



UNIVERSITI PUTRA MALAYSIA

**PRICE POLICIES IN CENTRAL JAVA, INDONESIA: IMPACT ON
DEMAND FOR UREA FERTILISER IN PADDY PRODUCTION AND
THE RESULTING NITRATE CONTAMINATION**

MULYADI

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THE RESULTING NITRATE CONTAMINATION**

**By
MULYADI**

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

November 2000



DEDICATION

This thesis is dedicated to:

Late father, Yahman Yosohardjono

My mother, Yosohardjono

Late father in law, Harjokko Taroediredjo

My mother in law, Suhatmini

My wife, Dr.Ir.Suhatmini Hardyastuti,MS

My daughter Evy Indra Wardhani

Brothers and Sisters

Abstract of thesis submitted to the Senate of Universiti Putra Malaysia
in fulfilment of the requirement for the degree of Doctor of Philosophy

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Chairman: Professor Nik Mustapha Raja Abdullah, Ph.D.

Faculty: Economics and Management

Since late 1970's, the Indonesian government has implemented a price support policy on paddy and a price subsidy policy on fertiliser for paddy production. These policies had been successful both in increasing fertiliser use as well as paddy production. Increase in fertiliser use, in particular nitrogen fertiliser, however, also means increase in nitrate contamination in ground water. Nitrate contamination in ground water exceeding 10 NO₃ mg/L is known to cause "blue baby" syndrome or methemoglobinaemia and stomach cancer (Lebby and Bogges, 1990). As most of rural population in Java depends on ground water as a source of drinking water, nitrate contamination poses serious threat to society and should be mitigated immediately.

This study attempts to evaluate the impact of price support policy on paddy and subsidy policy on fertiliser price on fertiliser use, paddy production, farmers' welfare and nitrate contamination in ground water in Central Java Province Indonesia. Cross sectional data of paddy farms and dug-wells were used in this study. Eight regencies were selected using stratified random

sampling based on urea application rates. For each regency, two districts were selected and for each district, five units of farm and five dug-well samples were chosen based on simple random sampling. A translog profit function and cost share function for urea with nitrate contamination were estimated simultaneously for derived demand for urea fertiliser and supply of paddy functions. These functions were then used to evaluate the impact of price policies.

Fertilisation of nitrogen in paddy cultivation is the main source of nitrate contamination in ground water. About 86.9 percent of the dug-wells water samples had nitrate contamination with an average of 2.01 ppm $\text{NO}_3\text{-N}$, 1.3 percent had contamination exceeding the maximum admissible requirement for drinking water at 10 ppm.

The price subsidy on urea fertiliser and price support on paddy were effective in boosting profit of paddy farms as well as paddy production. The price policies contributed significantly to urea fertilisation rate, and thereby to paddy productivity. At the same time these policies also generated nitrate contamination in rural ground water. Nitrate contamination had not significantly influenced profit as well as demand for urea fertiliser and supply of paddy.

Simulation results confirmed that price policies, which did incorporate environmental policy, in particular nitrate contamination, would generate nitrate contamination in ground water. It is likely to continue to increase in the future if environmental consideration continued to be ignored. Hence, the environmental policy should be integrated in price policies.

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

**DASAR HARGA DI JAWA TENGAH, INDONESIA: KESAN TERHADAP
PERMINTAAN BAJA UREA DIDALAM PENGELUARAN PADI DAN
PENGHASILAN KONTAMINASI NITRAT**

By

MULYADI

November 2000

Pengerusi: Professor Nik Mustapha Raja Abdullah, Ph.D.

Fakulti: Ekonomi dan Pengurusan

Sejak akhir 1970an, kerajaan Indonesia telah mengamalkan dasar penyokongan harga padi dan subsidi harga baja untuk pengeluaran padi. Dasar tersebut telah berjaya meningkatkan penggunaan baja urea dan juga pengeluaran padi. Bagaimanapun peningkatan penggunaan baja khususnya baja urea juga bererti peningkatan pencemaran nitrat pada air sumur. Pencemaran nitrat pada air sumur yang melebihi 10 ppm diketahui menyebabkan sindrom "blue baby" atau methemoglobinaemia dan kanser perut (Lebby and Bogges, 1990). Oleh sebab sumber air minuman penduduk luar bandar di Indonesia bergantung pada air tanah atau air sumur pencemaran nitrat merupakan masalah yang serius dan perlu ditangani dengan segera.

Kajian ini bertujuan menilai keberkesanan dasar penyokongan harga padi dan dasar subsidi harga baja terhadap penggunaan baja urea, pengeluaran padi dan pencemaran nitrat pada air sumur di Daerah Jawa Tengah, Indonesia. Data

keratan lintang perladangan padi dan air sumur digunakan pada kajian ini. Dalam kajian ini, dipilih lapan wilayah daripada secara rawak berlapis mengikut paras penggunaan baja urea. Dari setiap kabupaten dipilih dua kecamatan dan setiap kecamatan dipilih lima sampel unit perladangan padi dan lima sampel air sumur secara rawak. Fungsi translog keuntungan dan fungsi penyertaan kos baja urea dengan penglibatan pencemaran nitrat diestimasi secara serentak untuk menerbitkan fungsi permintaan baja urea dan fungsi penawaran padi. Kedua fungsi terbitan ini selanjutnya digunakan untuk menilai keberkesanan dasar harga.

