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PREVIEW

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**An *ex ante* evaluation of the interaction between risk behavior  
and technology adoption in Morocco's dryland agriculture: The  
case of bread wheat supplementary irrigation**

Moussaoui, Mohamed, Ph.D.

The University of Nebraska - Lincoln, 1994

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PREVIEW

**AN *EX ANTE* EVALUATION OF THE INTERACTION BETWEEN  
RISK BEHAVIOR AND TECHNOLOGY ADOPTION IN MOROCCO'S  
DRYLAND AGRICULTURE: THE CASE OF BREAD WHEAT  
SUPPLEMENTARY IRRIGATION**

by

Mohamed Moussaoui

A DISSERTATION

Presented to the Faculty of

The graduate College at the University of Nebraska

In Partial Fulfillment of Requirements

For the Degree of Doctor of Philosophy.

Major: Agricultural Economics

Under the Supervision of Professors

Azzeddine M. Azzam and Glenn A. Helmers

Lincoln, Nebraska

August 1994

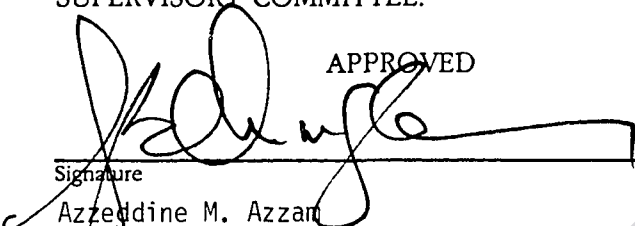
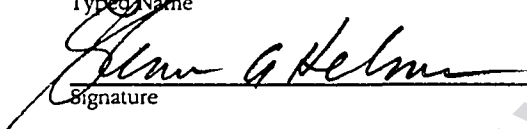


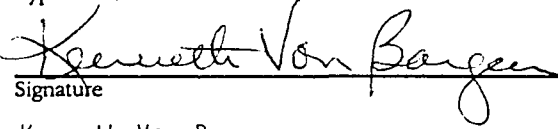
DISSERTATION TITLE

An Ex Ante Evaluation of the Interaction Between Risk Behavior and  
Technology Adoption in Morocco's Dryland Agriculture:  
The Case of Bread Wheat Supplementary Irrigation

BY

Mohamed Moussaoui

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**AN *EX ANTE* EVALUATION OF THE INTERACTION BETWEEN  
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Advisors: Azzeddine M. Azzam and Glenn A. Helmers

The purpose of this study was to develop and implement an empirical framework for testing whether farmers' ex post risk behavior is relevant to assess *ex ante* technology adoption. The framework was applied to a sample of 80 farmers in the dryland Chaouia region of Morocco. The farmers were presented with a set of supplementary irrigation alternatives on bread wheat.

Measures of ex post risk behavior were estimated using Roy's safety-first rule. Five supplementary irrigation alternatives were considered and generalized stochastic dominance risk efficient sets were derived for three types of risk behavior. A multichoice experiment was implemented on a subsample of forty farmers who were presented with the five alternatives, and a sign test was performed to assess switching in risk behavior. Results showed that farmers' risk attitudes were not sticky, thus questioning attempts usually made to design and assess technology according to ex post risk attitudes. The implications of the research finding are as follows. First, the aridoculture research agenda must emphasize production and transfer of knowledge regarding uncertainty of the physical environment, as well as the risk-efficiency characteristics of generated technologies. Second, dissemination should focus on

providing farmers with sound and timely risk information. Finally, agricultural policy needs to be reoriented in order to enhance farmers' safety-first capabilities.

Future research should concentrate on the improvement of data accuracy in estimating risk coefficients and on the emerging issue of differentiating between long-run and short-run risk behavior in assessing technology adoption.

PREVIEW



*To: Fatima, Asmae, Laila, and Younes for their overwhelming love and daring patience.*

*To: Morocco's dryland farmers for their outstanding ingenuity.*

PREVIEW

## ACKNOWLEDGMENTS

To fully express my appreciation to all those who assisted me with this study would not be possible; however, I am indebted to many whose contribution, encouragement and counsel have made this research an enjoyable experience.

I express my sincere appreciation to Dr. Azzeddine Azzam whose guidance, counsel, and constructive criticism - since the inception of the proposal, during his visiting year in Morocco, through the completion of the manuscript - has greatly contributed to my 'getting most out of the least' in writing.

