UNIVERSITI PUTRA MALAYSIA

A SYSTEM DYNAMICS INVESTIGATION OF EMPLOYMENT IN THE IRANIAN AGRICULTURAL PRODUCTION

MOHAMMAD HASHEM MOOSAVI HAGHIGHI

FP 2007 11

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By

MOHAMMAD HASHEM MOOSAVI HAGHIGHI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Doctor Philosophy

August 2007

Dedications

To my wife, father, mother and sons, Mohammad Reza and Parsa who have supported me throughout in this study.

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

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Chairman: Professor Mad Nasir Shamsudin, PhD

Faculty: Agriculture

Agriculture is an important economic sector and a strategic component for rural development in Iran. The sector contributed about 15% of the country's value added in 2005, and created 23% of the total employment in 2004. However, the sector is basseted with a labour surplus situation as indicated by the high labour/ land ratio. This situation, together with inappropriate combination of labour with other factors of production, has caused a low level of labour productivity, and hence, low growth rate in the agricultural sector. Thus, the general objective of this study is to determine the optimal employment and production policies in the agricultural sector of Iran. Whereas, the specific objectives are to estimate the econometric models of the Iranian agricultural sector to determine the production and other relationship in the System Dynamics (SD) model; to develop a SD model and identify the relationship among the socio-economic variables in the agricultural sector of Iran for simulating the future trend of employment and production; and to simulate the SD model pertaining to different scenarios.

This study employed the econometric methods and SD simulation model by incorporating the dynamic changes of the socio-economic variables. Econometric methods provide representations of the system in equations. Production, export-import, demand for labour and agricultural products, as well as the wage functions were estimated using data collected over 35 years, and substituted in the economic component of the SD model.

A dynamic demand for the labour equation incorporating a Disequilibrium Costs (DC) and Adjustment Costs (AC) was estimated from 1966/67 to 2000/01. The results indicated significant relationships between employment, production, wages and cross-price elasticity on labour demand. This suggests that the adjustment co-efficient was too slow (0.044) since AC was higher than DC, and the existent of substitution relation between the capital and labour, and the war which had negative effects on the agricultural labour demand.

The exchange rate variable had the expected sign in the export and import functions. The per capita income in the 'Organization for Economic Co-operation and Development' (OECD) countries, had a positive sign in the export equation. The agricultural price index and agricultural production had respectively negative and positive effect on the agricultural export. On the other hand, outcomes of the war and Islamic Revolution on the agricultural export were negative. In the import equation, the national income per capita

had a positive effect, while the real exchange rate had a negative effect on the agricultural import.

Analysis on the results of the production functions confirms the priori expectation that the Iranian agricultural sector is facing low marginal product. The capital and land were also found to be scarce resources, and have imposed a gradual binding constraint on the production. The Return to Scale (RTS) before the materialization of the Islamic Revolution was positive (1.87), but turned to negative after that event (-1.74). The Pure Technical Change (PTC) has increased over the time (0.30 to 0.43), while the Non-Neutral Technical Change (NNTC) has declined (-0.35 to -0.39). Obviously, the results of production functions reveal that the production technology of the Iranian agriculture does not have a well-behaved quality. The overall results suggest that policy makers should reduce the labour force in the agricultural sector, and improve the capital-intensive methods in order to simultaneously increase the output and productivity of the sector.

In developing the SD model of the Iranian agriculture, the specifications of the estimated equations are substituted in the SD model to specify some relationships between a number of important variables. However, other mathematical formulations are also used to build the SD model. The validity of the model was done based on several tests such as error checking, dimensional consistency, behaviour reproduction, sensitivity analysis, extreme condition, boundary adequacy, structure assessment, parameter assessment, and integration error tests. The results of all tests indicated that

the ability of the SD model to simulate agricultural sector was acceptable. The brief results of SD model are as follows:

The rural population showed a collapse behaviour type during the 1998-2021 period. The rural population is a source of agricultural supply. The results of the SD model simulation indicate that a turnpike for the labour surplus problem will happen in 2008. After that period, the agricultural employment will decline gradually per year. Hence, it can be stated that the labour surplus problem automatically declines in the mid-term period. On the other hand, the rate of migration from the rural to the urban areas will increase and consequently move the unemployment problem from the rural to the urban areas.