Pembajaan urea untuk tanaman padi merupakan sumber utama pencemaran nitrat pada air sumur. Lebih kurang 86.9 percent sampel air sumur mengandungi nitrat dengan rata-rata 2.0 ppm $\text{NO}_3\text{-N}$, 1.3 percent telah melebihi batas maksimum persyaratan air minum pada paras 10 ppm.

Instrument harga dalam bentuk subsidi harga baja urea dan harga padi berkesan meningkatkan keuntungan perladangan padi demikian juga produksi. Dasar harga menyokong penggunaan baja dan juga produktiviti padi. Pada waktu yang sama dasar menjana pencemaran nitrat pada air sumur di luar bandar. Penjanaan pencemaran nitrat belum mempengaruhi signifikan pencapaian keuntungan demikian halnya permintaan baja urea dan penawaran padi.

Dari kajian ini mendapati bahawa dasar harga yang tidak mengambil kira kesannya terhadap alam sekitar khususnya pencemaran nitrat. Pencemaran nitrat dijangka akan terus meningkat dimasa mendatang dalam rancangan

pembangunan jangka panjang kedua sekiranya teknologi pengeluaran padi tidak diubah dan pertimbangan terhadap alam sekitar khususnya pencemaran nitrat tidak diambil kira. Oleh kerana itu dasar alam sekitar sepatutnya diambil kira dalam dasar harga.

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CHAPTER I

INTRODUCTION

Background of the Problem

Indonesia's agriculture continues to be one of the major sectors of the economy, although its contribution has shown a steady decline since the late 1980's. In twenty three years from 1968 to 1990, the relative contribution of the sector to the Gross Domestic Product (GDP) diminished from 54.3 to 19.6 percent, respectively or at a rate of more than 2.6 percent per annum (Directorate of Food Crop, 1993).

A breakdown of the contribution of agriculture to GDP shows that food crop production contributed 66.7 percent in 1968, but declined to 60.0 percent in 1990. The major commodity in food-crop production is paddy, contributing to 29.0 percent of total value of food-crop production in 1990 (Directorate of Food Crop, 1993).

The food crop sub sector is also the main contributor to employment in the agricultural sector. In 1980, the food crop sub sector absorbed 27.797 million workers or 87.5 percent of the total employment in agriculture and 49.4 percent of the total work force. In 1990, however, its contribution declined to 26.446 million workers or 74.6 percent of the total employment in the agricultural sector and 36.7 percent for the whole country (Directorate of Food Crops, 1993).

Indonesia was a significant importer of rice until the early eighties when self-sufficiency was achieved. This achievement reflects twenty years of relentless efforts by the government to promote paddy production through irrigation development, price support on output and price subsidies on inputs, and the provision of subsidised credit and technological packages. As a result, paddy production grew considerably during the last twenty years (1968-1992) at a rate of 6.9 percent per annum, transforming Indonesia from a major rice importer in the late 1970's to self-sufficiency in 1984. The growth was mainly attributed to increase in the harvested area by 1.3 percent per annum and increases in yield by 4.2 percent per annum (Figure 1.1 and Appendix 1).

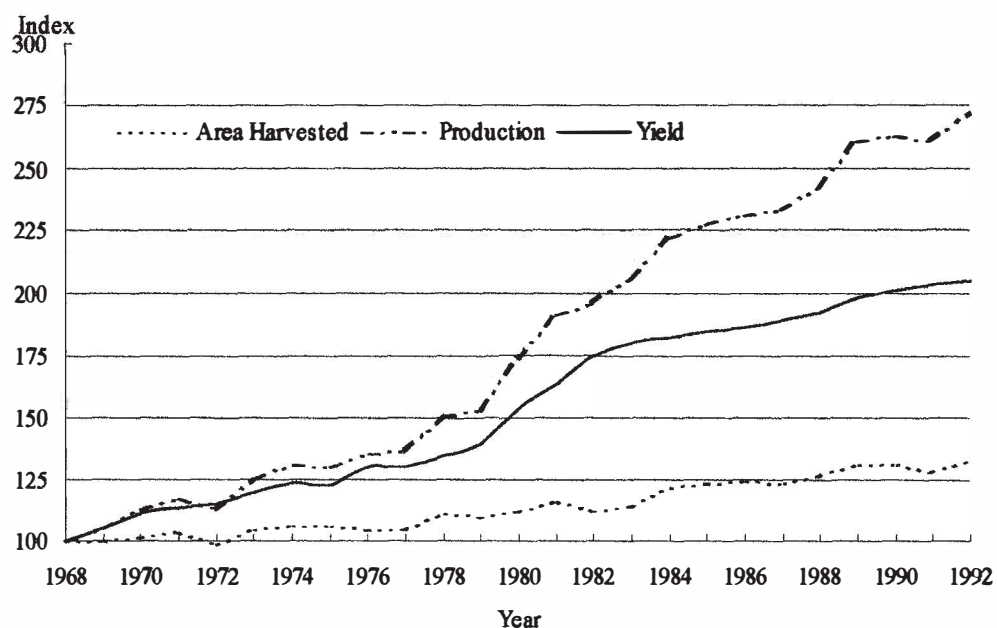


Figure 1.1: Harvested Area, Production and Yield of Paddy in Indonesia, 1968-1992

