

Zentrum für Entwicklungsforschung

---

**Gender- Differentiated Asset Dynamics in Bangladesh: Individual  
Adaptation and the Potential for Group Based Approaches in the  
Context of Climate Change**

Inaugural-Dissertation  
zur  
Erlangung des Grades

Doktorin der Agrarwissenschaften  
(Dr. agr.)

der

Landwirtschaftlichen Fakultät

der

Rheinischen Friedrich-Wilhelms-Universität Bonn

von

**MUNTAHA RAKIB**

aus

Moulvibazar, Bangladesch

Referent: - Professor Dr. Joachim von Braun

Koreferent: - Professorin Dr. Regina Birner

Tag der mündlichen Prüfung: 13.07.2015

Erscheinungsjahr: 2015

## ACKNOWLEDGEMENTS

All praise and thanks to Allah, the Almighty, the most Merciful. I owe my sincere gratitude and thanks to all who helped to complete my PhD research. It is a blessing to be a student of Professor Joachim von Braun and I am fortunate to complete my PhD under his supervision. I would like to express my heartiest gratitude to him for providing his kind and generous support, guidance and advice in different phases throughout my PhD studies. I am highly indebted to my tutor Julia Anna Matz for her thorough reviews of my thesis chapters several times, helpful comments and excellent tutoring of my work throughout the PhD period.

I sincerely acknowledge the scholarship aided and supported by the Federal Ministry for Economic Cooperation and Development (BMZ) and International Food Policy Research Institute (IFPRI), Germany under the project “Enhancing Women’s Assets to Manage Risk under Climate Change: Potential for Group-Based Approaches”. I gratefully acknowledge Dr. Hermann Eiselen Doctoral support for some of my field research. I would like to thank the donor and my project colleagues at IFPRI who provided their advice and support for my work. I am especially grateful to Agnes Quisumbing and Claudia Ringler for their helpful and valuable comments on my works and for providing relevant materials. I would like to thank Tim Thomas for sending me the baseline dataset and answering my questions regarding sampling and data. My appreciation extends to all of those who helped me during my field survey. I would like to thank all colleagues at DATA office, especially Md. Zahidul Hassan, Md. Zobair and AKM Mahfuzul Kabir for their sincere help to collect the good quality data. My field research has been greatly aided by all the enumerators and respondents participated in the survey.

Bonn is similar to my second home after Bangladesh and I feel myself proud to be a member of the ZEF family. I would like to thank to all my ZEF colleagues especially all my batch mates for their excellent companionship and support throughout the whole period. I would like to thank Tobias Wünschler and Franz W. Gatzweiler for the tutorship of my work during proposal formulation which helped me to set up my goal as well as to prepare myself for field survey. I would like to take the opportunity to express my sincere gratitude to Dr. Editha Potthoff and Dr. Ernst-Ulrich Karmeyer for their exceptional care and concern. They are not only extraordinary doctors who give their patients the strength to recover, but also extraordinary human beings with great caring attitude.

My sincere thanks for the administrative supports I received from Dr. Günther Manske, Mrs. Rosemarie Zabel, Mrs. Gisela Ritter-Pilger, Mrs. Karin Hagedorn-Mensah, Maike Retat Amin, Monika Kesting, Simon Forster, Elina Harzen, Maximilian Voit, Samantha Antonini, Sophie Köhler, and Roswitha Wyrwich. My special thanks to Monika Kesting for helping me to maintain all formalities to submit my thesis to the faculty. I also thank Volker Merx for being their always with books and references whatever asked for. Thanks to Mr. Ludger Hammer and Anja Köhler for providing technical supports to ease my work. I am highly indebted to Guido Lütcher for the immense support and helpful discussion related to statistics. I would like to thank to Jan Brockhaus, Valerie Graw and Holm Voigt for translating the abstract of the thesis into German. I

would like to thank Evita Hanie Pangaribowo and Christine Husmann for the helpful discussions and useful comments.

I am thankful to my colleagues at the Department of Economics at Shahjalal University of Science & Technology, Sylhet, Bangladesh. I am also immensely thankful to my teacher Professor Sayan Chakrabarty, a ZEF alumnus, who greatly encouraged me in directing myself to PhD studies. I remember respectfully and want to thank all my teachers in different stages of my academic journey. My thanks and gratitude goes to the Bengali community here in Bonn for giving me homely atmosphere in abroad.

I have been blessed with a very supportive family. Very special thanks to all my family members living in different parts of the world for their appreciation all through the time period. I would specially thank my parents-in-law for their moral support, prayers and for accompanying me to visit some of the remote places of the country during my field survey.

Words cannot express how grateful I am to my parents Golam Rakib Chowdhury and Marium Sultana Chowdhury - the best parents in the world. I respectfully remember their unequivocal support and unmeasurable contribution in each and every sphere of my life and above all their prayers what sustained me thus far. Thank you 'Ammu-Abbu' for taking care of my little kids in my absence which helped me to concentrate my works with a relax and peaceful mind.

My greatest gratitude goes to my husband, Shah Mohammad Hamza Anwar for the sacrifices, patience and endless support that he has made and for encouraging me to strive towards my goal. Thank you for not just helping me to set my career a priority in our life, but because of sharing the entire journey of my PhD. This dissertation stands as a testament to your love.

I would finish with the source of my spirit, the light of my life - my son Ashabul Yameen Bin Hamza and my daughter Tanaz Mahveen. Living in Bonn, they were like a panacea for me after long and tedious working days. Their smiles and hugs were my energy-bank to start days although I didn't have sufficient time in my calendar for them. Being far in the country, they have been the motivation to complete my work and their skype calls kept me inspiring.

Any errors and shortfalls are entirely mine.

## ABSTRACT

This dissertation examines the changes in intra household asset ownership induced by external events. The immediate coping mechanisms and long term adaptation strategies in response to climatic and non-climatic shocks and the impact of the actions on livelihood outcomes are also investigated. Therefore, a unique and detailed country representing household survey panel data is used, known as 'Bangladesh Climate Change Adaptation Survey' of 2010 and 2012.

The first part of the investigation deals with the dynamics of assets owned by the household head, his spouse, or jointly by both in response to diverse shocks in rural agricultural households in Bangladesh, one of the most vulnerable countries to climate change. Accumulating assets is an important means of coping with adverse events in developing countries, but the role of gendered ownership is not yet fully understood. Building on existing research, this study adds to the understanding of the responsiveness of asset holdings to shocks by providing a more comprehensive definition of asset ownership as well as a broader range of shocks than previous analyses. Looking at changes within rather than between households, the research shows that land is owned mostly by men, who are also wealthier than their spouses, but relative ownership varies by assets types. By constructing a comprehensive index including all types of asset holdings, the overall effect on wealth is investigated, which does not exist in the literature yet. The results suggest that husband's and wife's asset holdings respond differently depending on the type of shocks. Weather shocks such as cyclones adversely affect the asset holdings of household heads in general, while predicted external events such as seasonal droughts and dowry payments reduce assets of both spouses. The focus of the research, however, lies in perceiving changes in ownership of disaggregated asset holdings. This allows getting a detailed understanding as well as identifying substitution effects. The results suggest that jointly owned assets are not sold in response to shocks; either due to these assets being actively protected or due to the difficulty of agreeing on this coping strategy. Women's asset holdings and associated choices of substituting assets are shaped by their lesser involvement in agriculture.

To know the changes of behavioral patterns in response to these shocks, the factors determining farmers' perception of climate change, immediate coping mechanisms and long term adaptation strategies to the adverse effects of shocks are analyzed. The factors constraining the ability to adopt different strategies are also examined. The results suggest that households are more likely to adopt short-term coping mechanisms in response to non-climatic negative shocks rather than to climatic shocks, whereas households are more likely engage in adaptation strategies in response to the latter. Furthermore, adaptation strategies are often combined complementary efforts, whereas coping mechanisms are mutually independent across the study. In particular, group participation in general is associated with crop adaptation strategies and perceptions of climate change among women. Social capital attributed to women and political capital to both men and women are associated with crop adaptation strategies. Social capital is likely to discourage the adoption of immediate coping mechanisms which often have negative long term consequences. Such immediate coping mechanisms may include the reduction of school attendance or a reduced food intake. Political capital is positively associated with some coping mechanisms such as taking informal loans and pursuing migrant labor options.

Finally, the research seeks to explore the potential of group based approaches which is receiving a growing attention due to their possible role in securing household welfare in the presence of adverse events. Apart from examining the factors associated with men's and women's participation in different types of groups, the relationship between various forms of group based approaches including social and political capital and welfare are investigated. The inherent endogeneity is addressed by using instrumental variables. The results suggest that household heads mainly participate in groups that are welfare augmenting and income enhancing, while their spouses are mainly active in credit groups due to less personal wealth which are more strongly negatively affected by shocks. Furthermore, evidence is found for a positive association of social and political capital with household-level welfare and with asset holdings of the household head. Interestingly, it seems that this effect is not driven by mere participation in groups, but also by other aspects of social capital, for example informal networks, of both household heads and spouses.

## ZUSAMMENFASSUNG

Die vorliegende Arbeit befasst sich mit den Veränderungen der Vermögenswerte innerhalb eines Haushalts, die sich aus externen Ereignissen ergeben. Es werden auch kurzfristige Bewältigungsstrategien und langfristige Anpassungsstrategien als Reaktion auf klimatische oder sonstige Kalamitäten, sowie die Auswirkungen dieser Anpassungen auf den Lebensunterhalt untersucht. Die Untersuchung nutzt einen einzigartigen und detaillierten Haushalts-Paneldatensatz, der als „Bangladesh Climate Change Adaption Survey“ 2010 und 2012 durchgeführt wurde und alle agro-ökologischen Zonen des Landes abbildet.

Im ersten Teil der Untersuchungen werden die Vermögenswerte, die sich im Besitz des Familienoberhauptes, des Ehepartners oder im gemeinsamen Besitz befinden, und deren Dynamik hinsichtlich verschiedener Krisen für Landwirtschaft betreibende Haushalte im ländlichen Raum in Bangladesch untersucht. Bangladesch ist eines der Länder, das am stärksten vom Klimawandel betroffen ist. Die Ansammlung von Vermögenswerten ist eine wichtige Strategie, um externe Schocks zu überstehen, aber der Einfluss der relativen Vermögensverhältnisse innerhalb eines Haushaltes ist noch nicht weitreichend erfasst. Diese Studie unterscheidet sich von vorherigen Untersuchungen, da sie eine sehr viel detailliertere Aufschlüsselung der Vermögenswerte sowie eine umfassendere Bandbreite von Schocks berücksichtigt und somit tiefere Einblicke in die zugrunde liegenden Prozesse gewährt. Durch Betrachtung der Veränderungen innerhalb statt zwischen den Haushalten kann gezeigt werden, dass das Land größtenteils Männern gehört und dass diese gleichzeitig auch reicher sind als ihre Ehefrauen. Hingegen variieren relative Vermögenswerte in Abhängigkeit der Güter. Ein umfassender Index, der alle Vermögentypen beinhaltet, wird zur Analyse induzierter Änderungen verwendet, was in der bisherigen Literatur noch nicht existiert. Die Ergebnisse zeigen, dass der Einfluss verschiedener Krisen auf das Vermögen von Frauen und Männer unterschiedlich ist. Extreme Wetterlagen wie Zyklone verringern vor allem das Vermögen des Familienoberhauptes, während erwartete externe Veränderungen wie saisonale Dürren oder Mitgiftzahlungen das Vermögen beider Ehepartner reduzieren. Der Fokus der Untersuchung liegt in der Identifikation von Veränderungen der disaggregierten Vermögensverhältnisse, was ein tieferes Verständnis und die Bestimmung von Substitutionseffekten ermöglicht.

Um Änderungen im Verhalten als Reaktion auf Krisen festzustellen, werden die Faktoren, die die Wahrnehmung des Klimawandels seitens der Landwirte bestimmen, kurzfristige Bewältigungsstrategien und langfristige Anpassungsstrategien analysiert. Umstände, die die Fähigkeit zur Anpassung einschränken, werden ebenfalls untersucht. Es wird gezeigt, dass die Haushalte auf nicht-klimatische Krisen eher mit kurzfristigen Bewältigungsstrategien reagieren als auf klimatische, während als Reaktion auf letztere langfristige Anpassungsstrategien überwiegen. Außerdem beinhalten Anpassungsstrategien meistens kombinierte, komplementäre Anstrengungen, während Bewältigungsstrategien innerhalb der Studie wechselseitig unabhängig sind. Insbesondere spielt die Partizipation in Gruppen eine Rolle für Anbau-Anpassungsstrategien und die Wahrnehmung des Klimawandels unter Frauen. Soziales Kapital von Frauen und politisches Kapital von beiden Ehepartnern sind mit den Anbau-Anpassungsstrategien verknüpft. Soziales Kapital verhindert in vielen Fällen den Einsatz kurzfristiger Bewältigungsmechanismen, die häufig von langfristig negativen Konsequenzen begleitet werden. Politisches Kapital ist positiv mit einigen Bewältigungsmechanismen verknüpft wie beispielsweise der Aufnahme von informellen Krediten oder der Migration zwecks alternativer Arbeitsmöglichkeiten.

Abschließend wird das Potential von gruppenbasierten Ansätzen untersucht, welche eine große Aufmerksamkeit durch ihre mögliche Rolle in der Sicherung von Haushalten während ungünstiger Bedingungen erlangt haben. Neben der Untersuchung von unterschiedlichen Faktoren, welche Frauen und Männer in verschiedenen Gruppen aufweisen, wird die Beziehung zwischen verschiedenen Formen gruppenbasierter Ansätze, die das soziale und politische Kapital und den Wohlstand miteinbeziehen, analysiert. Die inhärente Endogenität wird durch die Verwendung von Instrumentvariablen adressiert. Die Ergebnisse legen nahe, dass Familienoberhäupter hauptsächlich in wohlstandsvermehrenden und einkommenserhöhenden Gruppen aktiv sind, während ihre Ehefrauen überwiegend in Kreditgruppen partizipieren mit geringeren persönlichen Vermögen und damit stärkerer Krisenabhängigkeit. Außerdem wurde ein positiver Zusammenhang zwischen sozialem und politischem Kapital mit dem Familienvermögen sowie mit dem Vermögen des Haushaltsoberhauptes festgestellt. Interessanterweise scheint dieser Effekt nicht alleine von der Gruppenmitgliedschaft, sondern auch von anderen Aspekten des sozialen Kapitals wie beispielsweise informellen Netzwerken der beiden Ehepartner abzuhängen.

# TABLE OF CONTENTS

<b>ACKNOWLEDGEMENTS.....</b>	<b>III</b>
<b>ABSTRACT.....</b>	<b>V</b>
<b>ZUSAMMENFASSUNG .....</b>	<b>VI</b>
<b>TABLE OF CONTENTS.....</b>	<b>VII</b>
<b>LIST OF TABLES AND FIGURES .....</b>	<b>X</b>
List of Tables.....	x
List of Figures.....	xii
<b>LIST OF ABBREVIATIONS AND ACRONYMS .....</b>	<b>XIII</b>
<b>CHAPTER 1. INTRODUCTION.....</b>	<b>1</b>
1.1 Background.....	1
1.2. Problem Statement and Study Objectives .....	4
1.3 Dissertation Structure .....	6
1.4 Expected Research Contributions.....	7
1.5 Data .....	8
<b>CHAPTER 2. THE IMPACT OF SHOCKS ON GENDER-DIFFERENTIATED ASSET DYNAMICS IN BANGLADESH.....</b>	<b>11</b>
2.1. Introduction.....	11
2.2 Relation to the Existing Literature .....	13
2.3. Data and Descriptive Statistics .....	18
2.3.1. Constructing the Asset Index.....	19

2.3.2. Shocks .....	20
2.3.3. Asset Ownership .....	21
2.3.4. Household Characteristics .....	24
2.4. Empirical Approach .....	26
2.4.1. The Impact of Shocks on Comprehensive Asset Holdings .....	27
2.4.2. The Impact of Shocks on Natural, Physical, and Livestock Assets .....	29
2.4.3. The Impact of Shocks on Disaggregated Physical Assets .....	33
2.4.4. The Impact of Shocks on Financial Capital .....	36
2.5. Conclusions .....	38
<b>CHAPTER 3. STRATEGIES FOR ADAPTING TO AND COPING WITH SHOCKS AMONG AGRICULTURAL HOUSEHOLDS IN BANGLADESH.....</b>	<b>40</b>
3.1. Introduction.....	40
3.2. Literature Review.....	42
3.3. Data and Summary Statistics.....	44
3.4. Empirical Findings .....	50
3.4.1. Description of Variables .....	51
3.4.2. Determinants of Farmer Perceptions of Climate Change .....	53
3.4.3. Determinants of Crop Production Adaptation Strategies .....	56
3.4.4. Determinants of Livestock Production Adaptation Strategies .....	59
3.4.5. Determinants of Coping Mechanisms.....	61
3.5. Conclusions .....	65
<b>CHAPTER 4. PROTECTING ASSETS AND ENHANCING WELFARE: THE GENDER-DIFFERENTIATED POTENTIAL OF GROUP-BASED APPROACHES .....</b>	<b>68</b>
4.1. Introduction.....	68
4.2. Relation of the Study to the Existing Literature.....	69



<b>4.3. Data .....</b>	<b>73</b>
<b>4.3.1. Group Membership.....</b>	<b>73</b>
<b>4.3.2. Group Membership and Shock Resiliency .....</b>	<b>76</b>
<b>4.3.3. Social and Political Capital .....</b>	<b>77</b>
<b>4.4. Empirical Findings .....</b>	<b>80</b>
<b>4.4.1. Correlates of Participation in Groups .....</b>	<b>80</b>
<b>4.4.2. Group Membership, Social and Political Capital, and Welfare.....</b>	<b>84</b>
<b>4.4.3. Addressing the Endogeneity.....</b>	<b>87</b>
<b>4.4.4. Gender-disaggregated Welfare .....</b>	<b>94</b>
<b>4.5. Conclusions .....</b>	<b>96</b>
<b>CHAPTER 5. GENERAL CONCLUSIONS AND POLICY IMPLICATIONS .....</b>	<b>98</b>
<b>REFERENCES.....</b>	<b>103</b>
<b>APPENDIX.....</b>	<b>113</b>
<b>Appendix A2: Supplementary Tables .....</b>	<b>113</b>
<b>Appendix A3: Supplementary Tables .....</b>	<b>119</b>
<b>Appendix A4: Supplementary tables .....</b>	<b>129</b>