The results of the simulated agricultural production indicate that the average production growth rate in 2007-2021 is about 2% per year. According to the development plan, the real growth rate in the whole economy should increase 8.6% annually. Obviously, this shows that the growth rate in the agricultural sector is not much over the future time with the country's goals and production in the period (2007-2021) need more consideration. In supporting the increment in production, the increase in inputs (especially land and capital) is needed. When these increases in the process of production are successful, they have been accompanied with the improvement in the overall technical change.

Based on the SD simulation model for the period of 2006-2021; the results indicated that rural population, export, and employment would decline (35%, 21%, and 30%, respectively) while the rural emigration, labour and agricultural demands, production, capital, and import would also increase (116%, 21%, 43%, 32%, 102%, and 193%, respectively).

The major policy implications from the study suggest that if the government could increase arable land by providing improvement in the irrigation system, reduce labour in order to decrease labour/land ratio, improvement in the overall technological methods (PTC and NNTC), these efforts would considerably improve the agricultural productivity. When the government changes the market factors such as the agricultural price index, real exchange rate, worker wage, they will have great effects on the employment, but only a small effect on the production. The overall results of study demonstrate the way to combine the different methodologies, i.e., the SD and econometrics, to be further effective.

Keywords: System Dynamics Simulation, Socio-Economic Model, Agricultural Labour, Production Functions, Dynamic Demand for Labour, Export-Import Functions, Agricultural Demand

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

KAJIAN MENGGUNAKAN SISTEM DINAMIK KE ATAS PELUANG PEKERJAAN DALAM PENGELUARAN PERTANIAN IRAN

Oleh

MOHAMMAD HASHEM MOOSAVI HAGHIGHI

Ogos 2007

Pengerusi : Professor Dr. Mad Nasir Shamsudin, PhD

Fakulti : Pertanian

Pertanian merupakan sektor ekonomi yang penting dan juga komponen strategik untuk pembangunan luar bandar di Iran. Sektor pertanian menyumbangkan 15% nilai tambah negara pada 2005, dan mewujudkan 23% peluang pekerjaan pada 2004. Walaubagaimanapun, sektor tersebut dibebani dengan situasi lebihan tenaga kerja seperti yang ditunjukkan oleh nisbah tenaga kerja/tanah yang tinggi. Situasi ini, disertakan dengan kombinasi tenaga kerja dan faktor-faktor pengeluaran lain yang tidak bersesuaian telah menyebabkan tahap produktiviti tenaga kerja yang rendah dan seterusnya mengakibatkan kadar pertumbuhan yang rendah dalam sektor pertanian. Oleh itu, objektif am kajian ini adalah untuk menentukan polisi-polisi pekerjaan optima dan pengeluaran dalam sektor pertanian Iran. Objektif spesifik adalah untuk menganggarkan model-model ekonometrik sektor pertanian Iran untuk menentukan pengeluaran dan hubungan lain di dalam model Sistem Dinamik (SD); untuk membangunkan model SD dan

mengenalpasti hubungan antara angkubah-angkubah sosio-ekonomi di dalam sektor pertanian Iran untuk mensimulasikan aliran peluang pekerjaan dan pengeluaran masa hadapan; dan untuk mensimulasikan model SD dengan senario-senario yang berbeza.

Kajian ini menggunakan kaedah-kaedah ekonometrik dan model simulasi SD dengan menggabungkan perubahan-perubahan dinamik angkubah-angkubah sosio-ekonomi. Kaedah-kaedah ekonometrik mewakili sistem di dalam bentuk persamaan - persamaan. Pengeluaran, eksport-import, permintaan untuk tenaga kerja dan produk-produk pertanian, dan juga fungsi-fungsi upah yang dianggarkan dengan menggunakan data yang dikumpul selama 35 tahun, dan menggantikan komponen ekonomi dalam model SD.

Permintaan dinamik untuk persamaan tenaga kerja menggabungkan kos tidak seimbang (DC) dan kos penyelarasan (AC) yang dianggarkan dari tahun 1996/97 sehingga 2000/01. Keputusan kajian menunjukkan hubungan yang signifikan di antara peluang pekerjaan, pengeluaran, upah keanjalan harga silang dalam permintaan tenaga kerja. Ini menunjukkan bahawa penyelarasan ko-efisien adalah terlalu rendah (0.044) memandangkan AC lebih tinggi dari DC, wujudnya hubungan penggantian di antara modal dan tenaga kerja dan kesan negatif perang terhadap permintaan tenaga kerja untuk pertanian.

