

## Table of Contents

1.0	Introduction to the Study.....	1
1.1	Background .....	1
1.2	Statement of the Problem .....	3
1.3	Significance of the Study .....	6
1.4	Organization of the Study .....	7
2.0	Literature Review .....	8
2.1	Introduction .....	8
2.2	Theories on Water as a Natural Resource .....	8
2.3	Empirical Literature on Water.....	11
2.4	River Basin Literature Review .....	14
2.5	Objectives and Research Questions .....	19
2.5.1	The Research Questions .....	20
2.6	Hypotheses of the Study.....	20
2.7	Conceptual Framework .....	20
3.0	The Importance of Agriculture in the Economy of Ghana	22
3.1	The Role of Agriculture in Ghana.....	22
3.1.1	The Agricultural and Water Sector in Ghana.....	23
3.2	Water Demand.....	28
3.2.1	Factors That Determine the Demand for Water in Ghana .....	28
3.2.2	Consumption Factors.....	29
3.2.3	Urbanization .....	30
3.2.4	Income Growth.....	31
3.2.5	Economic Structure .....	32
3.3	Ghana's Agriculture Sector Policies and Water Demand	34
3.3.1	Pricing Policy .....	34
3.3.2	Subsidies on Inputs Policy .....	37
3.3.3	Credit Policy.....	40
3.3.4	Land Policy .....	44
3.3.5	Macroeconomic Policies .....	45
3.4	Irrigation Policies .....	46
3.4.1	Overview of Irrigation Policy .....	46
3.4.2	The Extent of Irrigation in Ghana .....	48
3.4.3	Small Scale Irrigation in Ghana .....	49
3.4.4	Irrigation Pricing .....	51
3.4.5	The Importance of Irrigation to Agriculture .....	51
3.5	Water Supply.....	52
3.6	Water Demand and Supply Situation in Ghana .....	55
4.0	Methodology and Theoretical Background.....	58
4.1	Types of Models.....	58
4.2	Why the Need to Use the MATA Model .....	60
4.2.1	The Agricultural Production Module .....	63
4.2.2	Risk in the Constraints .....	67
4.2.3	The Consumption Module.....	68

4.2.4	The Macro Economic Module (Context Module).....	69
4.2.5	Water Demand Module .....	70
4.2.6	Connecting Production and the Water Component... .....	71
4.3	Water Supply.....	72
4.3.1	Effective Rainfall .....	76
4.4	The Structure of the MATA Model.....	77
4.4.1	Data Acquisition.....	78
4.5	Agro Ecological Regions in Ghana.....	80
4.5.1	Zoning of Basin Area .....	83
4.5.2	Farm Typology .....	83
4.5.3	Principal Component Analysis.....	84
4.6	Farm Types.....	88
4.6.1	Data Sources.....	89
4.6.2	Data Description.....	94
4.7	Data Requirement.....	95
4.7.1	Data at the Agro-Ecological Zone.....	95
4.7.2	Data Collected at the Farm-Level .....	96
4.8	CROPWAT (Water Requirement) .....	97
5.0	Empirical Overview of the MATA Model.....	98
5.1	Basic Equations for Farming System Model.....	98
5.1.1	Objective Function of the MATA Model.....	98
5.2	The Constraints in the Model .....	99
5.3	Yield Water Response .....	103
5.3.1	Incorporation of Water in Crop Yield Function.....	104
5.4	Calibration and Validation of the Model Results.....	104
5.4.1	Model Validation Robustness .....	107
5.5	The Model Limitations.....	109
6.0	Analysis of Empirical Model Results and Interpretation	110
6.1	Introduction .....	110
6.2	Baseline Model Scenario.....	112
6.3	Policy Simulations and Their Impact on Water Demand and Farm Performance .....	114
6.4	Water Pricing Scenario.....	114
6.4.1	Crop Choice.....	116
6.4.2	Economic Impact.....	121
6.4.3	Social Impact.....	126
6.4.4	Non Agricultural Employment.....	129
6.4.5	Total Wealth.....	131
6.5	Environmental impact .....	134
6.6	Summary .....	134
6.7	Water Availability Scenario .....	135
6.7.1	Impact on Agricultural Income .....	139
6.7.2	Impact on Employment .....	139
6.7.3	Impact on Agricultural Farm Wealth .....	141
6.8	Changes in Input Prices.....	142

6.8.1	Impact of Input Price Increase on Agricultural Income .....	145
6.8.2	Impact of Input Price Increase on Non-Farm Employment .....	147
6.8.3	Impact of Input Price Increase on Farm Wealth ....	148
6.9	Impact of Increase in Credit Availability .....	149
6.9.1	Impact of Credit Availability on Agricultural Income..	153
6.9.2	Impact of Credit Availability on Agricultural Employment.....	154
6.9.3	Impact of credit Availability on Non Agricultural Consumption.....	156
6.10	Price Expectations .....	157
6.10.1	Impact on Yearly Agricultural Production.....	160
6.10.2	Impact on Agricultural Income .....	161
6.11	Land Reform Scenario .....	162
6.11.1	Impact on Agricultural Income .....	164
6.11.2	Impact on Employment .....	166
6.11.3	Impact on Total Farm Wealth .....	167
6.12	Change in Technology Scenario .....	168
6.12.1	Impact on Agricultural Income .....	170
6.12.2	Impact on Agricultural Employment .....	171
6.12.3	Impact on Farm wealth.....	172
7.0	Summary, Conclusions and Recommendations .....	173
7.1	Introduction .....	173
7.1.1	Analytical framework.....	174
7.2	Application to Real Life Situation .....	179
7.3	Further Research .....	180
	REFERENCES.....	182
8.0	APPENDICES.....	199