## LIST OF TABLES AND FIGURES

### List of Tables

TABLE 2.1: REPORTED SHOCKS AND EXTERNAL EVENTS BETWEEN 2010 AND 2012	21
TABLE 2.2: SUMMARY STATISTICS OF ASSET OWNERSHIP	23
TABLE 2.3: THE DISTRIBUTION OF THE COMPREHENSIVE ASSET INDEX BY SHOCK EXPERIENCE, HOUSEHOLD HEAD'S EDUCATION LEVEL, AND AGE	25
TABLE 2.4: IMPACT OF SHOCKS ON THE COMPREHENSIVE ASSET INDEX (FIXED EFFECTS ESTIMATES)	28
TABLE 2.5: IMPACT OF SHOCKS ON NATURAL, PHYSICAL, AND LIVESTOCK ASSETS (FIXED EFFECTS ESTIMATES)	31
LET US NOW TAKE A LOOK AT MORE SPECIFIC TYPES OF NONLAND PHYSICAL AND LIVESTOCK ASSETS. TABLE 2.6 PRESENTS THE RESULTS OF ESTIMATING EQUATION 3 SEPARATELY FOR CONSUMER DURABLES (COLUMNS 1 THROUGH 3), AGRICULTURAL TOOLS (COLUMNS 4 THROUGH 6), AND VEHICLES (COLUMNS 7 THROUGH 9) BY OWNERSHIP AS DEPENDENT VARIABLES. TABLE 2.7 REPORTS THE RESULTS FOR JEWELRY IN COLUMNS 1 THROUGH 3, FOR POULTRY IN COLUMNS 4 THROUGH 6, AND FOR CATTLE IN COLUMNS 7 THROUGH 9.	33
TABLE 2.6: IMPACT OF SHOCKS ON CONSUMER DURABLES, AGRICULTURAL TOOLS, AND VEHICLES (FIXED EFFECTS ESTIMATES)	34
TABLE 2.7: IMPACT OF SHOCKS ON JEWELRY, POULTRY, AND LIVESTOCK (FIXED EFFECTS ESTIMATES)	35
TABLE 2.8: THE IMPACT OF SHOCKS ON THE LOGARITHMIC VALUE OF LOANS TO BE PAID BACK (FIXED EFFECTS ESTIMATES)	37
TABLE 3.1: HOUSEHOLD PERCEPTIONS OF PRECIPITATION AND TEMPERATURE CHANGES OVER THE PAST 20 YEARS IN BANGLADESH	45
TABLE 3.2: CROP AND LIVESTOCK ADAPTATION STRATEGIES BY GENDER OF THE HOUSEHOLD HEAD IN BANGLADESH, 2010 AND 2012	47
TABLE 3.3: MAJOR CONSTRAINTS ON THE ADOPTION OF ADAPTIVE STRATEGIES FOR CROP AND LIVESTOCK PRODUCTION BY HOUSEHOLD HEAD GENDER IN BANGLADESH	48
TABLE 3.4: HOUSEHOLD COPING MECHANISMS FOR SHOCKS BY HOUSEHOLD HEAD GENDER IN BANGLADESH	49
TABLE 3.5: MARGINAL EFFECTS OF FARMER PERCEPTIONS OF CLIMATE CHANGE WITH GROUP PARTICIPATION IN BANGLADESH	54
TABLE 3.6: MULTIVARIATE PROBIT RESULTS FOR MARGINAL EFFECTS OF THE DETERMINANTS OF GROUP-BASED CROP PRODUCTION ADAPTATION STRATEGIES IN BANGLADESH, 2012	57
TABLE 3.7: DETERMINANTS OF HOUSEHOLD LIVESTOCK PRODUCTION ADAPTATION STRATEGIES WITH GROUP PARTICIPATION IN BANGLADESH, 2012	60
TABLE 3.8: MULTIVARIATE PROBIT MODEL RESULTS FOR CORRELATES OF HOUSEHOLD SHOCK COPING MECHANISMS BASED ON GROUP PARTICIPATION IN BANGLADESH, 2012	64
TABLE 4.1: GROUP MEMBERSHIP RATES OF HOUSEHOLD HEADS, THEIR SPOUSES, AND ANY HOUSEHOLD MEMBERS	74
TABLE 4.2: COSTS OF PARTICIPATION IN THE MOST IMPORTANT GROUP	75
TABLE 4.3: THE BENEFITS OF GROUP MEMBERSHIP	75
TABLE 4.4: PERCENTAGE OF HOUSEHOLDS AFFECTED BY DIFFERENT TYPES OF SHOCKS FROM 2006 TO 2010 REPORTED IN THE BASELINE WITH RESPECT TO THEIR YEAR OF JOINING IN GROUPS	76
TABLE 4.5: PERCENTAGE OF HOUSEHOLDS AFFECTED BY DIFFERENT TYPES OF SHOCKS FROM 2011 TO 2012 REPORTED IN THE RESURVEY ROUND WITH RESPECT TO THEIR YEAR OF JOINING IN GROUPS	77

TABLE 4.6: VALUES OF THE SOCIAL AND POLITICAL CAPITAL INDICES FOR HOUSEHOLD HEADS AND THEIR SPOUSES BY BINARY INDIVIDUAL AND HOUSEHOLD CHARACTERISTICS	79
TABLE 4.7: MARGINAL EFFECTS OF FACTORS ASSOCIATED WITH PARTICIPATION IN GROUPS BY GENDER	81
TABLE 4.8: MARGINAL EFFECTS OF FACTORS ASSOCIATED WITH HOUSEHOLD-LEVEL PARTICIPATION IN GROUPS BY GROUP TYPE	83
TABLE 4.9: AGGREGATE SOCIAL AND POLITICAL CAPITAL AND ECONOMIC WELL-BEING: OLS RESULTS	86
TABLE 4.10: THE FIRST STAGE	89
TABLE 4.11: AGGREGATE SOCIAL AND POLITICAL CAPITAL AND HOUSEHOLD WELFARE: IV RESULTS	91
TABLE 4.12: INFORMAL NETWORK AND HOUSEHOLD WELFARE: IV RESULTS	93
TABLE 4.13: AGGREGATE SOCIAL AND POLITICAL CAPITAL AND GENDER-DISAGGREGATED WELFARE	95
TABLE A2.1: TYPES OF ASSETS USED IN THE CONSTRUCTION OF THE PHYSICAL ASSET INDEX	113
TABLE A2.2: SUMMARY STATISTICS OF DISAGGREGATED PHYSICAL ASSET OWNERSHIP	114
TABLE A2.3: SUMMARY STATISTICS OF HOUSEHOLD CHARACTERISTICS	115
TABLE A2.4: THE IMPACT OF SHOCKS ON LAND, NON-LAND PHYSICAL, AND LIVESTOCK ASSETS (ORDINARY LEAST SQUARES ESTIMATES)	116
TABLE A2.5: THE IMPACT OF SHOCKS ON LAND, NON-LAND PHYSICAL, AND LIVESTOCK ASSETS (WEATHER SHOCKS REPORTED BY COMMUNITY, FIXED EFFECTS ESTIMATES)	117
TABLE A2.6: THE IMPACT OF SHOCKS ON MONETARY VALUES OF LAND, NON-LAND PHYSICAL, AND LIVESTOCK ASSETS (FIXED EFFECTS ESTIMATES)	118
TABLE A3.1: SAMPLE HOUSEHOLD SUMMARY STATISTICS	119
TABLE A3.2: FARMER PERCEPTIONS OF CLIMATE CHANGE BASED ON GROUP PARTICIPATION IN BANGLADESH	120
TABLE A3.3: FARMER PERCEPTIONS OF CLIMATE CHANGE BASED ON SOCIAL AND POLITICAL CAPITAL IN BANGLADESH	121
TABLE A3.4: FARMER PERCEPTIONS OF CLIMATE CHANGE BASED ON SOCIAL AND POLITICAL CAPITAL IN BANGLADESH (RESULTS OF SEEMINGLY UNRELATED BIPOBIT MODEL)	122
TABLE A3.5: MARGINAL EFFECTS ESTIMATED FOR DETERMINANTS OF HOUSEHOLD CROP ADAPTATION STRATEGIES IN BANGLADESH, 2012	123
TABLE A3.6: MARGINAL EFFECTS ESTIMATED FOR DETERMINANTS OF HOUSEHOLD CROP ADAPTATION STRATEGIES IN BANGLADESH, 2012 (RESULTS OF MULTIVARIATE PROBIT MODEL)	124
TABLE A3.7: MARGINAL EFFECTS ESTIMATED FROM PROBIT MODEL OF CORRELATES OF HOUSEHOLD LIVESTOCK PRODUCTION ADAPTATION STRATEGIES IN BANGLADESH, 2012	125
TABLE A3.8: MARGINAL EFFECTS ESTIMATED FROM PROBIT MODEL OF HOUSEHOLD COPING MECHANISM CORRELATES BASED ON GROUP PARTICIPATION IN BANGLADESH, 2012	126
TABLE A3.9: MARGINAL EFFECTS ESTIMATED FROM PROBIT MODEL FOR HOUSEHOLD COPING MECHANISM CORRELATES, BASED ON SOCIAL AND POLITICAL CAPITAL INDICES IN BANGLADESH, 2012	127
TABLE A3.10: MARGINAL EFFECTS ESTIMATED FROM THE MULTIVARIATE PROBIT MODEL FOR CORRELATES OF HOUSEHOLD SHOCK COPING MECHANISMS IN BANGLADESH, 2012	128
TABLE A4.1: HOUSEHOLD SUMMARY STATISTICS	129
TABLE A4.2: AGGREGATE SOCIAL AND POLITICAL CAPITAL AND THE ASSET INDEX: OLS AND IV RESULTS	130
TABLE A4.3: SOCIAL AND POLITICAL CAPITAL SEPARATELY AND HOUSEHOLD WELFARE: OLS RESULTS	131
TABLE A4.4: GROUP PARTICIPATION AND HOUSEHOLD WELFARE: OLS RESULTS	132
TABLE A4.5: INFORMAL NETWORK AND HOUSEHOLD WELFARE: OLS RESULTS	133
TABLE A4.6: SOCIAL AND POLITICAL CAPITAL SEPARATELY AND HOUSEHOLD WELFARE: IV RESULTS	134
TABLE A4.7: GROUP PARTICIPATION AND HOUSEHOLD WELFARE: IV RESULTS	135
TABLE A4.8: GROUP PARTICIPATION BY TYPES OF GROUP AND HOUSEHOLD WELFARE: IV RESULTS	136

## List of Figures

FIGURE 1.1 COVERAGE OF THE BANGLADESH CLIMATE CHANGE ADAPTATION SURVEY (BCAS) WITH RED DOTS  
INDICATING THE LOCATION OF THE STUDY SITES ADOPTED FROM THOMAS ET AL. (2013) .....9

## **LIST OF ABBREVIATIONS AND ACRONYMS**

AEZ	Agroecological Zone
BCAS	Bangladesh Center of Advanced Studies
DATA	Data Analysis and Technical Assistance Limited
FGD	Focus Group Discussion
GBA	Group Based Approaches
HH	Household
ICT	Information and Communication Technology
IFPRI	International Food Policy Research Institute
IIA	Independence of Irrelevant Alternatives
IPCC	Intergovernmental Panel on Climate Change
ISET	Institute for Social and Environmental Transition
IV	Instrumental Variable
MoEF	Ministry of Environment and Forest
NGOs	Nongovernmental Organizations
OLS	Ordinary Least Squares
PCA	Principal Component Analysis
TLU	Tropical Livestock Unit
ZEF	Zentrum für Entwicklungsforschung/ Center for Development Research

# CHAPTER 1. INTRODUCTION

## 1.1 Background

Assets are a form of stored wealth that can be liquidated for instant needs as well as provide services and generate cash returns and therefore are an important component of livelihood outcomes (Quisumbing et al. 2014). Assets support people's ability to withstand the negative effects of shocks, whether they are predictable or not. In developing countries poor households typically lack most forms of assets.<sup>1</sup> As a result, it is difficult for poor households to cope with the wide variety of shocks, such as climate change related phenomena that affect large numbers of people or other idiosyncratic shocks like illness, death, dowry expenses that often affect relatively smaller numbers of people or households (Dercon 2010). Shocks can severely affect income levels, assets, and other productive resources, especially among the poor who are forced to sell belongings to cope with the resulting impacts, potentially foregoing future spending on non-tangible assets like health care and education for children (Hoddinott and Quisumbing 2003; Hoddinott 2006). As a consequence large-scale climate change shocks may have devastating long-term impacts on households without or with less valuable assets.

As in many other developing countries, the adverse impacts of climate change are a growing concern in Bangladesh due to its geographic and demographic characteristics. The country has a high incidence of poverty. High population density in coastal areas, heavy reliance on agriculture, and significant expected negative impacts from increased inland flooding and rising sea-level, making Bangladesh a suitable case study for assessing vulnerability to climate change that deserves more attention. The increasing frequency of disastrous floods and droughts is associated with huge losses in terms of lives, livelihoods, and property. From 1991 to 2000 there were 93 major natural disasters recorded that caused billions of dollars in damages, especially to the agricultural sector (Yu et al. 2010). Living in a developing, densely populated,

---

<sup>1</sup> Assets can include natural, physical, financial, human, social, and political capital (Meinzen-Dick et al. 2011).

level landscape, the poor people of Bangladesh face severe risks due to the effects of climate change. For example, from July to September in 2007 a severe flood affected approximately 13 million people from 46 out of 64 districts in the country. In November of the same year the powerful cyclone 'Sidr' caused over 3,000 deaths (Yu et al. 2010). In addition, sea level rise is predicted to displace around 15 million people in Bangladesh, with important implications for sediment balance and salinity, which have important consequences on agricultural production in the country (IPCC 2001; Akter 2009; Yu et al. 2010).

Several studies have highlighted the importance of assets and found positive correlations between household assets and income diversification to cope with shocks (Reardon et al. 1992; Barrett et al. 2001; Ersado 2003). Households with more tangible and non-tangible assets have greater means of production, income diversification, greater ability to live in more secure areas (those that are less affected by floods or salinity) or that can reallocate labor to off-farm employment alternatives when crops fail or livestock perish. Households with minimal assets have fewer opportunities to engage in a variety of economic activities, and temporal shocks can have permanent adverse impacts on these households that lead to greater poverty (Dercon 2004; Carter and Barrett 2006; Brouwer et al. 2007). Many research efforts on asset-based approaches to development and poverty alleviation support the notion that control over assets plays a fundamental role in increasing income levels, empowering the poor, and reducing vulnerability (Moser 2007).

Control over assets within a household does not follow the traditional theoretical unitary model of single preference and pooling resources; but rather husbands and wives within household own or control assets either individually or jointly (Quisumbing 2011; Quisumbing et al. 2011). Therefore socioeconomic aspects such as gender inequality are important components of asset analyses. The failure to identify gender differentiated roles and inequalities hinders the development process in many areas, especially among agricultural based societies, as well as the development of effective policies for enhancing household welfare (World Bank 2009 cited in Quisumbing et al. 2014). Shocks may have gender-specific impacts depending on which household members are most affected and their relative ability to cope with and adapt to

shocks. Not only do women typically earn less than men in Bangladesh, female-headed households are among the poorest of the poor (Zeller et al. 2001). Gender specific levels of control over and ownership of assets, as well as roles and responsibilities, imply distinct effects of shocks from either climatic or health events among men and women. Consequently assets and well-being are affected according to gender, which may exacerbate existing inequalities (Brody et al. 2008; Quisumbing et al. 2011).

Awareness of climate change among farmers is necessary to confront the immediate and long-term effect of related shocks to the agricultural sector. Among those who are aware, some may not be able to adapt to related effects due to various obstacles. Responses to different types of shocks have diverse implications for household welfare over the short- and long-term (Dercon 2010). Adaptation is often considered a long-term strategy to minimize the detrimental effects of climate change related shocks through adjustments to systems (ecological, social, economic) in response to actual or predicted climatic shocks and their impacts (IPCC 2001). A number of literature sources have summarized different types of adaptation strategies among households that faced shocks, especially climate change related shocks such as flood, drought, and other covariate shocks such as price spikes (Morduch 1999; Dercon 2004; Mogues 2006; Nhemachena and Hassan 2007; Kumar and Quisumbing 2011).

As an immediate coping mechanism for shocks, households can either take 'consumption-smoothing' or 'asset-smoothing' strategies depending on their assets (Townsend 1995; Dercon 2004). The poor already lack assets and typically are reluctant to sell them except as a last resort, because it is often very difficult or even impossible for them to recover those assets afterwards (Duval et al. 2007). As a result poor households typically prefer asset-smoothing strategies such as reducing consumption (Mogues 2006). A large number of literature sources emphasize physical resources and socio-economic variables for determining climate change adaptation strategies among farmers, which vary according to the types and extent of shocks (Nhemachena and Hassan 2007; Bryan et al. 2009). Less emphasis has been given to short-term coping mechanisms and explicitly distinguishing between the two, which is important for improving related policy interventions in rural Bangladesh.



The ability of households or societies to adapt is determined not only by individual adaptation strategies and coping mechanisms, but also by the ability to act collectively. Group-based approaches can support individual efforts to build assets or improve access to benefits that are derived by specific groups. This increases the ability to adapt to shocks by sharing information and traditional knowledge and is important for livelihoods, especially for those who lack traditional types of assets such as physical or financial assets (Anderson et al. 2002; Meinzen-Dick et al. 2014). Quisumbing (2009) finds that participation in NGO initiated collective efforts are higher among women than men in Bangladesh, especially for wealthy women who live close to their parents' village, and have relatively large shares of household assets for marriage. Using country representative dataset, however, Sraboni et al. (2013) find that the most important indicator of female disempowerment is the lack of participation in groups and public speaking with limited access to resources and control over income relative to men, despite the large-scale microfinance initiatives and women's groups in Bangladesh.

## **1.2. Problem Statement and Study Objectives**

Bangladesh, where agriculture is the basis of livelihoods for a majority of rural people, is one of the countries most vulnerable to the adverse impacts of climate change and the agricultural sector in particular is most affected by related shocks. Assets have an important role in mitigating these impacts, and both assets and shocks have gender specific characteristics. Households cope with the shocks by adopting either asset-smoothing or consumption-smoothing strategies depending on whether they are asset poor or affluent with respect to tangible assets such as physical capital. While households may degrade their asset base by engaging in consumption-smoothing strategies, asset-smoothing strategies often have long-term negative impacts on intangible assets such as human and social capital, which ultimately has deleterious effects on welfare and future asset accumulation. As a result it is necessary to examine entire range of assets to reveal household and individual asset dynamics, behavioral patterns, and welfare impacts. In addition, observing and perceiving the long-term effects of

climate change among farmers is vital for taking appropriate precautions in response. For example, if long-term adaptation strategies are not adopted the impacts of climate change will be more severe, especially for an agriculture reliant country like Bangladesh. In addition to individual adaptation strategies, group based approaches to asset enhancement have important welfare impacts among rural agricultural households, where increasing recognition of social capital and group participation has been supported by a large number of empirical research efforts. Most of these efforts treat social capital as a household-level variable, while others control for the gender of the household head (Grootaert 1999, 2001; Narayan and Pritchett 1999; Aker 2005). Individual social and political capital is important to welfare, which cannot be measured merely by group participation, but rather requires evaluation of the various formal and informal components. Political capital, which is an important component of group-based approaches to capital development, is often overlooked by empirical studies that employ econometric analyses.

