TABLE OF CONTENTS

1 INTRODUCTION 1

2 LITERATURE REVIEW 4

2.1 Inorganic fertilizers 4
2.2 Organic fertilizers 4
2.2.1 Biological nitrogen fixation 5
2.2.2 Decomposition and N release 5
2.2.3 Synchronisation 6
2.3 Legumes as green manure 6
2.4 *Azolla* as green manure 7
2.5 Decline in green manure use 8
2.6 Remaining gaps 8

3 MATERIALS AND METHODS 9

3.1 Researcher-managed trials 9
3.1.1 Site description 9
3.1.2 Experimental description 10
The first season (2000B) 10
Mucuna biomass production 10
Estimation of biological nitrogen fixation 11
Production of ^{15}N-labeled mucuna 13
The second season (2001A) 14
Mucuna decomposition and N release 14
Maize response to alternative treatments in preceding season 15
N balance study (Fate of applied N) 16
3.1.3 Laboratory analysis 18
3.1.4 Statistical analysis 18
3.2 On – farm (farmer-managed) trials 19
3.2.1 Maize system 19
3.2.1.1 Site description 19
3.2.1.2 Experimental description 19
The first season treatments (2000B season) 20
Mucuna biomass production 20
Maize response to treatments in the preceding season (2001A season) 20
Economic analysis 21
3.2.2 Rice system 22
3.2.2.1 Site description 22
3.2.2.2 Experimental description 23
Nakisenye 23
The first season (2000B season) 23
Rice response to treatments of preceding season (2001A) 24
Doho irrigation scheme 25
The first (2000B) and second (2001A) season treatments 25
Economic analysis 26
3.2.3 Farmer evaluation of Mucuna, *Azolla* and inorganic fertilizers 26

4 RESULTS AND DISCUSSION....27

4.1 Researcher-managed trials.... 27
4.1.1 The first season (2000B).... 28
Maize and mucuna biomass production and N, P, K yield.... 28
Biological nitrogen fixation.... 29
4.1.2 The second season (2001A).... 30
Mucuna decomposition and nitrogen release.... 30
Maize response to alternative treatments in preceding season.... 31
4.1.2.1 Bulegeni ARDC.... 31
4.1.2.2 Kibale TVC.... 33
Comparison of treatments between Bulegeni and Kibale.... 34
Nitrogen uptake and balance (Fate of applied N).... 35
Summary and conclusion.... 37
4.2 On-farm (farmer-managed) trials.... 39
4.2.1 Maize system.... 39
4.2.1.1 Kongta.... 39
Maize and mucuna yield in first season (2000B).... 39
Maize response to alternative treatments in the preceding season (2001A). 41
Comparing the two fertility groups of fields.... 43
Combined grain yield of the two seasons (1-year period).... 44
4.2.1.2 Kasheshe/Nemba.... 45
Maize and mucuna yield in first season (2000B).... 45
Maize response to alternative treatments in the preceding season (2001A). 47
Comparing two fertility groups of fields.... 49
Combined grain yield of the two seasons (1-year period).... 50
4.2.1.3 Odwarat.... 51
Maize and mucuna yield in the first season (2000B).... 52
Maize response to alternative treatments in the preceding season (2001A). 54
Comparing the two fertility groups of fields.... 56
Combined grain yield of the two seasons (1-year period).... 56
4.2.1.4 Agonyo II.... 57
Maize and mucuna yield in first season (2000B).... 58
Maize response to alternative treatments in the preceding season (2001A). 59
Comparing the two fertility groups of fields.... 61
Combined grain yield of the two seasons (1-year period).... 62
4.2.1.5 *Cross – environment agronomic analysis*.... 63
4.2.1.6 *Cross – environment economic analysis*.... 64
High-potential environment.... 66
Low-potential environment.... 66
Fertilizer price.... 67
Summary and conclusion.... 67
4.2.2 Rice system.... 70
4.2.2.1 Nakisenye.... 70
Maize and mucuna yield in the first season (2000B).... 70
Rice yield in the subsequent season (2001A).... 71
4.2.2.2 Doho rice scheme.... 72
Azolla biomass.... 73
Rice yield.... 73

Economic analysis 74
Nakisenye 74
Doho rice scheme 75
Fertilizer cost 76
Summary and conclusion 76
4.2.3 Farmers' evaluation of mucuna, *Azolla* and inorganic fertilizers 77
4.2.3.1 Mucuna 78
4.2.3.2 Inorganic fertilizers in maize system 79
4.2.3.3 *Azolla* 80
4.2.3.4 Farmers' evaluation of inorganic fertilizers in rice system 80
Summary and conclusion 81

5 GENERAL DISCUSSION AND CONCLUSIONS 82

Conclusions 86
Recommendations for future research 87

6 REFERENCES 88

7 APPENDICES 97

ACKNOWLEDGEMENTS 102