to the national per capita paddy production (Table 1.1), the country as a whole has been generally short in supply of rice ever since 1982/83.

Until early 1980s rice used to be exported from the surplus *Tarai* region to the Indian markets due to easy transportation access to that market and difficulty in transporting grains to the food deficit hills within the country. Rice export to India and other countries during 1974/75 to 1986/87 is provided in Appendix A7. During the period, export of rice had reached up to 165,000 mt in 1975/76, which declined

¹ Assuming milling recovery of 64 percent and allowing 10 percent for seed and post harvest losses