To address this problem, the specific objectives of this study are as follows:

1. To better understand gender specific asset dynamics or the degree of joint or individual ownership and control of assets by men and women and the impacts of exogenous shocks on different types of assets.
2. To investigate farmer perceptions of climate change, the factors associated with short-term coping mechanisms and long-term adaptation strategies, and the factors that impose constraints on these activities.
3. To assess the potential of group approaches to asset development for men and women, the contribution of such group efforts to household welfare in the presence of climate change shocks, and to identify determinants of participation in such groups.

### **1.3 Dissertation Structure**

Each of the dissertation chapters features econometric analyses of detailed longitudinal data. Chapter 1 provides a general introduction that includes the background and justification of the research, specific objectives, and the outline of the entire thesis. Chapter 2 features an examination of the impacts of different shocks on the asset portfolios of men and women both individually and jointly in Bangladesh. The impacts of covariate and idiosyncratic negative and positive shocks on assets, including natural capital, financial capital, livestock, and other forms of physical capital are examined. The analyses include both aggregated and disaggregated approaches by constructing an overall index for men and women, and for jointly owned assets of all categories using a principal component analysis (PCA).

For the disaggregated analyses physical capital other than land and livestock, natural capital, and livestock are analyzed. A household fixed effect asset model is developed that allows control for unobserved heterogeneity across households, which is important for observing effects within households. In addition to using a broad definition of assets and shocks, we focus on disaggregated asset ownership by gender and by asset types, which enabled us to identify asset substitution and preferences among men and women. Chapter 2 also includes the analysis of which type of ownership is most affected and which is relatively more secure in terms of risk from the effects of climate change.

Chapter 3 presents an assessment of the short-term coping mechanisms for climatic and other shocks, and long-term adaptation strategies for the effects of climate change in Bangladesh according to the gender of the household head. This analysis is meant to improve understanding of perceptions of climate change among farmers as a starting point. Consequently, the types of immediate and long-term farmer responses are analyzed using probit and multivariate probit methods to identify the factors affecting adoption decisions and to observe whether the responses are complementary or substitutive. Not all of the farmers who perceive the effects of climate change engage in adaptive actions and therefore the analysis also identifies constraining factors that hinder the adoption of adaptation strategies.

Chapter 4 presents the investigation of potential for group approaches for enhancing welfare and asset accumulation. This analysis began with identifying the determinants of participating groups, differentiated by types and the gender of participants. The costs and benefits of group participation are also discussed on the basis of the information derived from the data set, which is an important dimension of group membership. The main focus of the chapter is the examination of the welfare impacts at the individual level based on asset variables and at the household level based on both asset and consumption expenditure variables. This analysis included instrumental variables (IV) using a two-stage least squares approach for any reverse causality inherent in the relationship between dependent and independent variables. Chapter 5 presents the conclusions drawn from the analyses and a discussion of relevant policy suggestions in Bangladesh.

#### **1.4 Expected Research Contributions**

Even though entire households experience external events, the negative or positive effects of those events depend on who is affected by what type of shocks within families, which is an especially important consideration for the design and implementation of poverty alleviation programs. Although a growing number of literature sources have examined the impacts of shocks on household assets, very few have evaluated gender specific intra-household impacts of shocks in Bangladesh (Quisumbing 2011; Quisumbing et al. 2011). To design and implement effective policy measures, it is important to understand the impacts of shocks on assets of both men and women based on a broad definition of assets and major shocks that may affect households with country specific data. Asset analyses differentiated by gender facilitate greater understanding of the nexus between control over assets by men and women within households, which is essential for effective measures to enhance those assets. This research effort provides an opportunity to know more about which types of asset ownership will better help men and women withstand shocks, and will support the development of more target

oriented policy guidelines that are necessary for effective poverty alleviation programs in Bangladesh.

Identification of local specific options, the factors that influence coping mechanisms and adaptation strategies, and identifying the obstacles to adopting such efforts are preconditions of effective policy and have not been examined by previous studies, which is an expected contribution of this study. This is the first study in Bangladesh that explicitly distinguishes between short-term coping mechanisms and long-term adaptation strategies based on econometric analysis of empirical evidence, which is very important for identifying effective measures to enhance the appropriate coping and adaptation efforts that vary with the nature of shocks.

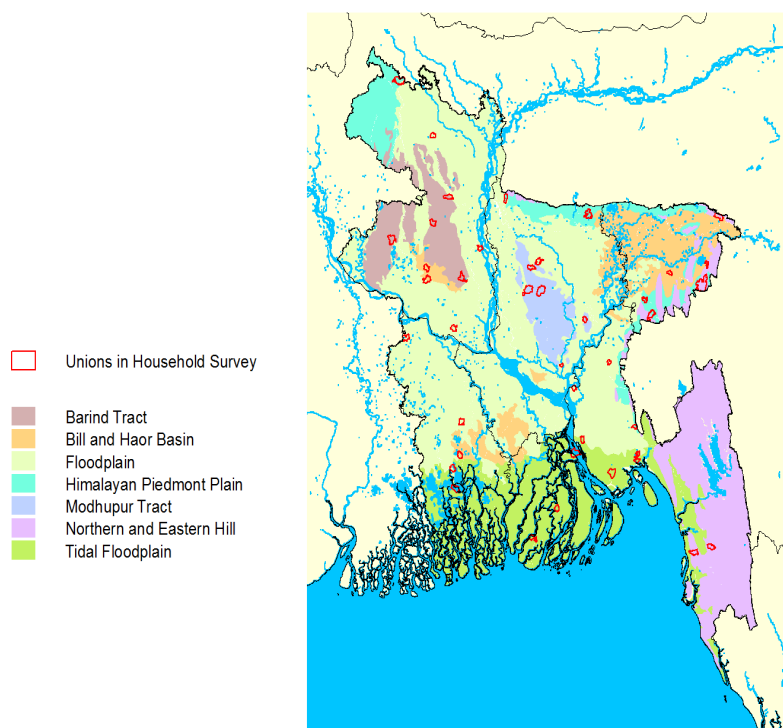
The research assesses the extent to which the group approaches can increase assets among both men and women and enhance welfare in the context of climate change and other non-climatic shocks. Men and women gain social capital either by participating in formal groups or by widening social networks, while the former is commonly captured as a measure of social capital in most of the existing literature, the latter is emphasized by very few papers, particularly on the basis of empirical evidence and the incorporation of gender issues. This research identifies the context-specific factors associated with group based approaches to asset enhancement under different aggregations, including: larger group attendance, greater social and political capital, and the possible impacts of not only formal group participation, but also through informal networks that effect household welfare. This provides a strong comparative analytical base to contribute to improved policy formulation and program design.

## **1.5 Data**

In 2010 a survey was conducted on 800 agricultural households in various unions (local administrative units) in Bangladesh. The International Food Policy Research Institute (IFPRI), and Data Analysis and Technical Assistance Limited (DATA), conducted the first round of the

survey in 2010 for the project, “The Economics of Adaptation to Climate Change in Bangladesh,” to study whether agricultural practices had changed due to climate change.<sup>2</sup>

The sample unions in this study were selected to represent the seven agro-ecological zones (AEZs) of Bangladesh as categorized by the Bangladesh Center for Advanced Studies (BCAS) as: the Barind Tract, Tidal Flood Plains, Modhupur Tract, Himalayan Piedmont Plain, the Bill and Haor Basins, the Northern and Eastern Hills, and the Floodplains (Figure 1.1).



**Figure 1.1 Coverage of the Bangladesh climate change adaptation survey (BCAS) with red dots indicating the location of the study sites adopted from Thomas et al. (2013)**

The study sample also covered all of the geopolitical divisions of Bangladesh: Dhaka, Chittagong, Khulna, Rajshahi, Sylhet, and Barisal. More unions were sampled in the larger AEZs. Twenty agricultural households were randomly selected in each sample union (from one village per union) for a total of 800 households surveyed. The survey data from 2010 was used as a

---

<sup>2</sup> DATA is a consultancy firm for large-scale household surveys and other research-related activities located in Dhaka, Bangladesh.

baseline and for constructing panel data in this study. In 2012, the Center for Development Research (ZEF) of the University of Bonn joined IFPRI and DATA to build on the initial round of the survey, known as the Bangladesh Climate Change Adaptation Survey, with a greater focus on gender and asset dynamics. We tried to track all the households including the split with an attrition rate of 2.66 percent.

In the analysis presented in the second chapter the sample was restricted to married, male-headed households according to intra-household analysis norms. Due to the lack of crucial information on livestock adaptation strategies, coping mechanisms, group participation, social and political capital details, and information on access to Information and Communication Technology (ICT) and training, etc., the follow-up survey data was used for the analysis of perception, adaptation, and coping correlates presented in Chapter 3. In Chapter 4 the analysis only included married, male-headed households in order to be comparable with other intra-household gender specific studies. The key dependent and independent variables examined in this study included different types of assets such as physical capital, livestock, natural capital, human capital, financial capital, social capital and political capital that were measured using values and indices, climatic and non-climatic shocks with both negative and positive impacts, individual and household characteristics, and access to services and facilities.

## CHAPTER 2. THE IMPACT OF SHOCKS ON GENDER-DIFFERENTIATED ASSET DYNAMICS IN BANGLADESH<sup>3</sup>

### 2.1. Introduction

An analysis of asset holdings is a crucial part of investigating household welfare as assets can be converted into cash for consumption if necessary, for example, to cope with shocks or as collateral in the credit market. Selling assets in response to shocks may push individuals into poverty in the long run, however, which is why exogenous shocks to assets may have long-lasting and even intergenerational effects for poor families (Dercon 2004). When financial assets such as credit, which are an important instrument to cope with severe covariate shocks, are limited, individuals sell their physical or natural assets (Dercon 2010). A good number of studies examine the interplay of asset dynamics and poverty traps in developing countries (for example, Dercon and Krishnan 2000; Carter and May 2001; Jalan and Ravallion 2002; Duflo and Udry 2004; Lybbert et al. 2004; Adato et al. 2006; Barrett et al. 2006; Carter and Barrett 2006; Carter et al. 2007; Quisumbing and Baulch 2009), but empirical research using longitudinal data on asset ownership at the intrahousehold level and the impact of shocks on asset holdings is limited (Quisumbing 2011; Quisumbing et al. 2011; Dillon and Quinones 2011), which is what this chapter contributes.

Men and women own and accumulate assets either individually or jointly, also when married (Antonopoulos and Floro 2005; Quisumbing 2011; Quisumbing et al. 2011), and draw down assets in different ways in response to shocks. Quisumbing et al. (2011), for example, find that floods have negative impacts on the land holdings of husbands, while droughts negatively affect their consumer and agricultural durable goods and the livestock of wives. Furthermore, women's assets in general are drawn down to cope with illnesses within the household. This is of particular importance as female control over assets and income positively affects household well-being, especially that of children (Duflo 2003; Qian 2008; Quisumbing and Maluccio 2003;

---

<sup>3</sup> This chapter of the thesis strongly builds on Rakib & Matz (2014).



Smith et al. 2003). Besides studying differentiated ownership of assets, an investigation of all types of assets, that is, financial, land, and nonland assets, is important to understand the comprehensive impact of shocks on assets, including possible substitution effects (Deere and Doss 2006).

Building on existing studies, this chapter adds to the understanding of the responsiveness of asset holdings to adverse external events by using unique panel data from Bangladesh, one of the countries most vulnerable to climate change due to its densely populated coastal areas and half of the population living below the poverty line. The data is unique in that it includes detailed information about shocks as well as ownership of assets, and allows to control for unobserved heterogeneity across households; that is, effects within rather than between households are investigated, which is particularly important in intrahousehold studies where bargaining power is a crucial factor, for example.

Furthermore, a relatively broad definition of assets is applied including financial assets such as credit and a comprehensive index including asset holdings of all types is constructed to see the overall effect on wealth, which is a contribution to the existing literature. The focus of the chapter, however, lies in identifying changes in disaggregated asset holdings, broken down by ownership in rural Bangladesh. We are thus able to study the impact on specific types of assets such as jewelry by ownership, which enables the identification of substitution effects within households.

The results suggest that men's and women's asset holdings respond differently depending on the type of shock. Shocks that occur due to climatic variability reduce the asset base of husbands in general, while negative nonweather shocks adversely affect both husbands' and wives' assets. In general, spouses aim to keep their jointly owned assets intact and draw them down only in response to predicted shocks such as seasonal droughts and dowry payments, which are classified as shocks in this research not because their occurrence is unexpected but because their timing and severity are. Livestock is used as a tool of coping, whereas land, husbands' vehicles, and agricultural tools appear important to agricultural production, which in

turn determines livelihoods of agriculture-dependent households, as households try to keep these goods in functioning condition.

The structure of the chapter is as follows: The next section outlines the existing literature that this study relates to. Section 2.3 describes the data and the construction of the comprehensive asset index and presents descriptive statistics. The empirical approach and the results are discussed in Section 2.4, and Section 2.5 concludes.

## **2.2 Relation to the Existing Literature**

As implied by the definition of poor people as those having low wealth and thus limited possibilities to smooth consumption or expenses, poor people are especially vulnerable to external events. Such an event, also called a shock, is defined as “a realization of the state of the world whose risk may or may not have been recognized beforehand” (Dercon 2010, 16), which means that it is an unanticipated event that may have positive or negative implications. To cope with negative shocks, especially the poor are often forced to sell tangible assets, which in turn leads to less investment in nontangible assets such as health, nutrition, and education, thereby possibly leading to long-term poverty (Hoddinott 2006; Hoddinott and Quisumbing 2003). Shocks may be covariate—that is, affecting a large number of individuals in a given locality at the same time, such as climatic shocks—or idiosyncratic—that is, affecting only a few individuals or households at a given time, such as an illness or death of a family member (Dercon 2010). An example of a positive idiosyncratic shock is the receipt of a dowry, an inheritance, or a remittance (Davis 2007; Quisumbing 2011; Quisumbing et al. 2011). Carter et al. (2007) divide shocks into asset and income shocks, depending on which of the two they affect. As examples of specific shocks that studies look at, Giesbert and Schindler (2010) investigate the effect of only droughts on short-term asset accumulation, and Kumar and Quisumbing (2011) study the effects of food price shocks on the consumption and poverty of female-headed households.

We investigate a large array of shocks in this dissertation—weather shocks such as floods, droughts, and cyclones; nonclimatic negative shocks such as death, illness, dowry, and wedding expenses; and positive shocks such as the receipt of an inheritance, a remittance, or a dowry—as qualitative studies on rural Bangladesh find that dowry payments, illness, and large household size are the three most important factors associated with poverty (Davis 2007, 2011b). While some of these negative shocks are anticipated, their timing and severity are unknown in advance, which still qualifies them as shocks. Take the example of dowry payments: even though parents in Bangladesh, as soon as a daughter is born, know that they will at some point have to pay a dowry, the timing and the amount of the dowry payment is unknown *ex ante*. Davis (2011b) also specifically argues that life-cycle events are crucial to be included when studying the interplay of asset dynamics and the economic well-being of households, and Quisumbing (2011) argues that wedding and dowry expenses are a type of shock due to the large amount of income lost at one point in time.<sup>4</sup>

With similar reasoning, one could claim that remittances, which are often large enough to affect the wealth of poor households, are to be expected when a child, especially a son, is born. However, only 18 percent of the households in the sample receive remittances, in most cases from children and from the Middle East. A possible explanation for the low incidence of remittances being sent is that the rural poor are unaware of the legal provisions related to international labor migration (Davis 2007). In addition, migrating is costly, difficult, and often illegal, which lowers the chances of the migrant being able to support his or her family on top of providing for him- or herself. It should also be noted that the households in the sample are in large part agricultural subsistence farmers for whom saving to pay for migration or weddings is unusual.

Assets are not only a measure of wealth but a more general indicator of well-being, according to Babbington (1999), and are categorized in different ways. Sherraden (1991), for instance, defines tangible assets as those that are owned legally while intangible assets are nonphysical

---

<sup>4</sup>Classifying dowry payments and other life-cycle events as shocks is disputable. Note that the results do not hinge on the inclusion of these shocks.

in nature and relate to social relationships. Among legally owned assets he includes financial assets, durable goods, property, production inputs, natural assets, copyrights, and patent rights (Nam et al. 2008; Kim and Kim 2013; Lau 2012). What this distinction misses is that tangible, or physical, assets may also be controlled without legal ownership, for example, in cases where land cannot be owned but use rights are issued. Examples of tangible assets are jewelry, appliances, shops, and vehicles, while net savings are nontangible and are classified as a financial asset according to Antonopoulos and Floro (2005). Further distinctions are made between productive assets, consumer durables, and assets that are used to secure livelihoods. Haveman and Wolff (2001; 2004) argue that vehicles should be excluded from an analysis of asset holdings as they constitute an essential source of income to owners.

Existing studies on intrahousehold asset accumulation and the dynamics of these asset holdings often use livestock and household capital (Dillon and Quinones 2011) or, more generally, land and nonland assets (Quisumbing 2011; Quisumbing et al. 2011). In a qualitative study on poverty dynamics, Davis (2011b) uses an even broader definition of assets. He includes productive assets, defined as nontradeable but income-generating assets and protective assets, which can be sold in times of distress. He further argues that some assets need investment and cannot be traded in a conventional way—for example, human and social capital—but that they are necessary to generate income and provide protection in times of need. Meinzen-Dick et al. (2011) is followed to categorize assets into natural capital, that is, land holdings; physical capital, which are measured either directly or with the help of an index made up of nonland assets and housing conditions; livestock holdings; and financial capital measured by outstanding credit, which allows investigating a comprehensive picture of asset holdings. A disaggregated investigation of assets by gender of the owner is important as assets are not equally distributed between men and women, who also differ in their ability to accumulate assets. The asset base of an individual depends on assets brought to marriage (Quisumbing and Maluccio 2003), and the ability to accumulate more assets further depends on marital status, religion, ethnicity, and inheritance and property rights. In more general terms, individuals with more assets are better able to accumulate further assets, which exacerbates existing inequalities (Lybbert et al. 2004). On the other hand, asset accumulation of the initially rich may slow down due to diminishing

returns, and the poor have a chance to catch up by initially forgoing some consumption and reinvesting (Zimmerman and Carter 2003; Deaton 1989). Especially for women the accumulation of assets is also context dependent; that is, social and traditional rules with respect to their participation in the labor force or inheritance are important determinants of women's wealth-generating potential.