Angkubah pertukaran sebenar mempunyai tanda yang dijangkakan dalam fungsi eksport dan import. Pendapatan per kapita dalam negara-negara Kesatuan Kerjasama Ekonomi dan Pembangunan (OECD) mempunyai tanda yang positif dalam persamaan eksport. Indeks harga pertanian dan pengeluaran pertanian masing-masing mempunyai kesan yang positif dan negatif ke atas eksport pertanian. Namun begitu, kesan dari perang dan revolusi Islam mempunyai kesan yang negatif ke atas eksport pertanian. Dalam persamaan import, pendapatan per kapita negara mempunyai kesan yang positif, manakala kadar pertukaran sebenar mempunyai kesan yang negatif ke atas import pertanian.

Analisis ke atas keputusan-keputusan fungsi-fungsi pengeluaran mengesahkan tanggapan awal bahawa sektor pertanian Iran menghadapi produk marginal yang rendah. Modal dan tanah merupakan sumber-sumber tidak mencukupi dan menyebabkan kekangan ke atas. Pulangan pada skala (RTC) sebelum berlakunya Revolusi Islam adalah positif (1.87) tetapi menjadi negatif selepas revolusi tersebut (-1.74). Perubahan teknikal tulen (PTC) telah meningkat (0.30 kepada 0.43) manakala perubahan teknikal tidak neutral (NNTC) telah menurun (-0.35 kepada -0.39). Secara amnya, keputusan-keputusan dari fungsi-fungsi pengeluaran menunjukkan bahawa teknologi pengeluaran pertanian Iran tidak mempunyai kualiti yang baik. Keputusan keseluruhan mencadangkan bahawa pembentuk dasar patut mengurangkan tenaga kerja dalam sektor pertanian, dan memperbaiki kaedah-kaedah intensif modal untuk meningkatkan hasil pengeluaran dan produktiviti sektor secara serentak.

Dalam membangunkan model SD pertanian Iran, spesifikasi-spesifikasi dalam persamaan-persamaan yang telah dianggarkan digantikan ke dalam model SD untuk menentukan hubungan-hubungan di antara beberapa angkubah yang penting. Walaubagaimanapun, formulasi-formulasi matenatik juga turut digunakan untuk membangunkan model SD. Kesahan model tersebut telah dilakukan berdasarkan beberapa ujian seperti pemeriksaan kesilapan, konsistensi dimensi, tingkahlaku reproduksi, analisis sensitiviti, keadaan ekstrem, kebolehcukupan sempadan, penilaian struktur, penilaian parameter dan ujian ralat integrasi. Keputusan-keputusan ujian menunjukkan bahawa kemampuan model SD untuk mensimulasikan sektor pertanian diterima. Keputusan-keputusan model SD adalah seperti berikut:

Populasi luar bandar telah menunjukkan perubahan gelagat dari tahun 1998-2021. Populasi luar bandar merupakan sumber penawaran pertanian. Keputusan dari simulasi model SD menunjukkan bahawa masalah lebihan penawaran tenaga kerja akan berlaku pada tahun 2008. Kemudian, peluang pekerjaan dalam bidang pertanian akan menurun secara perlahan-lahan setiap tahun. Oleh yang demikian, masalah lebihan tenaga kerja akan menurun secara automatik di pertengahan jangkamasa tersebut. Namun begitu, kadar migrasi dari kawasan luar bandar ke kawasan bandar akan meningkat dan sekaligus menyebabkan masalah pengangguran berubah dari kawasan luar bandar ke bandar.

Keputusan dari simulasi pengeluaran pertanian menunjukkan bahawa purata kadar pertumbuhan pengeluaran pada 2007-2021 ialah sebanyak 2% per

tahun. Berdasarkan pada pelan pembangunan, kadar pertumbuhan sebenar dalam keseluruhan ekonomi sepatutnya meningkat 8.6% setiap tahun. Secara kasarnya, ini menunjukkan bahawa kadar pertumbuhan dalam sektor pertanian adalah tidak sejajar dengan matlamat negara dan pengeluaran pada jangkamasa tersebut (2007-2021) memerlukan lebih pertimbangan. Dalam usaha menyokong peningkatan dalam pengeluaran, peningkatan dalam input (terutamanya tanah dan modal) diperlukan. Apabila peningkatan dalam proses pengeluaran ini berjaya maka ia akan disertai oleh kemajuan dalam keseluruhan perubahan teknikal.