I also express my gratitude to Dr. Glenn Helmers, who did his best in watching after me while I was completing the first step in the Ph.D. program. He will be remembered by the highly suggestive statement that people do not have to worry about risk until they face it.

My recognition is extended to the members of my supervisory committee, Drs. Paul Gessaman and Wesley Peterson of the Department of Agricultural Economics and Dr. Kenneth Von Barga from the Department of Biological Systems. Their reading of the manuscript and suggestions for improving this dissertation are appreciated.

I would like to thank Dr. K. Eskridge in the Department of Biometry for his instructive comments and suggestions.

My appreciation goes to the faculty, the chair of the Graduate Committee, Dr. Baker, the graduate students and the staff at the Department of Agricultural Economics at UNL, who made my stay at Lincoln a learning and enjoyable experience.

I am indebted to the Institut National de la Recherche Agronomique of Morocco (INRA), to the U.S. Agency for International Development (USAID), and Mid-America International Agricultural Consortium (MIAC) for the financial support during the conduct of my school and field works in the United States and Morocco.

I am deeply thankful to the MIAC/INRA Morocco Project staff in Lincoln and in Settlat, particularly Drs. Dan Bigbee and Larry and Tom Gillard-Byers, respectively, former and current project coordinator and team leader; Mr. Arifi and Faraj, respectively, current and former INRA Directors, and Dr. El Mourid and Kamal, Aridcculture Center Directors.

I would like to express my thanks to all colleagues and staff at the Aridoculture Center and of the Department of Socioeconomics, in particular, Dr. El Mourid, Dr. Karrou, Dr. G. Rafsnider, J. Rafsnider, Laamari, Bouáyad, Nassif, Herzenni, Bandaoud, Boughlala, Ben Aouda, Fadlaoui, and Mezzour. Their help during the conception and implementation of research are appreciated. My thanks are also extended to Dr. Driouchi and Dr. Doukkali, respectively, at the Department of Rural Economics, ENA, Maknes, and the Department of Human Sciences, IAV. Hassan II, Babat, for their moral support.

I would like to thank my wife Fatima, daughters Asmae and Laila, and my son Younes for their love, support, patience, and understanding through my education program. Be advised, my dearest, that I shall be all yours; no more extra hour work!

Sincere thanks go to my friends Chriaa, El Bouhssini, El Mourid, Derkaoui, El Yamani, Laamari, El Mejahed, Ben Halima, Grich, Bari, Sekkat, Lahmar, Nadori,

Hilal, Hmimina and their families for being so nice to my family during my absence.

I would like also to express my recognition to the following families: Bahri, El Gharras, Bigbee, Anderson, Keith, Azzam, Sarroub, Zerkoune, Newquist, Jennane, Mirghani, and Gandoul for their encouragement and hospitality during the last period of my study at Lincoln.

I would like to extend gratitude to my father Rahou and mother Zineb from whom I learned education is the best investment ever. Special thoughts are due to Aunt Techfa, to my brothers Lahcen, Mimoun, Hassan, Belkacem, Mostafa, my sisters Aicha, Fatima, and Khadija, and to my cousin Mohamed and their families.

My deep appreciation is also expressed to my father and mother-in-law, Haj Mohamed and Hajja Oumcheikh, to my brothers-in-law Ahmad, Haesan, Radouane, Mahmoud and Mostafa, and sisters-in-law, Aicha, Roukia, and Latifa, for their outstanding care of my children during my absence from Morocco.

Last, but surely not the least, I wish to record my sincere appreciation to Pat Bryant for her patient care and professional excellence in typing this dissertation.

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## **CHAPTER I**

### **INTRODUCTION**

#### **I.1. Background.**

Morocco's agriculture in the arid and semi-arid regions occupies 87 percent of total arable land (El Mourid, 1988), involves more than 40 percent of total population (MARA, 1993), and provides a relatively significant portion of the country's most important crops and livestock. It is the source of about half of the cereal and sheep production (El Mourid, 1988; Mezzour 1993), and approximately 75 percent of the 1.3 million farm households rely on rainfed agriculture for 75 percent to 85 percent of their income (MARA, 1993). Eighty percent of those households own less than 5 hectares and 85 percent are reported as living in poverty (MARA, 1993; DAARP, 1993).