Women store their wealth in the form of jewelry and shop assets in Thailand rather than in formal financial assets due to their lack of control over the latter, and men hold higher values of transportation assets (Antonopoulos and Floro 2005). Similarly and with the help of panel data covering a 10-year period in Bangladesh (1996–2006), Quisumbing (2011), comparing changes in asset portfolios between husband and wife, finds that the asset composition changes from poultry and livestock to other nonagricultural assets for wives, while jewelry remains their most important storage of value, and initial endowments of assets affect the ability to accumulate further assets and to cope with shocks according to Quisumbing and Baulch (2009). The impact of initial endowments is larger for men in the accumulation of livestock and household capital than for women, whose assets also grow less quickly in Nigeria. These differences were further exacerbated as livestock, a typically male asset, faced a high price rise, whereas household goods and jewelry, typically female assets, were subject to lower price increases (Dillon and Quinones 2011).

In one of the few empirical studies on intrahousehold gender-differentiated asset accumulation, Quisumbing (2011) finds complementarities between wives' human capital and husbands' natural capital when investigating longitudinal data including groups that were or were not subject to an intervention related to microcredit, allowances to support education, and the adoption of innovative agricultural technologies in Bangladesh. Possibly due to the involvement of nongovernmental organizations, female land ownership increased during the study period. The author, furthermore, finds that weather shocks reduce jointly owned assets, while death and illness reduce wives' agricultural tools, and dowries appear to be paid for with husbands' agricultural assets. Interesting to note, remittances lead to an increase in jointly owned consumer assets, whereas the receipt of dowry payments leads to a reduction in jointly

owned agricultural assets (Quisumbing 2011). In a related study, Quisumbing et al. (2011) find that remittances entail a diversification from agricultural to nonagricultural assets and that husbands' land holdings are negatively affected by floods, whereas those of wives suffer when dowries have to be paid. While these two studies are similar to this study, by using data that are representative of Bangladesh's AEZs, the results of this research being more generalizable. Specifically, these studies use data that were purposively collected to evaluate "microfinance, agricultural technologies, and educational transfers programs" (Quisumbing et al. 2011, 10) in a limited number of districts. Furthermore, the results cannot easily be extended to agricultural households without program interventions. Last, neither of the other papers covers cyclones, which have been the most devastating weather event in Bangladesh in recent decades and therefore deserve attention as well.

Ownership of one type of asset may facilitate access to another. For example, land is necessary as collateral for credit markets, which in turn opens up the market for inputs (Quisumbing 2011). Credit from commercial sources, however, also may lead to a loss of collateral due to high interest rates, while off-farm employment may generate income and thereby encourage land accumulation (Quisumbing and Baulch 2009). Thakur et al. (2009) find that credit encourages women to save, which enables coping with adverse effects of shocks and allows investment in income-generating activities. Family allowances, for example, old age pensions, allowances for children, food for education, and school stipends for female students, also have a positive effect on female economic well-being. Nevertheless, the fact that women take out credit does not necessarily imply that they are the ones controlling it. Microcredit programs in Bangladesh have been found to improve women's use of credit, which positively correlates with the occurrence of male-controlled, rather than female-regulated, microenterprises (Chowdhury 2009).

### 2.3. Data and Descriptive Statistics

A short-term representative household survey panel dataset is employed including various types of assets and shocks collected in 31 of Bangladesh's 64 districts, covering all divisions and all of the 7 AEZs.<sup>5</sup> Bangladesh's AEZs are characterized by different climates, which makes employing data from all over Bangladesh necessary when investigating the ability of households to deal with weather shocks in a representative manner. The Barind tract in the northwestern part of the country, for example, experiences seasonal droughts, which are less common in other AEZs, while the Flood plain and the Bill and haor basin are more prone to floods and the Tidal flood plain sees cyclones often relative to the rest of the country.

The 2012 questionnaire was specifically designed to capture the gender dimension of asset ownership. The 2010 questionnaire did not include the ownership information, so this information for the first round of the survey had to be collected retrospectively in 2012. To be specific, besides asking about the current owner of an asset in 2012, the questionnaire asked whether ownership had changed since 2010 and who was responsible if assets had been sold or consumed. Besides information about natural capital such as land, physical capital such as nonland assets and housing characteristics, and livestock, information about intangible assets such as social capital and the use of credit was gathered.

Regarding data on shocks, households were asked whether they had been affected (positively or negatively) by any weather shocks or other external events and to what extent. Furthermore, households as well as community leaders were interviewed about the extent of, for example, weather shocks in terms of what share of households in the community were affected. To ensure that idiosyncratic shocks were mentioned, households were asked whether they had experienced any surprises that led to sudden financial losses or gains, out of which the two with the highest absolute amounts are considered. Often-mentioned events leading to losses are dowry payments and wedding expenses as well as illnesses or deaths of family members, while

---

<sup>5</sup> The names of the seven AEZs categorized by the Bangladesh Center for Advanced Studies are Barind tract, Flood plain, Bill and haor basin, Modhupur tract, Northern and eastern hill, Tidal flood plain, and Himalayan Piedmont Plain (Thomas et al. 2013).

typically mentioned gains occur from the receipt of a remittance or inheritance.<sup>6</sup> Similar to gender-disaggregated asset ownership, data on idiosyncratic shocks were not gathered in the first round of the survey, so the 2012 round included questions about the past two years, that is, between the two rounds, and about the two years prior to the baseline interview.

To investigate the distribution of asset holdings between husband and wife, the sample is restricted to families in which both a household head and his spouse are present and unchanged in both survey rounds. Furthermore, female-headed households are excluded due to them possibly being very different from male-headed ones in terms of relative bargaining power, for example, leading to a final sample size of 678 households.

### 2.3.1. Constructing the Asset Index

An index as a comprehensive measure of all physical assets held is constructed. The types of assets included here are listed in Table A2.1 in the Appendix. The index is computed using the following:

$$C_{ijt} = \sum_{k=1}^K w_t^k a_{ijt}^k \quad (1)$$

for individual  $j$  in household  $i$  in time period  $t$  with capital  $C$  made up of type- $k$  assets  $a$  (Moser and Felton 2007). The choice of assets to be included is supported by both the Kaiser-Meyer-Olkin and Bartlett's test, and the weight  $w$  of each asset is based on a principal components analysis following Filmer and Pritchett (2001).<sup>7</sup> Note that assets that are owned by less than 3 percent or more than 97 percent of the sample are excluded. Furthermore, all indices are normalized, with larger values implying larger asset holdings. Besides this index for nonland

---

<sup>6</sup> Some households also mention scholarships given to girls, which come as a periodic inflow of cash from the government for the costs of school supplies, as positive income shocks. The monetary value of these grants is too small to affect a household's asset holdings, however, so these are not considered as a shock for the purposes of this study.

<sup>7</sup> Bartlett's test of sphericity helps to identify the factors used in a factor analysis by choosing those with eigenvalues greater than 1 (Chang et al. 2007). The Kaiser-Meyer-Olkin criterion measures the adequacy of included variables, and a value of 70 percent is sufficient for inclusion according to Kaiser (1974). The data yield a value of 75 percent.



physical assets including household durables and housing characteristics, a comprehensive index of asset holdings is constructed for which livestock and land are included through simple indicators for ownership.

### **2.3.2. Shocks**

Regarding data on shocks, household heads were asked whether their households had been affected (positively or negatively) by any shocks and to what extent. Furthermore, household heads as well as community leaders were interviewed about the extent of, for example, weather shocks in terms of what share of households in the community were affected. To ensure that idiosyncratic shocks, were mentioned, respondents were asked whether their households had experienced any surprises that led to sudden financial losses or gains, out of which we consider the two with the highest absolute amounts. Often-mentioned events leading to losses are dowry payments and wedding expenses as well as illnesses or deaths of family members, while typically mentioned gains occur from the receipt of a remittance or inheritance.<sup>8</sup> Similar to gender-disaggregated asset ownership, data on idiosyncratic shocks were not gathered in the first round of the survey so the 2012 round included questions on this about the past two years, that is, between the two rounds, and about the two years prior to the baseline interview.

Table 2.1 presents summary statistics on external events experienced by the households in our sample between the two survey rounds, grouped into weather shocks, other negative shocks, and positive shocks. Due to reporting bias being a possible concern (Quisumbing et al. 2011), we compare the incidence of weather shocks based on information from household and community reports, the latter being obtained from individuals knowing a community well such as

---

<sup>8</sup> Some households also mention scholarships given to girls, which come as a periodic inflow of cash from the government for the costs of school supplies, as positive income shocks. The monetary value of these grants is too small to affect a household's asset holdings, however, so we do not consider them as a shock for the purposes of this study.

administrative or traditional leaders or teachers.<sup>9</sup> We find that the difference in reporting is smaller the more severe a shock was and, generally, that the two are relatively similar. For example, 38 per cent of household heads report that they had been affected by floods, while the percentage of affected households was 32 per cent according to community leaders. The bottom of Table 2.1 reports incidences of idiosyncratic shocks. Similar to the findings of Quisumbing (2011) and Quisumbing et al. (2011), death and illness are more prevalent than wedding or dowry expenses. With respect to positive shocks, 20 per cent of households mention benefitting from remittances, while 4 per cent have received an inheritance or dowry.

**Table 2.1: Reported shocks and external events between 2010 and 2012**

	Mean	Std. dev.
<b>Weather shocks according to household reports</b>		
Proportion of households affected by flood	0.38	0.49
Proportion of households affected by drought	0.45	0.50
Proportion of households affected by cyclone or tornado	0.31	0.46
<b>Severe weather shocks according to community reports</b>		
Proportion of households affected by flood	0.32	0.47
Proportion of households affected by drought	0.52	0.50
Proportion of households affected by cyclone or tornado	0.29	0.46
<b>Non-climatic negative shocks</b>		
Proportion of households experiencing death or illness of any members	0.26	0.44
Proportion of households incurring dowry or wedding expenses	0.05	0.22
<b>Positive shocks or events</b>		
Proportion of households receiving remittances	0.20	0.40
Proportion of households receiving a dowry or inheritance	0.04	0.21

### 2.3.3. Asset Ownership

Summary statistics on land, livestock, credit, and physical asset (index) ownership by gender, on the other hand, are presented in Table 2.2, and descriptive statistics for specific types of non-

<sup>9</sup> Community leaders were asked whether a natural disaster had occurred and to assess its impact. If the impact was classified as “devastating”, “very serious” or “serious” we classified the event as a shock. If it was classified as “manageable” or “not [leading] to much damage”, we did not classify the event as a shock.

land physical assets presented in Table A2.2 in the appendix. Note that the construction of the asset index is presented in the appendix and that all monetary values used in this paper have been deflated to 2010 Bangladeshi Taka.<sup>10</sup> A general trend emanating from Tables 2.2 and A2.2 is that households were able to accumulate land, livestock, and non-land physical assets as measured by the composite index between the two survey rounds, even though the picture is less clear when the values of livestock and total asset holdings are used. While women hold less livestock measured in tropical livestock units (TLU) and physical assets exclusively or also jointly with their husbands than household heads exclusively, the most noticeable difference in ownership is apparent with respect to land holdings: land is to the largest part held exclusively by men in Bangladesh (96% of the total area of households' land is individually owned by household heads in our sample), which is rooted in tradition and religion. Even though Muslim law allows sons to inherit a larger share of land than daughters (Deere and Doss, 2006), daughters often forgo even their smaller share to continue a good relationship with their brothers (Quisumbing, 2011).<sup>11</sup> Furthermore, Hindu women are not permitted to inherit property from their fathers in Bangladesh (Jinnah, 2013; Aktar and Abdullah, 2007). Another factor making land ownership difficult for women is that men are often reluctant to give inherited land to their sisters as they are afraid of the land being split and their privacy being impeded on if the land is sold subsequently. They therefore prefer paying their sisters a lump sum instead of transferring the actual land (Rahman and van Schendel, 1997, cited in Arens, 2013).

---

<sup>10</sup> To be specific, all monetary values are deflated on the basis of an inflation rate of food and nonfood items that is calculated with the help of the included information about expenditure from the survey data. Furthermore, 1 US-Dollar corresponded to 81 Bangladeshi Taka in September 2012 (International Monetary Fund, 2012).

<sup>11</sup> Arens (2013), however, finds that there are incidences of Muslim women claiming land once both parents are deceased.

**Table 2.2: Summary statistics of asset ownership**

	N	Mean	Std. dev.	Minimum	Median	Maximum
<b>2010</b>						
Plot size in square meters (husband)	678	2,775	3,913.82	0	1,113	27,836
Plot size in square meters (wife)	678	34	309.92	0	0	4,693
Plot size in square meters (joint)	678	102	1,014.01	0	0	21,120
Livestock value in taka (husband)	678	15,360	30,328.21	0	1,275	455,200
Livestock value in taka (wife)	678	2,915	18,096.91	0	0	425,000
Livestock value in taka (joint)	678	1,277	7,493.40	0	0	83,500
Livestock in TLU (husband)	678	0.61	0.85	0	0.10	5.10
Livestock in TLU (wife)	678	0.34	0.72	0	0	7.90
Livestock in TLU (joint)	678	0.09	0.47	0	0	7.90
Total value of physical assets in taka (husband)	678	36,068	74,680.39	0	14,300	855,930
Total value of physical assets in taka (wife)	678	8,351	24,305.28	0	875	425,000
Total value of physical assets in taka (joint)	678	7,130	23,017.67	0	0	256,700
Physical asset index (husband)	678	0.19	0.12	0	0.17	1.00
Physical asset index (wife)	678	0.09	0.07	0	0.08	1.00
Physical asset index (joint)	678	0.20	0.15	0	0.2	1.00
Credit (husband)	678	11,548	66,514.34	0	0	1,275,000
Credit (wife)	678	5,157	26,682.01	0	0	595,000
Credit (joint)	678	5,980	24,929.63	0	0	391,000
<b>2012</b>						
Plot size in square meters (husband)	678	3,095	4,650.894	0	1,355	38,053
Plot size in square meters (wife)	678	40	338.23	0	0	4,855
Plot size in square meters (joint)	678	57	521.39	0	0	11,531
Livestock value in taka (husband)	678	16,856	29,026.51	0	1,700	287,900
Livestock value in taka (wife)	678	1,864	6,845.14	0	0	78,100
Livestock value in taka (joint)	678	1,136	7,907.05	0	0	150,000
Livestock in TLU (husband)	678	0.70	0.91	0	0.22	6.20
Livestock in TLU (wife)	678	0.38	0.73	0	0	4.06
Livestock in TLU (joint)	678	0.09	0.38	0	0	2.86
Total value of physical assets in taka (husband)	678	35,617	58,552.99	0	15,577	530,150
Total value of physical assets in taka (wife)	678	9,279	26,139.63	0	1,200	321,500
Total value of physical assets in taka (joint)	678	8,724	27,916.24	0	0	300,000
Physical asset index (husband)	678	0.25	0.15	0	0.22	1.00
Physical asset index (wife)	678	0.21	0.11	0	0.18	1.00
Physical asset index (joint)	678	0.20	0.14	0	0.18	1.00
Credit (husband)	678	4,913	15,037.25	0	0	148,750
Credit (wife)	678	6,096	26,037.77	0	0	425,000
Credit (joint)	678	6,792	25,835.53	0	0	382,500

Notes: TLU denotes tropical livestock units.

The difficulties of inheriting land for women also extend to the case of widow inheritance. Muslim law stipulates that widows should receive one-eighth of their deceased husband's land and that the rest should be distributed among their children (Jinnah, 2013). In practice, widows usually live in a son's household without owning land in their own names, however. Widows without offspring receive one-quarter of their husband's land, the rest is inherited by the brothers of the deceased (Jinnah, 2013).

Similarly to the data in Table 2.2, there are clear differences when assets are disaggregated as presented in Table A2.2: men generally hold more assets with the exception of jewellery, which is a female-owned asset traditionally. Furthermore, jewellery is an often jointly-held asset as well as, to some extent, consumer goods, while most productive assets are under exclusive male ownership. It should be noted that even though the value of women's non-land assets measured by the comprehensive asset index have increased between the survey rounds as displayed in Table 2.2, a large part of the monetary value of physical assets is still in the hands of husbands. Overall, non-land assets are more equally distributed than land, however.

#### **2.3.4. Household Characteristics**

Descriptive statistics of other household characteristics are presented in Table A2.3 in the appendix. Household heads have a mean age of 46 years during baseline data collection and less than 4 years of schooling. Households have, on average, five members and own 3,193 square meters of land with a value of 598,938 Taka in 2012 and non-land assets of 33,763 Taka. The size of land owned increased by 282 square meters, which is equivalent to 7 decimals, between survey rounds.<sup>12</sup> Livestock holdings are relatively small with a mean worth of 19,857 Taka or less than 1 tropical livestock unit, which is surprising considering that approximately two-thirds of male household members older than 15 years of age in our sample report agriculture as their

---

<sup>12</sup> Decimal is the common measurement of land size in Bangladesh; 1 decimal is equal to 40.46 square meters.

main occupation in 2010. Women, on the other hand, are focused on domestic work even though their involvement in off-farm activities increased between 2010 and 2012.

