

## Table of Contents

ACKNOWLEDGEMENT . . . . .	i
ABSTRACT . . . . .	ii
CHAPTER 1 INTRODUCTION . . . . .	1
CHAPTER 2 LITERATURE REVIEW . . . . .	3
2.1. Introduction . . . . .	3
2.2. Studies of Size Efficiencies in the Developing Countries . . . . .	4
2.3. Approaches of Empirical Studies . . . . .	6
2.3.1. The Economic Engineering or Synthetic Firm Approach . . . . .	6
2.3.2. Cross Section Data From Actual Farm Records. . . . .	7
2.3.3. Census Data on Changing Size Distribution of Farms . . . . .	8
2.3.4. Econometric Models of Economies of Farm Size . . . . .	9
2.3.4.1. Efficiencies in terms of cost . . . . .	9
2.3.4.2. Efficiencies in terms of profit . . . . .	9
2.3.4.3. Conventional Production Function . . . . .	10
CHAPTER 3 FRONTIER MODELS . . . . .	11
3.1. Development of Frontier Functions . . . . .	11
3.1.1. Deterministic Non-parametric Frontiers . . . . .	11
3.1.2. Deterministic Parametric Frontiers . . . . .	13
3.1.3. Deterministic Statistical Frontiers . . . . .	14
3.1.4. Probabilistic Frontiers . . . . .	15
3.1.5. Stochastic Frontier . . . . .	15
3.2. Stochastic Frontier: The Case of Half Normal Distribution . . . . .	16
3.3. Duality Consideration . . . . .	19
CHAPTER 4 DATA, DESCRIPTIVE STATISTICS AND ESTIMATION METHODS . . . . .	22

4.1. The Study Area . . . . .	22
4.2. Data Collection . . . . .	24
4.3. General Description of the Sample Farmers . . . . .	25
4.3.1. Rental Status of the Sample Farmers . . . . .	25
4.3.2. Agricultural Machines and Equipments . . . . .	26
4.4. Explanatory Variables . . . . .	26
4.4.1. Operation Size . . . . .	26
4.4.2. Chemical Fertilizer . . . . .	27
4.4.3. Labor . . . . .	30
4.4.4. Pesticide and Herbicide . . . . .	31
4.4.5. Seeds . . . . .	32
4.5. The Dependent Variable . . . . .	33
4.6. The Model and Specification . . . . .	34
4.6.1. Model Specification . . . . .	36
4.6.2. Frontier Production Function Estimation . . . . .	37
4.6.3. Calculating Technical Efficiency and Identifying Factors Associated with Technical Efficiency . . . . .	39
<b>CHAPTER 5. EMPIRICAL RESULTS AND DISCUSSION . . . . .</b>	<b>41</b>
5.1. Simple Correlations among the Explanatory Variables . . . . .	41
5.2. Ordinary Least Squares (OLS) or Generalized Least Squares (GLS) Estimates . . . . .	44
5.2.1. Labor . . . . .	44
5.2.2. Chemical Fertilizer . . . . .	45
5.2.3. Pesticide and Herbicide . . . . .	47
5.2.4. Seeds . . . . .	48
5.3. Returns to Scale . . . . .	48
5.4. Frontier Production Function Estimation . . . . .	49
5.5. Factors Associated with Technical Efficiency . . . . .	53
5.6. Discussion . . . . .	57
5.6.1. Almost Zero Marginal Productivity of Labor . . . . .	57
5.6.2. Land Holding and Cropping Intensity . . . . .	58
<b>CHAPTER 6 CONCLUSION AND REMARKS . . . . .</b>	<b>60</b>
<b>REFERENCES . . . . .</b>	<b>62</b>
<b>APPENDIX . . . . .</b>	<b>67</b>