Agriculture in the arid and semi-arid regions faces serious constraints. These regions are characterized by low rainfall (200-400 mm) and a highly erratic distribution of annual precipitations within the year, from year to year, and from region to region (Watts and El Mourid, 1988). Soils are frequently shallow with low moisture holding capacity. Thus, the major feature of this dryland agriculture is a large production variance due to the low level and variability of rainfall.

Risk is, then, inherently greater under these conditions. Severe droughts like the ones experienced in 1981-1985 and 1991-93 growing seasons show that years of marginal crops productions, if any at all, are common. It follows that investments in inputs (such as fertilizer, improved seeds, and pesticides) that might increase yields may be lost when drought results in crop failure.



Because the highest priority for agricultural development was, until the mid-seventies, given to more favorable agricultural areas, technologies that are well adapted to regions of greater rainfall or irrigated areas are frequently inappropriate for dryland agriculture. To create technologies more appropriate for dryland areas, the Dryland Agriculture Applied Research Project (DAARP) was initiated in 1980 by the government of Morocco, USAID, and Mid-America International Agricultural Consortium (MIAC).

The DAARP is a comprehensive multidisciplinary agricultural research project that has been in the implementation stage over the past fifteen years. It is located within the regional center of the National Agricultural Research Institute (INRA) at Settat, Morocco (Figure 1). The project's geographic area represents 46 percent of total arable land, half of which is cropped to cereal production (INRA, 1990). The purpose of DAARP was to develop a research center that would have the capability of generating technologies to improve the productivity and stability of production as well as income of dryland farmers.

Two major areas of research activities were proposed for that purpose. The first was directed at alleviating constraints on crop production, especially those related to water availability. The second dealt with socioeconomic studies of farm economics and family behavior patterns as they interact in the decision making process. The task of the socioeconomic program was to study the production practices and strategies for risk management used by farmers, and to find avenues through which improved technology may best be introduced.

SCALE  
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0 150 mi

PORTUGAL SPAIN  
MEDITERRANEAN SEA  
ALGERIA  
ATLANTIC OCEAN  
Tangiers  
Rabat  
Casablanca  
El-Jadida  
Settat  
Safi  
Essaouira  
Marrakech  
Agadir  
Sahara Desert  
CANARY ISLANDS  
MAURITANIA  
ARIDOCULTURE PROJECT AREA (detail)  
Ouarzazate  
Berrechid  
Sidi-El-Ayouch  
Settat  
Oued Zem  
El-Borouj  
Benguelte  
El-Kela-Sraïene  
Tassout  
Marrakech  
Issaouira  
Chemala  
Yousoufia  
Jema-Shaim  
Khemis-Zem  
Safi  
Ouarzazate  
El-Jadida  
Sidi-El-Ayouch  
Settat  
Berrechid  
Oued Zem  
El-Borouj  
Benguelte  
El-Kela-Sraïene  
Tassout  
Marrakech  
Issaouira  
Chemala  
Yousoufia  
Jema-Shaim  
Khemis-Zem  
Safi

● = research stations  
□ = study area

(Adapted from Watts and El Mourid, 1988)

Since the inception of DAARP, a considerable volume of information on dryland agriculture has been generated. This includes data on low-resource farmers in the regions and the production constraints they face. Improved varieties and agronomic practices have already been adopted. Others are shelf technologies and still need to be transferred to farmers.

## **1.2. Statement of the Problem.**

A major recommendation of the DAARP final evaluation is that on-shelf technologies be transferred to farmers. However, implementing this recommendation requires taking into account the context of Morocco's dryland agriculture. The latter makes uncertainty particularly worrying to farmers who operate at the margin of economic survival. Therefore, farmer's risk behavior as well as technology risk efficiency are of considerable relevance when considering diffusion of improved technologies such as those generated under the DAARP.

Farmers are reported as being mostly risk averse (Anderson and Thampapillai, 1990). In a highly risky environment, such an attitude is conventionally associated with low-risk technology adoption (Pascon, 1980; Moussaoui, 1989). But, since low-risk alternatives are also low-productivity ones, no production improvement in Morocco's dryland agriculture is to happen unless farmers are allowed either to behave differently or to have their risk attitudes altered as adoption is anticipated. As far as farmers decision making is concerned one needs to answer the two following questions:

- What are Morocco's dryland farmer's attitudes towards risk?