**Table 2.3: The distribution of the comprehensive asset index by shock experience, household head’s education level, and age**

	N	Husband		Wife		Joint	
		Mean	SD	Mean	SD	Mean	SD
<b>Experience of shocks</b>							
Experienced weather shocks	1,272	0.27	0.12	0.24	0.08	0.14	0.11
Not experienced weather shocks	84	0.28	0.12	0.24	0.07	0.14	0.13
Experienced negative shocks	413	0.26	0.12	0.24	0.06	0.14	0.11
Not experienced negative shocks	943	0.27	0.13	0.24	0.08	0.14	0.11
Experienced positive shocks	267	0.28	0.13	0.25	0.07	0.14	0.10
Not experienced positive shocks	1,089	0.26	0.12	0.24	0.08	0.14	0.11
<b>Years of schooling of household head</b>							
No education	582	0.25	0.11	0.23	0.06	0.12	0.10
Lower primary level (1 to 3 years)	157	0.25	0.11	0.23	0.06	0.14	0.10
Primary level (4 or 5 years)	233	0.25	0.12	0.24	0.08	0.14	0.09
Junior level (6 to 8 years)	149	0.29	0.14	0.25	0.06	0.15	0.12
Secondary level (9 or 10 years)	166	0.30	0.14	0.27	0.12	0.17	0.14
Higher secondary level (11 or 12 years)	31	0.34	0.13	0.25	0.05	0.17	0.13
More than 12 years	38	0.38	0.12	0.27	0.06	0.17	0.10
<b>Age of household head</b>							
Less than 25 years	26	0.22	0.10	0.21	0.09	0.13	0.09
26 to 35 years	273	0.26	0.12	0.24	0.08	0.15	0.13
36 to 45 years	353	0.26	0.13	0.24	0.09	0.13	0.10
46 to 55 years	333	0.27	0.12	0.24	0.07	0.14	0.11
56 to 65 years	245	0.28	0.12	0.24	0.09	0.14	0.11
66 to 70 years	61	0.28	0.15	0.22	0.06	0.14	0.09
More than 70 years	65	0.25	0.12	0.23	0.05	0.13	0.07

Table 2.3 presents gender-differentiated mean values of the comprehensive asset index including land, non-land, and livestock assets, by whether a shock has been experienced, by education, and by age of the household head. Negative shocks affect mainly the assets of husbands, while those of wives and those that are jointly owned appear to be protected. Experiencing positive shocks is associated with larger values of the index for both husbands and wives, however. It is interesting that more educated heads have more assets across all categories of ownership, while this association begins only above primary schooling. The picture is not as clear with respect to age of the household head. The data suggest that assets need to be accumulated first as very young households do not hold many assets but also suggest that

assets appear to be disposed of after a certain age, possibly due to sale or early bequests and older individuals living with their children rather than working with the assets themselves.

## 2.4. Empirical Approach

In this section we investigate the effects of different external events on the asset holdings of household heads, those of their wives, and those owned jointly. We move from a general measure to more specific measures of assets to exploit intra-household dynamics and substitution effects. Let us first consider a simple regression equation to be estimated using ordinary least squares and heteroskedasticity-robust standard errors:

$$A_{ijt} = \beta_0 + \mathbf{S}'_{it}\boldsymbol{\alpha} + \mathbf{X}'_{it}\boldsymbol{\delta} + \beta_1 Year2010_t + \mu_{ijt} , \quad (2)$$

where  $A$  denotes different measures of assets owned by individual  $j$  in household  $i$  at time  $t$ . To be specific, asset holdings are first measured by the comprehensive index of land, livestock, and non-land assets including housing characteristics to get an overall picture of the impact of shocks. Subsequently, we investigate the impact on land, on an index of non-land physical assets, and livestock separately. In addition, physical assets and livestock are further disaggregated. As a final measure, we look at financial assets, which we measure as the amount of loans taken out by the household that still need to be paid back due to our data unfortunately not including savings. The ability to borrow is indicative of financial assets as well, however, so we feel this exercise is informative in any case. Note that we run separate regressions for assets owned by the household head, by his wife, or jointly as denoted by  $j$ .

$\mathbf{S}$  denotes a vector of shocks including binary variables for having experienced weather shocks and other negative or positive shocks.  $Year2010$  is a binary variable that takes a value of 1 for observations from the 2010 survey round and 0 for observations from 2012,  $\mu$  is an error term.  $\mathbf{X}$  is a vector of household characteristics including the age of the household head, household

size, the male-to-female ratio, the dependency ratio, and education of the household head.<sup>13</sup> It may, however, be the case that there are unobserved characteristics of households that go hand in hand with both the exposure to shocks and asset holdings, which the naïve estimation strategy outlined in equation 2 does not account for. The advantage of having panel data is that we are able to control for this time-invariant unobserved heterogeneity across households by including household fixed effects:

$$A_{ijt} = \mathbf{S}'_{it}\boldsymbol{\alpha} + \mathbf{X}'_{it}\boldsymbol{\delta} + \theta_i + \mu_{ijt} , \quad (3)$$

which yields our main empirical strategy. Parameter  $\theta$  represents the inclusion of household fixed effects which control for characteristics of a household that do not change over time, that is, we investigate changes within households over time, rather than computing average effects generated by differences between households. It should be noted, however, that we can no longer estimate the effect of time-invariant household characteristics such as education of the household head in this case. Furthermore, due to the possibility of the error variances not being independent within households, we estimate all our results including household fixed effects with heteroskedasticity-robust standard errors clustered at the household level.

#### **2.4.1. The Impact of Shocks on Comprehensive Asset Holdings**

The results of estimating equation 3 for the comprehensive asset index including land, nonland, and livestock assets are presented in Table 2.4. The effect on the assets of household heads is displayed in column 1, the effect on those of spouses in column 2, and the effect on the index of jointly owned assets in column 3.

Surprisingly, having experienced a flood is not associated with overall asset holdings in a statistically significant way, and experiencing a drought is related to the asset holdings of wives

---

<sup>13</sup> We do not include binary measures for the use of credit or extension agents due to the possibility of simultaneity bias. Note that the results are robust to the inclusion of these variables, however.



in a positive way. The latter is partly explained with the low involvement of women in agriculture, which leads to their owning assets that are not affected by weather events. A cyclone and dowry payments reduce the asset holdings of household heads, while death and illness lead to spouses disposing of their individually owned assets, which is in line with Quisumbing et al. (2011). Interestingly, jointly owned assets appear not to be very responsive to shocks with all coefficients being statistically insignificant.

**Table 2.4: Impact of shocks on the comprehensive asset index (fixed effects estimates)**

	Comprehensive Asset Index		
	Husband (1)	Wife (2)	Joint (3)
Flood	-0.007 (0.010)	0.005 (0.005)	-0.001 (0.009)
Drought	0.015 (0.010)	0.017*** (0.006)	0.010 (0.008)
Cyclone	-0.033*** (0.009)	0.005 (0.006)	0.003 (0.010)
Death/illness	-0.008 (0.006)	-0.008** (0.004)	0.000 (0.006)
Dowry payment	-0.020* (0.011)	0.008 (0.010)	-0.001 (0.019)
Remittance	0.020** (0.008)	0.006 (0.005)	-0.001 (0.007)
Inheritance/dowry receipt	0.006 (0.015)	-0.000 (0.010)	0.000 (0.011)
Age of household head	-0.001** (0.000)	0.001* (0.001)	-0.002* (0.001)
Household size	-0.001 (0.004)	0.000 (0.002)	0.000 (0.004)
Male-to-female ratio	-0.015** (0.008)	-0.003 (0.005)	0.007 (0.007)
Dependency ratio	-0.088*** (0.032)	-0.002 (0.022)	-0.004 (0.032)
Household fixed effects	Yes	Yes	Yes
R-squared	0.079	0.032	0.018
N	1,356	1,356	1,356

Notes: Standard errors are clustered at the household level and are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.

The fact that dowry payments affect the asset base of only the household head is not surprising and in line with Quisumbing (2011), considering that the payment of wedding costs is the obligation of the father of the bride traditionally. Davis (2011a) states that poor people in Bangladesh may need to put a mortgage on their land or sell livestock to pay for dowries and

wedding expenses, and Quisumbing et al. (2011) also find that land and livestock of wives are drawn down to meet these expenses, which illustrates the immense financial burden of the tradition.

The results on death and illness are partly in line with Quisumbing (2011), who finds that death and illness affect land and nonland assets of household heads negatively and that there are mixed effects for land and nonland assets of their spouses, and with Quisumbing et al. (2011), who find that the consumer durables and nonagricultural assets of household heads, and the land and jewelry of their wives, are drawn down to cope with death and illness. We find remittances to increase only male assets and no statistically significant coefficient for the receipt of dowries or an inheritance.

The magnitude of the coefficients is not straightforward to interpret due to the dependent variable being a normalized index, but it should be noted that the effects are of a meaningful size in comparison to the means of the indices. To be precise, the coefficients on the variables for shocks range between 0.008 and 0.033 in absolute size conditional on statistical significance, and the means of the comprehensive asset index between 0.09 and 0.21 so the former are indicative of economically significant effects of shocks on asset holdings.

The low coefficient of determination (R-squared) is likely to be due to the omission of variables relevant to asset creation, for example education, and due to the fact that we aim to explain wealth as a function of demographic and socio-economic characteristics. We are unable to control for factors such as income, however, because of difficulties of measuring it in this rural setting and because of questionable data quality in case information is reported.

#### **2.4.2. The Impact of Shocks on Natural, Physical, and Livestock Assets**

Let us investigate asset holdings in more detail. Table 2.5 presents the results of the main results, that is, of estimating equation 3 separately for land, nonland physical, and livestock

assets by ownership. Land holdings, the dependent variable in columns 1 through 3, are measured as the logarithmic value of plot size in square meters. Nonland physical assets in columns 4 through 6 are represented by an index, and livestock in columns 7 through 9 are measured in TLUs.

While floods appear to reduce female-owned livestock, droughts, which can to some extent be predicted due to seasonality to negatively affect female-owned non-land physical assets. Furthermore, cyclones are associated with larger husband-owned and jointly owned land holdings, which is surprising, and with a reduction in the physical assets of household heads. While non-land physical assets are likely to be drawn down to cope with unexpected weather shocks, land is an asset with low liquidity that is also difficult to re-accumulate once sold, which may explain that land holdings are not negatively associated with the experience of unexpected and adverse weather events in contrast to Quisumbing et al. (2011).

Interestingly, the receipt of remittances yields a statistically significant and negative coefficient for land holdings of household heads. A possible explanation lies in migration and its high costs. Firstly, this variable may be picking up the effect of migration rather than remittances but, unfortunately, we are unable to control for migration in the estimation apart from migration between survey rounds due to neither of the questionnaires asking for household members having migrated.<sup>14</sup> Secondly, household heads may sell part of their land to facilitate migration of themselves or one of their children, for which the household receives remittances in return (Davis, 2007) so causality may run in the opposite direction. The positive effect of remittances on livestock and other physical assets of spouses is likely to be driven by cases wherein remittances are specifically sent to the wife of the household head (possibly even by himself), who invests in exclusively owned assets.

---

<sup>14</sup> To be specific, we can only observe migration if household members have left between the two survey rounds. While we are able to tell whether these individuals have left for purposes of employment, the fraction of households in which this has happened is very small with 2.95%. For this reason and due to the fact that remittances are relatively unlikely to be sent after recent migration (the correlation between a household having received remittances and a member having migrated is virtually zero in our data), we are unable to include a variable for migration in the estimation in order to net out its effect from that of the receipt of remittances.

**Table 2.5: Impact of shocks on natural, physical, and livestock assets (fixed effects estimates)**

	Land (square meters)			Physical assets (index)			Livestock (TLU)		
	Husband	Wife	Joint	Husband	Wife	Joint	Husband	Wife	Joint
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Flood	-0.025 (0.343)	-0.096 (0.074)	0.266 (0.170)	-0.016 (0.012)	-0.008 (0.011)	-0.003 (0.009)	-0.089 (0.067)	-0.142* (0.085)	-0.043 (0.042)
Drought	0.229 (0.297)	-0.039 (0.081)	0.154 (0.187)	-0.018 (0.012)	-0.024** (0.010)	-0.013 (0.009)	-0.086 (0.072)	0.079 (0.067)	0.045 (0.035)
Cyclone	0.598** (0.278)	-0.132 (0.089)	0.352* (0.183)	-0.023** (0.011)	0.004 (0.010)	0.003 (0.008)	0.065 (0.069)	0.010 (0.072)	-0.040 (0.040)
Death/illness	-0.019 (0.239)	0.058 (0.075)	0.054 (0.100)	-0.005 (0.007)	0.008 (0.009)	0.009* (0.005)	-0.003 (0.042)	-0.011 (0.041)	-0.006 (0.023)
Dowry payment	-0.403 (0.592)	-0.007 (0.042)	-0.005 (0.183)	-0.002 (0.016)	0.001 (0.016)	0.003 (0.010)	-0.166 (0.110)	-0.053 (0.125)	-0.121** (0.057)
Remittance	-0.918*** (0.278)	0.013 (0.083)	-0.283** (0.126)	0.011 (0.009)	0.022** (0.011)	-0.001 (0.005)	0.052 (0.061)	0.141** (0.067)	0.024 (0.025)
Inheritance/dowry receipt	1.121** (0.524)	-0.174 (0.218)	0.018 (0.182)	-0.029 (0.018)	0.000 (0.017)	0.018* (0.010)	0.122 (0.104)	0.004 (0.113)	0.023 (0.023)
Age of household head	-0.014 (0.022)	0.005 (0.012)	0.004 (0.009)	0.004*** (0.001)	0.008*** (0.002)	-0.001** (0.001)	0.007** (0.003)	-0.001 (0.003)	-0.002 (0.002)
Household size	-0.108 (0.133)	0.043 (0.039)	-0.019 (0.078)	-0.001 (0.004)	-0.010** (0.005)	0.006** (0.003)	0.007 (0.030)	-0.009 (0.033)	0.000 (0.019)
Male-to-female ratio	0.223 (0.280)	-0.069 (0.053)	0.237 (0.198)	0.001 (0.009)	0.012 (0.011)	0.005 (0.006)	0.040 (0.070)	-0.048 (0.071)	0.027 (0.032)
Dependency ratio	0.787 (1.230)	-0.043 (0.286)	0.010 (0.482)	-0.037 (0.033)	0.001 (0.041)	-0.007 (0.024)	-0.441* (0.230)	-0.369* (0.192)	-0.055 (0.131)
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.031	0.011	0.026	0.062	0.013	0.030	0.023	0.030	0.018
N	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356

Notes: Standard errors are clustered at the household level and are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.

Having to pay for a dowry reduces jointly owned livestock, which is traditionally acquired in advance specifically for the purpose of selling it to pay for the wedding expenses of daughters. Deere and Doss (2006) argue that livestock is relatively easy to sell and Davis and Ali (2014) also find evidence in support of livestock asset liquidation in response to adverse external events. The receipt of an inheritance or dowry yields mixed results: the positive effect on the land holdings of household heads is reasonable due to the practice of sons inheriting land, as explained above. A similar reasoning applies to the positive association with jointly owned other physical assets. We find that death/illness within the household is positively and statistically significantly associated with jointly-held non-land physical assets which is initially surprising. An

explanation may be that some of the deceased's wealth is transferred to the household without being entirely captured in the effect of receiving an inheritance.

In general, it should be noted that jointly held assets are less affected by unexpected events than individually owned assets and rather used to cope with shocks that can be predicted to a certain degree such as seasonal droughts and paying for dowries. It may be that assets owned by both the household head and his wife are protected compared to individually owned ones or that it is simply difficult for spouses to agree on selling jointly owned assets. With respect to household characteristics, our main results, in which we control for the unobserved heterogeneity across households, suggest that age of the household head is mostly positively, and a high dependency ratio negatively related to asset holdings in general.

We verify the robustness of our main results in several sensitivity checks. First, we compare Table 2.5 to the results of estimating equation 2, that is, the ordinary least squares specification whose results are presented in Table A2.4 in the appendix. They suggest that, if an external event yields a statistically significant coefficient, they are positive, even for shocks such as droughts, floods, and cyclones, which may be explained partly by emergency relief in the aftermath of severe covariate shocks. The inconsistency in coefficients in terms of sign and statistical significance compared to our main results suggests that unobserved heterogeneity across households plays a role and, thus, that using household fixed effects is plausible.

Furthermore, while the variables for the exposure to external events are self-reported by households throughout the paper, we also use community reports on weather-related shocks. The results are presented in Table A2.5 in the appendix and largely support the main results with respect to the effects of idiosyncratic and still self-reported shocks such as death and illness, dowry payments, and positive events such as the receipt of remittances, an inheritance, or dowries. When it comes to covariate shocks, the effects of shocks reported by the community are only partly supportive of our main results and stronger in terms of statistical significance, most likely due to community officials being aware only of events affecting a large number of households, which probably implies that the shocks and its consequences are severe.

Table A2.6 in the appendix presents another sensitivity check in which we use the logarithmic value of the self-reported monetary values of the three categories of assets as dependent variables rather than plot size for land, the index for physical non-land assets, and TLU for livestock. The main results in Table 2.5 are well-supported for land holdings, but only partly so for non-land assets and livestock, which may be due to the index for non-land physical assets and the measurement in TLU being relatively crude compared to the values of assets. Irrespective of these shortcomings, Table A2.6 allows us to compare effects across different categories of assets. A cyclone, for example, is associated with an increase in the value of jointly-held land holdings by 96.6%, but with a reduction in non-land physical assets and livestock by 30.3% and 32.4%, respectively.<sup>15</sup>

### **2.4.3. The Impact of Shocks on Disaggregated Physical Assets**

Let us now take a look at more specific types of nonland physical and livestock assets. Table 2.6 presents the results of estimating equation 3 separately for consumer durables (columns 1 through 3), agricultural tools (columns 4 through 6), and vehicles (columns 7 through 9) by ownership as dependent variables. Table 2.7 reports the results for jewelry in columns 1 through 3, for poultry in columns 4 through 6, and for cattle in columns 7 through 9.

---

<sup>15</sup> Note that this is not directly given by the coefficient on the variable denoting the occurrence of a shock as the latter is binary and the outcome in logarithmic terms. Please see, for example, Halvorsen and Palmquist (1980) for an explanation of how to interpret coefficients such as these.

**Table 2.6: Impact of shocks on consumer durables, agricultural tools, and vehicles (fixed effects estimates)**

	Log(value of consumer durables)			Log(value of agricultural tools)			Log(value of vehicles)		
	Husband	Wife	Joint	Husband	Wife	Joint	Husband	Wife	Joint
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Flood	-0.319 (0.307)	-0.088 (0.233)	0.003 (0.182)	-0.383 (0.323)	0.325 (0.218)	0.191 (0.165)	0.417 (0.292)	0.068 (0.094)	-0.205 (0.143)
Drought	0.219 (0.249)	-0.395** (0.200)	0.168 (0.147)	0.263 (0.319)	-0.069 (0.203)	-0.055 (0.139)	0.252 (0.276)	-0.394*** (0.150)	-0.131 (0.165)
Cyclone	-0.871*** (0.289)	0.236 (0.195)	-0.122 (0.166)	-0.187 (0.285)	0.597*** (0.220)	0.252* (0.145)	-0.284 (0.288)	0.016 (0.123)	-0.236 (0.156)
Death/illness	0.304 (0.192)	-0.061 (0.158)	0.121 (0.124)	-0.205 (0.214)	0.085 (0.141)	0.072 (0.092)	0.053 (0.220)	0.085 (0.103)	-0.104 (0.086)
Dowry payment	-0.191 (0.395)	0.388 (0.330)	-0.091 (0.328)	0.283 (0.474)	-0.023 (0.389)	-0.119 (0.214)	0.400 (0.480)	-0.474* (0.264)	0.219 (0.251)
Remittance	0.681*** (0.205)	-0.650*** (0.193)	-0.080 (0.165)	1.487*** (0.267)	-0.389** (0.184)	-0.201** (0.094)	0.406 (0.278)	-0.023 (0.122)	-0.175* (0.096)
Inheritance/dowry receipt	0.057 (0.368)	0.113 (0.374)	0.302 (0.322)	-0.579 (0.501)	0.430 (0.375)	0.042 (0.126)	0.762 (0.500)	0.217 (0.142)	-0.173 (0.166)
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.057	0.041	0.017	0.075	0.032	0.038	0.023	0.031	0.026
N	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356

Notes: The specification includes the same control variables as those reported in Tables 2.5 and 2.6. Standard errors are clustered at the household level and are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.