Berdasarkan model simulasi SD dari tahun 2006-2021, hasil kajian menunjukkan bahawa populasi luar bandar, eksport dan peluang pekerjaan akan menurun (35%, 21% dan 30% masing-masing) manakala emigrasi luar bandar, permintaan tenaga kerja dan pertanian, pengeluaran, modal dan import akan meningkat (116%, 21%, 43%, 32%, 102%, and 193% masing-masing).

Implikasi polisi yang utama dari kajian ini mencadangkan jika kerajaan dapat menambahkan tanah yang sesuai untuk dibajak dengan membekalkan pembaikan dalam sistem pengairan, mengurangkan tenaga kerja untuk mengurangkan nisbah tenaga kerja/tanah, pembaikan dalam kaedah teknologi secara keseluruhan (PTC dan NNTC), usaha-usaha ini dianggap akan dapat meningkatkan produktiviti pertanian. Apabila kerajaan mengubah faktor-faktor pasaran seperti indeks harga pertanian, kadar tukaran wang asing, upah pekerja di mana ianya akan mempunyai kesan yang besar

terhadap pekerjaan tetapi kesan yang kecil ke atas pengeluaran. Keputusan dari kajian ini secara amnya menunjukkan cara untuk menggabungkan kaedah-kaedah yang berbeza seperti SD dan ekonometrik, untuk menjadi lebih berkesan.

Kata kunci: Simulasi sistem dinamik, model sosio-ekonomi, tenaga kerja pertanian , fungsi-fungsi pengeluaran, permintaan dinamik tenaga kerja, fungsi-fungsi eksport-import, permintaan pertanian

ACKNOWLEDGEMENTS

All praises to the Almighty Allah, the Most Gracious and Merciful, who is omnipresent, for giving me the strength and determination to complete this study. No words can express adequately my sense of indebtedness yet I feel I shall be failing in my obligation if I do not put on record my gratitude to the following persons:

I am deeply indebted to Prof. Dr. Mad Nasir Shamsudin, Department of Agribusiness and Information System, Universiti Putra Malaysia, as the chairman of supervisory committee who, provided valuable guidance in all aspects of the research process. Special thanks are also due to my supervisory committee members, Associate Prof. Dr. Zainal Abidin Mohamed, and Dr. Norsida Man for sharing their time and ideas, comments and advice on developing and reporting this research and for serving as members of my committee.

I wish to express my special thanks to Dr. Mansoor Zibaei and Prof. Dr Seeyd Ahang Kowsar, Dr Amini, Mr. Amir Khalesi, Mr Amir Bahaman Hassan Agahei, Mr. Akbarpoor, Mr. Masoud Fanni, Mr. Ali Fanni, Mr. Dastbala, Dr. Badjian, Dr. Rahimi Soorahe, Dr. Bostaki, Mr. Arabkhedri and Mr. Sharam Karimi for their support I will never forget. It is also my pleasure to thank all the lecturers and staff at the Department of Agribusiness and Information System, Faculty of Agriculture, UPM for their guidance and support throughout my study**.**

I would like to thank Dr. Mehrdad Mohammadnia, Mr. Nejabat and all members of Agricultural and Natural Resources Research Centre of Fars province for their support**.** My thanks are also to my colleagues Ms. Golnaz Rezai, Majid Sanai from Iran and Dr. Abudulla Faraha from Somalia. Special thanks to my Iranian friends and their family (in Malaysia) whom I will never forget**.**

I want to express thanks to my dear wife for her love, and my Father, Mother, Sisters, and Sons for moral support and their long patience. Finally I want to express my special deep thanks and appreciation to Mr. Kerammat Mohammadnia, who helped me in one way or the other during my absence from Iran.

I certify that an Examination Committee met on 9th August 2007 to conduct the final examination of Mohammad Hashem Moosavi Haghighi on his of Doctor Philosophy thesis entitled "A System Dynamics Investigation of Employment in the Iranian Agricultural Production" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee are as follows:

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Date:

DECLARATION

I hereby declare that this thesis is based on my original work except for quotations and citations, which 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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MOHAMMAD HASHEM MOOSAVI HAGHIGHI

Date:

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