The policy in the form of price subsidies on inputs and price support on output since the late 1970's were used to increase the rice supply to meet the

rapidly growing demands due to population and economic growth. Among the agricultural inputs that received the subsidies are fertilisers, pesticides, seeds, and water. The fertiliser subsidy has been the largest. It accounts for about 2.5 percent of the total government expenditure since 1980 and has averaged about 450¹ billion rupiahs annually. Between 1980 and 1987 fertiliser subsidy the farmers pay less than 50 percent of the total economic costs of fertiliser production.

Between 1971/1972 to 1993/1994 paddy seasons, the total consumption of nitrogen fertiliser has increased from 196 to 1,700 thousand metric tons or close to nine times or at a rate of 34.8 percent per year (FAO, 1994) (Appendix 2). Trend in consumption of nitrogen fertiliser is presented in Figure 1.2. As shown in Figure 1.2 after the implementation of price support on paddy output and price subsidy on nitrogen fertiliser, consumption of nitrogen fertiliser initially increased at an annual rate of 77 percent but it stabilised during 1972/1973 until 1976/1977. During the period of 1977/1978-1993/1994, consumption of nitrogen fertiliser again increased sharply from 549 in 1977/1978 to 1,700 thousand metric tons in 1993/1994 or at a rate of 37.1 percent annually. During the same period, Malaysia and Philippine's nitrogen fertiliser consumption increased only by 4.4 and 3 times, respectively, while Thailand by 9.6 times (Appendix 3). In 1992/1993 paddy seasons, Indonesia's nitrogen fertiliser consumption rate was highest among countries of Southeast Asia, but its price was the lowest (Appendix 4 and 5).

1). US\$ 1 = 2,490 Rupiahs

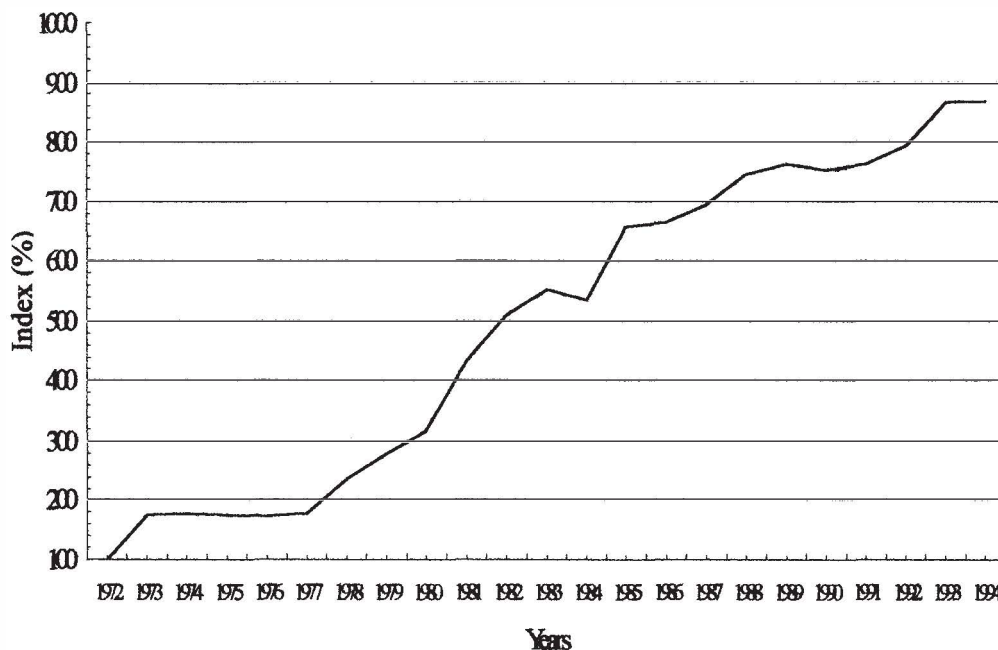


Figure 1.2: Trend in Consumption of Nitrogen Fertiliser in Indonesia, 1971/1972-1993/1994

In order to maintain rice self-sufficiency in the Second Long-term Development Planning (1993-2018), paddy production is projected to increase by 5.1 percent per annum. The sources of this increase are the harvested area, which must be increased by 0.3 percent and the yield by 3.2 percent per annum (Directorate of Food Crops, 1993) (Appendix 6). These increases in area harvested, production and yield during in the First Long-term Development Planning (1968-1992) and in the Second Long-term Development Planning (1993-2018) are presented in Figure 1.3. The increase in area harvested will be minimal because the area for expanding paddy production in the country is limited. Therefore, the targeted increase in paddy production can only be achieved by enhancing yield through improved variety with high yield features. The high yielding variety (HVY) usually requires a high fertilisation level, so that