The most interesting result is that the finding from Table 2.5 that cyclones are associated with a decrease in non-land physical assets of household heads is supported and enriched in Table 2.7: the reduction in physical assets is driven by drawing down consumer durables, while household heads protect their agricultural tools and vehicles, possibly due to their role in income generation of rural families. To be specific, a cyclone is associated with a reduction in the value of consumer durables by 58.1% but not with agricultural tools or vehicles of household heads in a statistically significant way. It should be noted, however, that vehicles owned by the spouse are drawn down to cope with droughts and dowry expenses, which is in line with Davis (2011a, b) who finds that dowry expenses in Bangladesh are often paid by parents selling (productive) assets such as livestock, rickshaws, land, household durables, and jewellery, which pushes them even deeper into poverty. The positive effects of covariate shocks found here are most likely due to aid programs as mentioned above.

**Table 2.7: Impact of shocks on jewelry, poultry, and livestock (fixed effects estimates)**

Type of shock	Log(value of jewellery)			Log(value of poultry)			Log(value of cattle)		
	Husband (1)	Wife (2)	Joint (3)	Husband (4)	Wife (5)	Joint (6)	Husband (7)	Wife (8)	Joint (9)
Flood	-0.049 (0.410)	-0.063 (0.385)	-0.343 (0.334)	-0.149 (0.398)	-0.655* (0.365)	-0.031 (0.137)	-1.488*** (0.454)	0.610** (0.276)	0.198 (0.228)
Drought	-0.961** (0.382)	1.434*** (0.380)	0.101 (0.288)	-1.209*** (0.365)	0.833** (0.347)	0.407*** (0.145)	0.206 (0.426)	0.427* (0.231)	0.320 (0.212)
Cyclone	0.256 (0.356)	-0.849** (0.364)	-0.316 (0.308)	0.003 (0.377)	-0.976*** (0.333)	-0.274* (0.154)	-0.264 (0.410)	-0.085 (0.243)	-0.224 (0.184)
Death/illness	0.169 (0.266)	0.041 (0.296)	0.046 (0.216)	0.029 (0.259)	-0.265 (0.260)	0.099 (0.107)	-0.196 (0.332)	-0.097 (0.204)	-0.071 (0.111)
Dowry payment	0.396 (0.584)	-0.896 (0.598)	-0.330 (0.568)	0.179 (0.529)	-0.146 (0.611)	-0.357* (0.198)	-0.942 (0.749)	0.497 (0.472)	-0.094 (0.249)
Remittance	-0.894*** (0.334)	1.824*** (0.349)	0.588** (0.257)	-0.778** (0.307)	1.468*** (0.316)	0.119 (0.127)	0.121 (0.382)	0.247 (0.236)	0.280** (0.130)
Inheritance/dowry receipt	0.237 (0.567)	-1.260** (0.622)	-0.123 (0.406)	-0.228 (0.530)	-0.702 (0.617)	0.082 (0.135)	0.808 (0.743)	-0.426 (0.421)	-0.014 (0.149)
Household effects	fixed Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.041	0.111	0.021	0.044	0.087	0.038	0.029	0.016	0.025
N	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356

Notes: The specification includes the same control variables as those reported in Tables 2.5 and 2.6. Standard errors are clustered at the household level and are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.

When looking at Tables 2.6 and 2.7 in conjunction, it is obvious that remittances impact on assets positively and negatively depending on the type of asset. Spouses of household heads appear to use remittances to accumulate jewellery and poultry instead of consumer goods and agricultural tools, while the case is reversed for household heads. While the explanation for the negative association between remittances and land holdings of the household head found in Table 2.5 is likely to be grounded on their liquidation to finance migration, the motivation for the different strategies presented here may lie in differences of bargaining power and of characteristics of the remittance-sending process: women prefer investing in assets that obviously belong to them (also for the case of the possibly migrated household head sending the remittances returns) due to less control over other assets of the family, while men staying in the household and receiving remittances, for example from migrated children, may generally have more bargaining power to protect their assets and invest to improve the economic well-being of the whole family.



Surprisingly, the receipt of an inheritance or dowry is associated with a decrease in jewellery owned by the wife of the household head by 71.6% as displayed in column 2 of Table 2.7, which is probably due to the spouse of the household head also transferring some of her jewellery to her daughters(-in-law). Another interesting finding from Table 2.7 is that poultry of spouses is drawn down in response to floods and cyclones, while poultry of household heads is reduced in association with droughts, which are positively related to the jewellery and cattle of wives, possibly due to the accumulation of these as an ex ante coping strategy as droughts can partly be predicted due to seasonality. And even though the cattle holdings of household heads decrease by 77.4% in response to a flood, this is possibly not because of sales to cope with the shock but because of animals not being able to survive such a covariate shock, which is partly in line with Quisumbing et al. (2011) who argue that the livestock of wives is relatively strongly affected by droughts and the associated lack of water and feedstuff in Bangladesh. In accordance with our main findings in Table 2.5, dowry and wedding expenses appear to be paid for with jointly owned poultry, and households generally appear to prefer keeping larger livestock, which may also play a role in agriculture, and rather sell smaller animals. In conclusion, the picture emerging from Table 2.5 is supported: weather shocks are generally negatively associated with physical assets held individually by household heads and their spouses.

#### **2.4.4. The Impact of Shocks on Financial Capital**

Financial capital is an important means of coping with unexpected external events, but measuring it is difficult, especially if saving is not part of the data as in our case. Even though the ability to borrow and the amount of credit to be paid back depend on other assets serving as collateral and most likely a minimum level of education, it is the best measure we have for financial capital. Table 2.8 reports the results of estimating equation 3 for the log of amount of money borrowed that still needs to be paid back as the dependent variable.

**Table 2.8: The impact of shocks on the logarithmic value of loans to be paid back (fixed effects estimates)**

Explanatory variables	Husband (1)	Wife (2)	Joint (3)
Flood	-0.577 (0.523)	0.641 (0.490)	-0.729 (0.492)
Drought	1.038** (0.486)	0.252 (0.482)	1.374*** (0.473)
Cyclone	-2.053*** (0.525)	-1.973*** (0.464)	-1.578*** (0.518)
Death/illness	0.094 (0.369)	0.181 (0.341)	0.073 (0.358)
Dowry payment	0.459 (0.879)	-0.743 (0.781)	1.190 (0.904)
Remittance	1.854*** (0.463)	0.905** (0.434)	2.522*** (0.479)
Inheritance/dowry receipt	-0.708 (0.773)	0.811 (0.884)	0.271 (0.752)
Age of household head	-0.016 (0.025)	0.020 (0.024)	0.042 (0.034)
Household size	0.108 (0.250)	-0.461** (0.210)	0.265 (0.261)
Male-to-female ratio	-0.575 (0.429)	-0.987** (0.394)	-0.580 (0.450)
Dependency ratio	-2.427 (1.679)	-1.615 (1.546)	-1.070 (1.627)
Household fixed effects	Yes	Yes	Yes
R-squared	0.087	0.082	0.113
N	1,356	1,356	1,356

Notes: Standard errors are clustered at the household level and are given in parentheses.

\*\*p < .05. \*\*\*p < .01.

The two most striking results of Table 2.8 are: cyclones are associated with lower outstanding credit, and the opposite is true for receiving remittances. Even though both of these findings appear surprising at first, they are possibly both rooted in less or more collateral being available when applying for a loan, respectively. An alternative explanation is that loans may be used to finance migration associated with remittances and that disaster relief after severe covariate shocks is effective enough for borrowing not to be necessary. Spouses of household heads are found to borrow less in families that are bigger and have a relatively high share of male members, possibly due to income diversification.

## 2.5. Conclusions

Asset holdings as well as strategies to cope with external events differ depending on whether the household head or his wife is concerned, even when a shock affects the whole household. With respect to asset holdings and in line with the existing literature, we find men to hold more assets than their spouses in general and especially with respect to land, while jewellery is traditionally a female-owned asset.

To investigate the effects of external events, we initially look at a comprehensive measure of asset holdings differentiated by who owns them; we subsequently disaggregate assets into land, non-land physical, and livestock assets; and finally disaggregate them into specific types of the latter two categories. The overall picture that emerges is that household heads' physical assets are negatively affected by unexpected weather events, particularly by cyclones, and that assets owned by the spouses are drawn down to cope with the death or illness of family members. Expenses for weddings and dowries are found to be met by selling assets of household heads when measured crudely and smaller jointly owned livestock when investigating the specific types of assets.

The fact that the results change and complement each other when moving from the comprehensive index of asset holdings to categories of assets and, finally, to specific types highlights the importance of substitution effects within a household's asset portfolio. One important finding emanating from this is that larger animals and other assets employed in the generation of income, for example agricultural tools, are protected when coping with unexpected events, and especially household heads sell their consumer durables as they do not have to be as concerned with keeping assets that clearly belong to them (such as jewellery for women) but can focus on the economic well-being of the whole family. Interestingly, we also find that jointly owned assets are not drawn down easily and mostly in response to expected shocks, possibly due to an ad hoc agreement on their sale being difficult.

As mentioned above, assets in the hands of women are often found to be beneficial to the well-being of children with respect to health, education, and nutrition, which illustrates the

importance of programs aimed at protecting these assets or at encouraging female ownership of assets that are not easily drawn down to cope with shocks, for example land, through reforming and enforcing inheritance laws. Land ownership, in turn, may also enable women to be more active in financial markets due to collateral being available. Female asset holdings, relative bargaining power within families, and the position of women in Bangladeshi society in general are interrelated so the protection of female-owned assets may positively affect women's social and human capital and vice versa, ultimately possibly even extending to an abolition of the tradition of paying dowries. The latter constitutes a large financial burden for the poor, and laws against the practice have been passed but, unfortunately, with little success. Trainings and the provision of credit may, furthermore, enhance asset holdings of both household heads and their spouses. In conclusion, our findings suggest that the design of policies to protect assets when facing a shock needs to take into account the different accumulation and coping strategies of men and women.

## **CHAPTER 3. STRATEGIES FOR ADAPTING TO AND COPING WITH SHOCKS AMONG AGRICULTURAL HOUSEHOLDS IN BANGLADESH**

### **3.1. Introduction**

With the increasing threat of climate change, farmers are required to find suitable adaptation strategies. Adaptation is an effective way to mitigate adverse long-term impacts of related shocks and to reduce vulnerability (Easterling et al. 1993; Rosenzweig and Parry 1994). Farmers must perceive climate change beforehand and be aware of the available adaptation strategies in order to choose from a given a set of options in their immediate regions. By reducing potential damage, adaptation provides rural people with a means for coping with the adverse consequences of climatic shocks and variability (IPCC 2001).

Adaptation differs from coping in that the latter is typically a short-term measure taken immediately in response to shocks (flood, drought, death, etc.,) in order to survive, often by degrading existing resource bases. Adaptation is typically a long-term strategy adopted in anticipation of shocks for the purpose of securing livelihoods by using available resources efficiently (Taylor et al. 2010). Much attention has focused on farmer adaptation strategies to the effects of long-term climate change, some of which considers adaptation as a single decision, while other consider the available options as individual decisions. Relatively little attention has been given to the explicit distinction between short-term coping mechanisms to climatic shocks and long-term adaptation strategies to climate change based on empirical evidence, especially in Bangladesh. It is found that rather than migrating or changing livelihoods to off-farm activities, female-headed households chose fewer adaptation strategies in terms of both crop production and livestock management, and were more likely to undertake coping mechanisms in response to shocks, which has adverse long-term impacts on their livelihoods and well-being such as dietary changes and keeping children out of school.

Some recent literature on adaptation follows a top-down approach that begins assessing vulnerability from a global perspective (Carter and Mäkinen 2011). Other recent empirical research efforts have focused on bottom-up approaches to examine adaptation strategies at the local level, particularly in Africa (Maddison 2007; Nhemachena and Hassan 2007; Deressa et al. 2008; Gbetibouo 2009). Many of these studies do not explicitly distinguish between short-term coping mechanisms and long-term adaptation strategies. A few studies have examined coping mechanisms for shocks, particularly for floods in Bangladesh (Brouwer et al. 2007; Santos et al. 2011).

To date there has not been any known empirical examination of farmer adaptation efforts to climate change or coping mechanisms for climatic and other negative shocks in Bangladesh using econometric analyses. Using the baseline survey featured in this research effort and a limited number of regressors, Thomas et al. (2013) identifies correlates of farmer crop production adaptation strategies, although their main focus is to observe the impacts of climate change on agriculture by modeling crop production. This research is expected to contribute to the understanding of the perceptions and the crop and livestock adaptation strategies and coping mechanisms of Bangladeshi farmers from an empirical perspective by separately examining the factors associated with each. This research also examines how farmer perceptions can constrain the adoption of relevant strategies.

Agriculture, which is heavily affected by climatic shocks in Bangladesh, accounts for 65% of the total labor force and approximately 20% of the country's GDP (Yu et al. 2010). It has been predicted that a one-meter rise in sea level will inundate a 29,846 square kilometers of the country (15–17% of the national territory) and displace around 15 million people in the coming decades (IPCC 2001; Akter 2009).

The remainder of this chapter is organized as follows. The next section discusses the existing relevant literature. Section 3.3 gives an overview of the study area and data source with summary statistics of variables included. The empirical findings is discussed in Section 3.4 and Section 3.5 concludes with some policy suggestions and limitations of the study.

### 3.2. Literature Review

Adaptation is a dynamic social process of diversifying livelihood strategies to minimize the adverse effects of shocks through a range of public and private channels, planned and autonomous actions, collective and individual organization, and anticipatory and reactive responses. Adaptation of agricultural production is indispensable for the protection of the livelihoods of shock vulnerable people and to enhance their assets (Brouwer et al. 2007). The resilience of victims can be enhanced to mitigate the potential negative impacts of shocks by adjusting behaviors or changing habits (IPCC 1996; IPCC 2001; ISET 2008).

The understanding that climate is changing is the precondition for farmers to adjust behavior. Farmers have to first identify the indicators which cause long term climate change among which, delayed rainfall, prolonged drought, and temperature extremes are the most severe threats to agriculture in Bangladesh (MoEF 2005). However, BCAS (2009) find that erratic temperature and precipitation, extreme weather events, and soil salinity are the most prominent effects of climate change in Bangladesh. The country has experienced a positive temperature increase trend, which will continue and intensify drought conditions in near future (Adger et al. 2003, Yu et al. 2010). Most papers on Africa find that farmers are perceptive of temperature and rainfall changes (Maddison 2007; Nhemachena and Hassan 2007; Gbetibouo 2009). Among the very few studies on Bangladesh Thomas et al. (2013) find 80 percent of farmers are aware of the long term climate change through frequent flooding, cyclone, extreme temperature changes etc. Other than identifying the perception of farmers of whether and how climate is changing, this paper also tries to examine the underlying correlates of farmers' perception.

In spite perceiving climate change farmers sometimes find it difficult to adapt due to the associated costs. The IPCC (2001) defines these costs by the difference between total expenses and the value of benefit from the adoption of specific adaptation strategies, while it can also be defined as the maximum value of net revenues per acre under perfect perception of impending climate change minus the maximum value of net revenues per acre under current levels of

climate change perception (Kolstad et al. 1999; Maddison 2007). Fankhauser (1998) emphasizes the separation of the adaptation costs from any damages that may occur, even if the adaptation strategy is adopted. In this study crop and livestock adaptation by farmers includes different options that have distinct costs. Purchasing fertilizer or motorized pumps and constructing irrigation water reservoirs are the respective actions that determine the costs of adaptation in crop production, although there might still be reductions in yields during drought periods. Furthermore, there is the possibility of other natural disaster that might damage crops even though the farmers change planting dates. In the case of livestock production, even if farmers change feeds and use vaccinations there is still the possibility that a cyclone or other natural calamity could cause livestock deaths. Therefore for each adaptation strategy there is an expected benefit of reducing the negative effects of climatic shocks and increasing resiliency even though some unavoidable residual costs or damages may be incurred that in turn influence farmer decisions of whether or what strategies to adopt.

To maximize the expected benefit it is imperative to choose effective adaptation strategies by integrating and combining basic knowledge with modern scientific idea in a complementary manner (Ajani et al. 2013). Various studies have identified crop adaptation strategy options such as changing crop varieties, planting trees, soil conservation, changing planting dates, irrigation water storage, crop diversification, and changing the area of land cultivated (Nhemachena and Hassan 2007; Deressa et al. 2008; Bryan et al. 2009; Gbetibouo 2009). These options are often categorized into two broad classes on the basis of crop diversification and management with evidence of complementarities among them (Nhemachena and Hassan 2007). Likewise, individual adaptation strategies are also categorized broadly as crop, livestock, livelihood, and land management (Bryan et al. 2011). Although the studies mentioned above took place in Africa, Thomas et al. (2013) identify changing crop varieties, increasing irrigation, and fertilizer application changes as the three major crop adaptation options in Bangladesh. To add with the existing finding in Bangladesh, this chapter examines associating factors in choosing adaptation options in crop and livestock including relevant factors along with group participation by male and female.



Both short-term coping mechanisms and long-term adaptation strategies can be interdependent in their effects on the livelihood outcomes of shock vulnerable people. Strategies adopted before adverse events are reflected in the immediate coping mechanisms in response to shocks, which in turn influence the decision about whether or not to adopt further adaptation strategies in future (Dercon 2010). Households not only cope with climatic shocks, but also to idiosyncratic shocks such as sudden changes in health, which is typically managed better than the covariate climatic shocks in Bangladesh (Santos et al. 2011). That study also find that poorer Bangladeshis are more affected by climatic shocks while having more limited ability to employ coping mechanisms, either by taking asset-smoothing strategies by sacrificing essential and nonessential consumption or by taking consumption-smoothing strategies by forgoing asset bases, often by reducing savings, selling assets, or borrowing. Unlike other studies, the present research distinguishes between immediate coping mechanisms and long-term adaptation strategies and investigates the correlates by using a broader definition of shocks and considering wider types of group membership rather than only concentrated in microcredit groups.

### **3.3. Data and Summary Statistics**

The dataset used for this study includes all the geopolitical and agro-ecological areas in Bangladesh, making it more representative of the entire set of major climatic shocks than the very few past empirical surveys on coping and adaptation in Bangladesh (Brouwer et al. 2007; Santos et al. 2011). In order to assess farmer perceptions, adaptation strategies, and short-term coping mechanisms, information was collected on demographic characteristics, physical assets, livestock and land ownership, crop and livestock management practices, access to credit and extension services, prior experience with climatic and non-climatic shocks, perceptions about climate change, social, political capital, group participation by main adult male and female household members, and coping mechanisms. Of the sample households, 89% are headed by men and 11% are headed by women. Among the female-headed households about 32% are

widowed or separated, while in the rest of the cases husbands had left the home, mostly for work purposes.

Farmers first have to understand the changing pattern of climate change so that they can timely adopt the appropriate adaptation strategies. Decreasing precipitation and increasing temperature are two widely used indicators of climate change. Household respondents were asked about their perceptions of changes in temperature, precipitation, and the overall climate over the previous 20 years. About 90% of the households reported perceiving that the overall climate had changed over the last 20 years. Almost 88% of households reported awareness that precipitation is decreasing and approximately 86% reported that temperatures are increasing (Table 3.1). The three most cited changes are more erratic rainfall, longer periods of drought, and later onset of seasonal precipitation. This is consistent with Thomas et al. (2013) by using the baseline survey of the present research, which is expected given that the follow-up survey was conducted only two years afterwards.

**Table 3.1: Household perceptions of precipitation and temperature changes over the past 20 years in Bangladesh**

Household perceptions	Precipitation	Temperature
Share of sample households (%) that...		
perceived an increase	8.5	86.0
perceived a decrease	88.4	8.9
perceived no change	2.8	4.6
did not know	0.3	0.5
Totals	100.0	100.0

For the purposes of this study adaptation strategies are divided into two broad categories as crop management and livestock management strategies which also comprises a range of subcategories. The available crop adaptation strategies are subdivided into six categories on the basis of taxonomy used in the literature and the adaptation types as follows: changes in fertilizer for Aman, Aus, and Boro rice varieties;<sup>16</sup> changes in crop variety, type and crop consumption; changes in field management such as increases in cultivable land, changes in field

<sup>16</sup> Aman, Aus, and Boro are the major rice varieties cultivated in Bangladesh.

location, planting trees for shade, constructing diversion ditches; and soil and water management techniques. Any changes in irrigation and water harvesting are categorized as irrigation change, changes in cultivation dates are categorized as change in cultivation dates, and labor related migration and off-farm employment are in a separate category.

Table 3.2 shows the adaptation strategy differences between male- and female-headed households in 2010. Agriculture, mainly crop production, is mostly a male oriented occupation in Bangladesh and therefore females are typically less directly involved in field-level cultivation and management. This is not only due to social and cultural norms, but also because women have less access to productive capital such as natural capital and opportunities for implementing technological advances. Even though female participation in agriculture is growing, mostly among relatively deprived households and especially in the absence of adult male household members and particularly as wage laborers responsible for rice husking and managing post-harvest processing, women continue to have limited decision-making roles regarding adaptation strategies.

In a recent study using a representative sample from Bangladesh, Sraboni et al. (2013) find that only about one-third of male respondents reported that they were disempowered with regard to making decisions regarding agricultural production relative to most women respondents. This reflects the relative disadvantage women face with respect to making decisions about whether to adopt crop adaptation strategies or which strategies to adopt, although the frequency of choosing to adopt adaptation strategies is increasing among women from 17% in 2010 to 26% in 2012 (Table 3.2). Furthermore, female-headed households reported greater participation migratory labor and off-farm activities than male-headed households.

**Table 3.2: Crop and livestock adaptation strategies by gender of the household head in Bangladesh, 2010 and 2012**

Adaptation strategy	Male-headed households		Female-headed households	
	2010	2012	2010	2012
<b>Crop production adaptation</b>				
<i>Share of households (%) that...</i>				
changed crop cycle timing	39	35	35	23
changed fertilizer use	59	77	49	51
changed crop	63	78	60	56
used irrigation	65	64	54	50
changed field management practices	29	40	26	30
sought migratory or off-farm employment	16	14	19	24
did nothing	8	6	26	17
<b>Livestock production adaptation</b>				
<i>Share of households (%) that...</i>				
changed the number of livestock		12		07
changed livestock feed		33		16
sought veterinary intervention		38		27
did nothing		50		62

In addition to crop adaptation strategies, livestock adaptation strategies include changes in livestock number (increase or decrease in livestock breeding or herd/flock sizes), changes in livestock feed (any change, diversification, or supplementation of livestock feed) and changes in veterinary interventions. Livestock adaptations are less common than crop adaptation strategies, especially among female-headed households. Half of the male-headed households and a majority of female-headed households reported not adopting any adaptive livestock management strategies. Among those that did report adopting livestock adaptation strategies the most common is veterinary intervention, probably because of governmental and NGO initiatives for vaccination campaigns and other livestock veterinary support programs.

All of the households that reported perceiving climate changing may not adopt adaptation strategies. Households were asked to explain the major constraints on the adoption of adaptation strategies, the three most frequent responses are summarized in Table 3.3. Financial

limitations and the lack of information on climate change and adaptation options are two of the major barriers reported by both male and female household heads. Female-headed households expressed greater concern about water shortages, which is consistent with FGD findings from a qualitative study in the study area by Davis and Ali (2014). This is probably because women are traditionally responsible for water collection in rural Bangladesh. Male household heads reported greater need for access to inputs, while female heads reported that access to land is the most important constraint, probably because in Bangladesh land is typically owned by males. Lack of information, labor and financial limitations, and poor irrigation are identified as the major constraints by a similar study in the Nile Basin of Ethiopia (Deressa et al. 2008).

**Table 3.3: Major constraints on the adoption of adaptive strategies for crop and livestock production by household head gender in Bangladesh**

Constraints to adaptation	Male-headed households			Female-headed households		
	Ranked 1st	Ranked 2nd	Ranked 3rd	Ranked 1st	Ranked 2nd	Ranked 3rd
No information on climate change and adaptation options	22.06	14.72	14.04	14.47	10.2	6.67
Financial limitations	18.52	29.26	25.44	19.74	26.53	40
Lack of access to inputs	17.23	10.37	21.05	13.16	14.29	6.67
Lack of access to land	13.20	15.05	7.02	13.16	14.29	20
Water scarcity in irrigation	12.88	15.38	8.77	21.05	24.49	0
Lack of market	5.31	5.69	8.77	2.63	2.04	13.33
Labor limitations	1.77	3.34	3.51	5.26	2.04	0
Lack of access to credit	6.44	5.69	7.89	5.26	2.04	6.67
Others	2.58	0.67	3.51	5.26	4.08	6.67
Total	100	100	100	100	100	100

The major coping mechanisms utilized by households in rural Bangladesh are selling assets; borrowing from friends, relatives, or other informal lenders; changing diets (including eating less); keeping children out of school; and seeking migratory or off-farm employment (Table 3.4). Summary statistics indicate that male-headed households typically employed coping mechanisms that do not affect consumption, mostly by selling assets. Female-headed households typically keep their asset bases intact by modifying their diet and keeping children out of school, which may have been due to the lack of assets to sell in response of shocks. Male-

headed households are more likely to borrow money through informal lenders. Santos et al. (2011) also find borrowing to be a common coping mechanism in response to shocks in Bangladesh. Although a large percentage of the sample households did not take coping tools against shocks, still the variability of households who coped is more than one-third which validates our investigation. For each and every type of coping tools except food modification, the average physical and livestock assets of households which did not cope are higher than the copers. Although the maximum amount of physical and livestock assets of households who coped by modifying food habit is much lower than the maximum of non-copers. However, households having larger amount of land asset, cope by taking different types of mechanisms even though those with less land mostly coped by migrating elsewhere or by seeking off-farm employment. Therefore, it is not likely that the asset level induces the households to adopt the coping mechanisms.<sup>17</sup>

**Table 3.4: Household coping mechanisms for shocks by household head gender in Bangladesh**

Coping mechanisms	Male-headed households	Female-headed households
<i>Share of households (%) that...</i>		
did nothing	62	68
sold assets	8	5
borrowed from informal lenders	23	5
Sought migratory or off-farm employment	8	13
dietary modifications	5	8
kept children out of school	5	15

Literature on other developing countries has identified borrowing, selling assets, and forgoing children’s schooling as common coping mechanisms in response to shocks (Udry 1994; Jacoby and Skoufias 1997). The majority of the households reported that they did not employ coping mechanisms in response to shocks and this majority was greater among female-headed households (68%) than male-headed households (62%). These statistics support the research findings presented in Chapter 2 that wives typically own fewer assets than their husbands, which probably lessens their ability to cope with shocks through the use of assets. Santos et al.

<sup>17</sup> Later in this chapter we have analyzed the determinants of coping mechanisms.

(2011) find that almost 59% of Bangladeshi households were unable to cope with climate change related shocks.

Gender disparity is prevalent with respect to employing coping mechanisms among households responding to climate change related shocks. Household heads were asked which household member was responsible for employing coping mechanisms in the event of a shock. Among those who are responsible for employing coping mechanisms, husbands or adult males made the decision of whether or not to engage in a coping mechanism in response to flood among 86% of the respondent households, while wives or adult females only initiated coping mechanisms among 3% of the respondents. Among male-headed households 89% reported employing coping mechanisms in response to drought and 84% in response to cyclones, whereas among female-headed households only 2% reported employing coping mechanisms in response to either phenomena.

### **3.4. Empirical Findings**

We investigate the factors associated with the perception that climate change is occurring as well as with different crop and livestock adaptation strategies and the correlates of coping mechanisms of agricultural household heads. This begins with a simple probit model developed using the maximum likelihood method to identify the correlates of adaptation and coping strategies. Whether the adopted strategies are taken as complementary or substitutive is checked by applying bivariate and multivariate probit approaches in appropriate cases and these results are presented as the main results in this chapter. To address possible heteroscedasticity, a robust standard error is used throughout the analysis.

### 3.4.1. Description of Variables

Most of the relevant studies in the field include physical capital, natural capital and livestock variables for similar analysis (Nhemachena and Hassan 2007; Gbetibouo 2009; Deressa et al. 2010) even though there may be reverse causality or simultaneity among the different types of assets and the dependent variables. For example, current asset ownership might influence to the decision of whether or not to adopt adaptation strategies and vice versa. Therefore, the asset variables—physical capital, livestock, social capital, and political capital are calculated as ‘leave out mean’ instead of a regular mean within each village based on the tendency of people from same village to have similar asset endowments. The ‘leave out village mean’ of each household’s asset base is the mean value of the rest of the household assets in the same village, excluding the household in question (Goldstein 1999, Jacobi and Mansuri 2006). The hypothesis behind using the leave out village mean technique is that, the percentage of assets of other households in the village is not in a direct cause-and-effect relationship between choosing adaptive strategies or coping mechanisms of a specific household (Quisumbing and McNiven 2010). The robustness of the results is evaluated by using base year asset information, as well as by both including and excluding the asset variables in the models to minimize the simultaneity bias. The influence of group participation on perception, adaptation, and coping is examined by including group participation into the models and then to a broader extent by including social and political capital indices.

To identify the factors influencing the perception of climate change and decisions of whether or not to adopt adaptation strategies and/or coping mechanisms, a set of explanatory variables are chosen according to relevance and on the basis of theory and existing studies. The independent variables include: gender, years of schooling, work experience, and age of the household head, household land ownership, physical assets (measured by an index generated using a principal component analysis [PCA]),<sup>18</sup> livestock ownership (measured in tropical livestock units [TLU]), household access to agricultural extension services and credit, information on group

---

<sup>18</sup> See Chapter 2 for physical asset index construction details. The results are largely robust from using the total value of household physical assets measured by the leave out mean at the village level.



participation, social and political capital of the main adult male and female household members, household experiences with climate change shocks, access to ICT, and training of main adult male and female household members.<sup>19</sup> Basic summary statistics of the sample household characteristics are presented in Table A3.1 in the appendix.

The social and political capital indices are constructed by applying a PCA in the similar way as the physical capital index mentioned above.<sup>20</sup> Components included to construct the social capital index are: informal respondent networks, group membership costs, labor contributions to groups, regular meeting attendance, participation in group decision making, participation in community-based activities, whether or not respondents have trust in neighbors and fellow villagers, and whether or not group memberships are heterogeneous with respect to wealth and gender. The political capital index is based on information on: whether or not a respondent votes in national elections, attends local council meetings and protests, mentions local problems to the media or police, and whether or not respondents feel that their opinions and decisions are considered and valued by elites. Both indices are normalized to range between zero and one.

Land ownership is defined as a binary variable based on whether or not the household owns more than 50 *decimals* of land, which reflects functional land ownership from the Bangladeshi perspective (Hossain et al. 2007; Quisumbing 2011).<sup>21</sup> It is intuitive that choosing crop adaptation strategies is associated with whether farmers own plot rather than the size. However, the robustness of the results is also checked by household plot sizes.<sup>22</sup>

Another PCA derived index is based on access to ICT by the primary adult household member of either gender using components such as: whether or not the respondent received information on markets and government from electronic media, whether or not he/she watched television

---

<sup>19</sup> As not all of the household heads were married, the responsible adult male and female members of each household were directly asked for information on their membership and the extent of participation in formal and informal groups, and in voluntary and involuntary associations.

<sup>20</sup> See Chapter 4 for social and political capital index construction details.

<sup>21</sup> Decimal is a common measurement of land area in Bangladesh; one decimal is equal to 40.46 square meters.

<sup>22</sup> Note that the results are mostly robust based on the variable of total plot size of households calculated in the leave out village mean.

regularly, and whether or not the respondent used a mobile phones to make a call over the previous month. Similarly, whether or not the primary adult household member received training or not is indexed using the binary variables of receiving training on crop and livestock production over the last two years. Experience with climate change related shock is used as a control variable because shock affected farmers are expected to better understand the necessity of adopting adaptation strategies relative to farmers that has not experienced related extreme weather events.

### **3.4.2. Determinants of Farmer Perceptions of Climate Change**

Perception is a prerequisite to implement adaptation strategies in agricultural production and therefore it is important to know which types of farmers are more likely to perceive climate change. For this study temperature increase and precipitation decrease are considered as two separate perception variables. To identify the correlates of farmer perceptions of climate change the binary dependent variable takes a value of one if the household head perceives that temperature is increasing or precipitation is decreasing over the last 20 years and a value of zero otherwise. However, the perception of increasing temperature and decreasing precipitation are likely to be correlated to one other, which is why the seemingly unrelated biprobit model is used. The analysis results are presented in Table 3.5.

Columns (1) and (2) in Table 3.5 include farmer perceptions of climate change with asset variables calculated as 'leave out mean,' at the village level while columns (3) and (4) present the same as index value of asset. The results are consistent in terms of signs and statistical significance for all other variables in the first and last pairs of columns except for the livestock asset. Having livestock asset measured as 'leave out mean,' is positively and significantly associated with temperature increase and precipitation decrease, which is consistent with the findings of Gbetibouo (2009) in South Africa while household livestock in TLU does not show any association. Probably, the endogeneity inherent in the relationship drives the result.

**Table 3.5: Marginal effects of farmer perceptions of climate change with group participation in Bangladesh**

Variable	Seemingly Unrelated Biprobit model results			
	Temperature increase	Precipitation decrease	Temperature increase	Precipitation decrease
	(1)	(2)	(3)	(4)
Male-headed household	-0.072 (0.217)	-0.399* (0.238)	-0.055 (0.217)	-0.389* (0.236)
Age of HH head	0.008 (0.005)	0.000 (0.006)	0.005 (0.005)	-0.002 (0.006)
Years of formal education of HH head	0.017 (0.015)	-0.009 (0.018)	0.016 (0.016)	-0.009 (0.018)
Experience of HH head	0.002 (0.006)	-0.002 (0.005)	0.005 (0.006)	0.000 (0.005)
Whether or not HH functionally owns land	-0.074 (0.128)	0.199 (0.132)	-0.025 (0.127)	0.215 (0.133)
Physical asset index value (leave out village mean)	0.720 (0.927)	1.291 (0.989)		
Total livestock in TLU (leave out village mean)	0.323* (0.169)	0.477*** (0.181)		
Physical asset index value			0.106 (0.340)	-0.260 (0.390)
Total livestock in TLU			-0.102 (0.065)	0.010 (0.080)
Access to credit	-0.294** (0.142)	-0.114 (0.137)	-0.315** (0.141)	-0.132 (0.136)
Access to extension services	-0.112 (0.140)	0.214 (0.148)	-0.079 (0.138)	0.247* (0.145)
Affected by climatic shocks	0.212* (0.121)	0.128 (0.125)	0.232* (0.122)	0.140 (0.124)
Access to ICT by primary HH adult male	0.756*** (0.188)	0.541*** (0.201)	0.803*** (0.188)	0.566*** (0.199)
Access to ICT by primary HH adult female	0.135 (0.362)	0.380 (0.418)	0.083 (0.367)	0.397 (0.405)
Group participation by primary HH adult male	-0.182 (0.140)	0.089 (0.141)	-0.184 (0.141)	0.077 (0.140)
Group participation by primary HH adult female	0.305* (0.181)	0.422** (0.189)	0.341* (0.178)	0.449** (0.188)
Wald chi2(28)	68.99***		68.76***	
Total observations	740	740	740	740

Notes: Robust standard errors are given in parentheses

\*p < .10. \*\*p < .05. \*\*\*p < .01.

An important finding is that, access to information and technology by the primary adult male household member and group participation of primary household adult female are positively and significantly associated with the perception of both temperature and precipitation changes, which may reflect the importance of access to information in developing the perception of

climate change either by using technology or by coming in contact with others by actively taking part in groups. In particular, the positive significant association of group participation by primary household adult females with the perception of climate change may reflect the importance of group participation by women, which serves as a platform for women to develop outlook through social contacts.

Surprisingly, access to credit is negatively associated with the perception of climate change, perhaps because the credit groups do not emphasize this issue or because households that have access to credit might have the means of overcoming problems associated with temperature increases such as the means to increase irrigation. It is counterintuitive that education has no effect on the perception of climate change, probably because farmers in the study area have an average of three years of formal education, which is very limited and therefore would not be expected to contribute to awareness of climate change and variability. Table A3.2 in the appendix summarizes the marginal effects of standard probit results, which are consistent to the main results of table 3.5.<sup>23</sup> The results using 'leave out village mean' are robust for the relevant variables across the analyses.

Tables A3.3 and A3.4 replicates the results of Tables A3.2 and 3.5 respectively by using social and political capital, which are the measures beyond group participation. In each of the tables, columns (1) and (2) report the results with respect to the leave out village mean value of asset variables, while columns (3) and (4) present the results with index values. Especially when measured with respect to the leave out village mean households with physical and livestock assets are more likely perceive precipitation decrease, probably because adequate rainfall is necessary for the ownership of agricultural tools such as motorized pumps or supplementary livestock fodder. Political capital of primary household adult males is positively associated with climate change perception, while social capital of the primary adult males and females are negatively associated with the climate change perception. It is possible that households with more social capital are less likely to be directly involved in farming activities or that the relevant groups do not emphasize building awareness of climate change.

---

<sup>23</sup> The results are evaluated by using base year physical asset value, livestock in TLU and household plot size in square meter and are largely consistent to the main results in Table 3.5.

### **3.4.3. Determinants of Crop Production Adaptation Strategies**

For identifying the associating factors of crop adaptation strategies a univariate probit analysis is used as a starting approach for each of the six different types of crop adaptation options mentioned earlier. Given a set of available options, it is unlikely that farmers adopt a single adaptation strategy at a time, but rather may consider a number of strategies as either complementary or substitutive. Individual estimation of each binary dependent variable does not take into account the relationships among adaptation options, which could be revealed using a multivariate probit model, which is also applied to each type of crop and livestock adaptation strategy.

The marginal effects of the multivariate probit model using the resurvey data are presented in Table 3.6. Male-headed households are less likely to seek migratory labor opportunities or find off-farm employment which is also consistent with Table 3.4. Larger household size signifies greater available labor and thus has a significant positive association with farmers' decisions to use fertilizer and manage fields as shown in columns (2), and (5) respectively of Table 3.6. The model estimates that each additional household member reduces the probability of adopting irrigation, a strategy that requires financial resources to adopt, by 8.4%. More household dependents reduces the probability of adopting crop production adaptation strategies, while it is logical that families with more elderly and young children are less likely to spend more on adopting new production strategies.

Furthermore, households that own a meaningful amount of land, which is a durable and location specific asset, are less likely to relocate, seek migratory labor opportunities, or to seek off-farm employment, and are more likely to adopt individual adaptation strategies such as modifying the timing of cultivation cycles and irrigation. Household experiences with climate change related shocks and group participation among primary household adult males and females seem to be important factors associated with adopting crop production adaptation strategy, which is strongly and positively correlated to several adaptation options.

**Table 3.6: Multivariate probit results for marginal effects of the determinants of group-based crop production adaptation strategies in Bangladesh, 2012**

Variables	Crop cycle dates	Fertilizer	Change crop variety	Irrigation	Field management practices	Migratory/off-farm employment
	(1)	(2)	(3)	(4)	(5)	(6)
Male-headed households	-0.062 (0.215)	0.238 (0.208)	0.125 (0.211)	0.082 (0.193)	-0.169 (0.200)	-0.703*** (0.218)
HH size	0.009 (0.028)	0.061** (0.030)	-0.026 (0.030)	- 0.084*** (0.028)	0.060** (0.027)	0.044 (0.031)
Male to female ratio	0.024 (0.060)	-0.010 (0.062)	-0.020 (0.065)	0.024 (0.060)	-0.019 (0.060)	-0.098 (0.069)
Age of HH head	-0.006 (0.005)	-0.001 (0.005)	-0.003 (0.005)	-0.006 (0.005)	-0.005 (0.005)	-0.004 (0.006)
Years of formal education of HH head	0.002 (0.014)	0.007 (0.015)	-0.002 (0.016)	-0.012 (0.014)	0.028** (0.013)	-0.013 (0.016)
Dependency ratio	-1.100*** (0.300)	-0.684** (0.324)	-0.442 (0.345)	-0.579** (0.298)	-0.355 (0.286)	-0.687** (0.334)
Experience of HH head	0.000 (0.005)	0.009* (0.005)	0.007 (0.005)	-0.002 (0.005)	0.013*** (0.005)	0.008 (0.006)
Whether or not HH functionally owns land	0.300*** (0.105)	0.108 (0.110)	0.159 (0.112)	0.236** (0.107)	-0.192* (0.104)	-0.520*** (0.132)
Physical asset index value (leave out village mean)	0.354 (0.294)	0.358 (0.336)	0.225 (0.321)	-0.197 (0.303)	0.095 (0.297)	-0.204 (0.350)
Total livestock in TLU (leave out village mean)	-0.037 (0.058)	0.056 (0.057)	0.186** (0.075)	0.094 (0.062)	-0.026 (0.057)	-0.054 (0.081)
Access to credit	-0.145 (0.113)	-0.090 (0.121)	-0.230* (0.127)	-0.209* (0.117)	-0.067 (0.110)	0.067 (0.137)
Access to extension services	0.177 (0.113)	0.091 (0.125)	0.237* (0.132)	0.487*** (0.116)	0.259** (0.111)	0.194 (0.147)
Affected by climate change related shocks	0.342*** (0.107)	0.480*** (0.109)	0.487*** (0.110)	0.318*** (0.104)	0.159 (0.105)	0.692*** (0.143)
Training received by primary HH adult male	0.899 (0.656)	20.183*** (6.521)	0.065 (0.992)	-0.175 (0.799)	1.702** (0.735)	-0.105 (0.807)
Training received by primary HH adult female	0.093 (0.359)	0.372 (0.458)	1.738** (0.673)	0.079 (0.397)	0.311 (0.384)	0.179 (0.481)
Access to ICT by primary HH adult male (index)	0.013 (0.163)	0.393** (0.177)	0.130 (0.176)	0.152 (0.158)	-0.027 (0.162)	0.107 (0.184)
Access to ICT by primary HH adult female (index)	0.080 (0.299)	0.194 (0.321)	-0.408 (0.350)	0.164 (0.311)	-0.142 (0.304)	0.518 (0.380)
Group participation by primary HH adult male	0.285** (0.118)	0.208* (0.125)	0.304** (0.127)	0.366*** (0.120)	0.216* (0.115)	-0.052 (0.141)
Group participation by primary HH adult female	0.440*** (0.138)	0.060 (0.150)	0.241 (0.153)	0.233* (0.139)	0.182 (0.136)	0.048 (0.161)
	Rho1	Rho2	Rho3	Rho4	Rho5	Rho6
Rho1	1					
Rho2	0.571***	1				
Rho3	0.446***	0.418***	1			
Rho4	0.463***	0.507***	0.385***	1		
Rho5	0.246***	0.197***	0.135***	0.063	1	
Rho6	0.150**	0.135**	0.182**	0.124**	0.276***	1
Likelihood ratio test	chi2(15) = 296.63***					
Total observations	740					

Notes: Robust standard errors are given in parentheses  
\*p < .10. \*\*p < .05. \*\*\*p < .01.

Access to extension services, training opportunities for both men and women, and access to ICT by adult males are positively associated with adopting different crop production adaptation strategies, which are also consistent with other studies from Bangladesh and Africa (Nhemachena and Hassan 2007; Thomas et al. 2013). It is likely that increasing access to mobile phones and television broadcasting, male farmers have greater access to information and have greater awareness of adaptation options. Access to credit on the other hand is negatively associated with the decision to adopt crop production adaptation strategies and choosing irrigation as an adaptation strategy.

The standard probit and multivariate probit model results, including for social and political capital are mostly robust with the main results in table 3.6 (tables A3.5 and A3.6 in the appendix).<sup>24</sup> Surprisingly, social capital of primary household adult males is negatively associated with the adoption of crop production adaptation strategies, although social and political capitals of primary household adult females are positively associated with choosing alternative crop production adaptation options. By participating in social groups and political activities, women probably become more familiar with available adaptation options and are more likely to adopt the strategies. Political participation is associated with greater engagement in migratory labor among men, probably because it helps them form broader networks that enable increased mobility, even outside of their villages, by providing access to better information about seasonal migratory labor or off-farm employment opportunities.

The correlation coefficients of the error terms from the multivariate probit model results are positive and statistically significant, which implies complementarity among the adaptation strategies. For instance, households tend to modify crop varieties or the timing of cultivation cycles simultaneously with irrigation or fertilizer application efforts. This supports the notion that adaptation strategies are mutually dependent, while the significant differences of the alternative adaptation strategy coefficients validate the model. Additionally, the results of the likelihood ratio test of dependence based on the log-likelihood values of the multivariate model

---

<sup>24</sup> The results are also evaluated by using base year physical asset value, livestock in TLU and household plot size in square meter and are largely consistent to the main results in Table 3.6.

results indicate that the model equations are connected, with at least one covariance of the error term being statistically significant.

#### **3.4.4. Determinants of Livestock Production Adaptation Strategies**

The major factors that influence livestock adaptation strategies are identified by the marginal effects from the probit model (first three columns of Table 3.7) and the multivariate probit results (last three columns in Table 3.7) based on the follow-up survey data. Unlike crop production adaptation strategies, gender of the household head does not have a significant relationship with the adoption of livestock adaptation strategies. Similar to the results for crop adaptation strategies, wealthier households (in terms of land, livestock, and physical assets ownership) adopt more livestock adaptation strategies. Access to extension services, training by adult female household members, and to ICT by adult male household members all increase the likelihood of adopting livestock adaptation strategies, probably because these are the means of increasing awareness of effective adaptation options and training is particularly helpful for women to adopt livestock feed options.

Similar to crop adaptation, experience with climate change related shocks is significantly and positively related to the adoption of livestock adaptation strategies. People who had suffered shocks in the previous year might be more conscious of the advantages of adaptive measures to save their livestock from damage. Unlike crop adaptation, group participation has no influence on choosing livestock adaptation options. Probably, the groups that respondents participate in focus on crop rather than livestock production. Alternatively, respondents are more likely to be involved in crop production than livestock.



**Table 3.7: Determinants of household livestock production adaptation strategies with group participation in Bangladesh, 2012**

Variable	Probit model results			Multivariate probit model results		
	Veterinary intervention	Changes to livestock feed	Changes in livestock	Veterinary intervention	Changes to livestock feed	Changes in livestock
	(1)	(2)	(3)	(4)	(5)	(6)
Male-headed household	0.023 (0.077)	-0.018 (0.079)	-0.042 (0.053)	0.041 (0.211)	-0.060 (0.225)	-0.235 (0.263)
HH size	-0.022** (0.011)	0.002 (0.010)	0.003 (0.006)	-0.057** (0.028)	0.005 (0.028)	0.019 (0.038)
Male to female ratio	-0.038 (0.023)	0.004 (0.021)	0.006 (0.012)	-0.106* (0.064)	0.014 (0.062)	0.042 (0.076)
Age of HH head	-0.004** (0.002)	-0.003 (0.002)	-0.002 (0.001)	-0.011** (0.005)	-0.007 (0.005)	-0.010 (0.007)
Years of formal education of HH head	-0.010** (0.005)	-0.008* (0.005)	-0.003 (0.003)	-0.028** (0.014)	-0.025* (0.014)	-0.017 (0.017)
Dependency ratio	-0.043 (0.116)	-0.227** (0.106)	-0.015 (0.063)	-0.131 (0.310)	-0.643** (0.310)	-0.063 (0.388)
Experience of HH head	0.002 (0.002)	0.001 (0.002)	0.000 (0.001)	0.006 (0.005)	0.003 (0.005)	-0.001 (0.007)
Whether or not HH functionally owns land	0.117*** (0.039)	0.049 (0.038)	0.005 (0.022)	0.302*** (0.104)	0.172 (0.109)	0.044 (0.136)
Physical asset index value (leave out village mean)	-0.012 (0.117)	0.102 (0.103)	0.137** (0.058)	-0.063 (0.313)	0.323 (0.303)	0.787** (0.372)
Total livestock in TLU (leave out village mean)	0.118*** (0.023)	0.102*** (0.022)	0.036*** (0.010)	0.323*** (0.062)	0.317*** (0.064)	0.245*** (0.065)
Access to credit	-0.018 (0.044)	-0.027 (0.040)	0.032 (0.021)	-0.033 (0.116)	-0.050 (0.117)	0.228 (0.152)
Access to extension services	0.103** (0.044)	0.065 (0.040)	0.063** (0.027)	0.283** (0.114)	0.160 (0.116)	0.335** (0.147)
Affected by climatic shocks	0.163*** (0.037)	0.057 (0.037)	0.078*** (0.020)	0.448*** (0.109)	0.184* (0.112)	0.554*** (0.155)
Training received by primary HH adult male	-0.026 (0.275)	-0.061 (0.225)	0.190 (0.127)	-0.015 (0.738)	-0.165 (0.649)	1.186 (0.812)
Training received by primary HH adult female	0.015 (0.147)	0.223* (0.136)	0.054 (0.072)	0.065 (0.396)	0.721* (0.390)	0.415 (0.460)
Access to ICT by primary HH adult male (index)	0.009 (0.061)	0.165*** (0.057)	0.055* (0.032)	0.009 (0.162)	0.460*** (0.168)	0.316 (0.205)
Access to ICT by primary HH adult female (index)	-0.056 (0.115)	-0.096 (0.105)	0.041 (0.062)	-0.147 (0.306)	-0.273 (0.307)	0.227 (0.392)
Group participation by primary HH adult male	0.049 (0.044)	0.053 (0.041)	0.000 (0.023)	0.120 (0.118)	0.150 (0.120)	0.015 (0.145)
Group participation by primary HH adult female	0.071 (0.053)	0.024 (0.050)	-0.038 (0.024)	0.197 (0.139)	0.036 (0.148)	-0.277 (0.193)
				Rho1	Rho2	Rho3
Rho1				1		
Rho2				0.585***	1	
Rho3				0.318***	0.269***	1
Likelihood ratio test				chi2(3) = 124.28 ***		
Pseudo R-squared	0.109	0.100	0.130			
Total observations	740	740	740	740		

Notes: Robust standard errors are given in parentheses  
\*p < .10. \*\*p < .05. \*\*\*p < .01.

Larger households and household with older heads are less likely to adopt veterinary interventions. Older household heads may be less aware of the relatively new adaptation strategies or if they are aware, they may be less willing to modify their traditional practices. Thomas et al. (2013) find in crop adaptation that older farmers are likely to choose irrigation, while according to Gbetibouo (2009) the effects of farmer age are context specific. Similar to the determinants of crop adaptation strategies, the multivariate probit model results presented in Table 3.7 also exhibit complementarities among livestock production adaptation strategies.<sup>25</sup>

Table A3.7 includes the broader results of group-based approaches including social and political capital of the primary household adult males and females rather than their participation in group activities. Social capital of adult females and political capital of both males and females are positively correlated to the adoption of livestock adaptation strategies. The social capital of adult males is negatively associated with livestock adaptation measures, however, which is similar to the results for crop adaptation measures (Table A3.7). It is likely that adult males with greater social capital have to spend more time participating in groups and community activities and are therefore less likely to raise livestock. Alternatively, livestock fodder and feeding is typically managed by female household members and therefore men are less likely to be involved. Larger household size is positively associated with strategies involving changes to livestock feed and household livestock portfolios, probably because of greater labor availability within the household to care for livestock.

### **3.4.5. Determinants of Coping Mechanisms**

Among the coping mechanisms, selling assets; borrowing from friends, relatives, or informal sources; modifying or reducing diets; keeping children out of school; and seeking migratory or off-farm employment opportunities are the most reported (Table 3.4). Unlike a number of existing studies two-stage estimation by conditioning perception in the adaptation model is not

---

<sup>25</sup> The results are also evaluated by using base year physical asset value, livestock in TLU and household plot size in square meter and are largely consistent to the main results in Table 3.7.

applied. This is because almost 90% of farmers reported that they perceived climate change, which is quite a large percentage to use as a selection variable. The standard probit and multivariate probit models are used to be consistent with the previous analyses. In contrast to crop and livestock adaptation strategies presented in table 3.6 and 3.7, the results of the likelihood ratio test of dependence of the multivariate model in Table 3.8 do not indicate significant joint correlations. This implies that the model equations are not correlated to each other. The correlation coefficients of the error terms in the multivariate model in table 3.8 also exhibit a different scenario than the adaptation options in the previous analyses. Seeking migratory or off-farm employment and selling asset are weakly and negatively correlated with withdrawing children from school which reflects that the shock affected household either sell their asset or withdraw their children from school, however, there is no evidence of strong complementarity or substitution among the coping mechanisms. Tables 3.8 and A3.8 present the marginal effect of standard probit and multivariate probit model results respectively for the associated factors to cope with shocks using group participation. Tables A3.9 and A3.10 present the same by using social and political capital - a broader measure beyond group participation.

The results of tables A3.8 - A3.10 are largely consistent for the common variables with the main result reported in table 3.8.<sup>26</sup> Experiences with climatic and other negative shocks are significantly associated with household ability and willingness to take coping measures. Households are less likely to sell assets in response to floods, but rather would opt for dietary modifications. During seasonal drought periods in Bangladesh, people often cope by shifting to greater consumption of dried and processed foods. Households are more likely to keep their children out of school in response to cyclones and female-headed households are more likely to keep children out of school than male-headed households. This may be because women less access to income generating activities and inputs and technology in rural Bangladesh, which may make them more reliant on household labor, especially in times of shocks. However, non-climatic negative shocks and expenses associated with dowries, weddings, and illness, which can represent a relatively large amount of money for rural households, are more likely to elicit

---

<sup>26</sup> We also checked the robustness of asset variables by using base year information and the results are supportive to the original results presented in Table 3.8.

coping responses than climatic shocks. Unlike covariate shocks, the idiosyncratic shocks affect smaller numbers of people who can probably adopt coping mechanisms such as selling assets or borrowing from neighbors or friends who are not affected by the same shock.

Group participation by main adult male appears to cope by modifying diet while group participation by main female member cope with shocks by withdrawing her children from school. Probably because they want to save money by skipping school as well as are lack of extra labor in time of shocks (Table 3.8). On the other hand, households with trained adult female members are less likely to keep their children out of school, perhaps because they are better able to manage household matters without the help of child labor or else they are more aware of the detrimental effects of lost educational opportunities for their children. Those who are group members may be well aware of the long-term adverse impacts of most coping mechanisms such as selling assets, borrowing or, as a group member they might have a more extensive social network that can help them during crises, by improving access to credit or other financial or food assistance.

The choice of coping mechanisms differs according to demographic characteristics. Households with older heads are less likely to borrow from informal sources and seek migratory labor opportunities because of mobility challenges. Households borrow more in response to shocks when the household head is male headed, with more dependents in family and has experienced negative non-climatic shocks and those who have access to credit, probably with greater ability to repay loans from employers or credit organizations. Santos et al. (2011) also find that households with access to micro-credit institutions are better able to cope with shocks. Households with adult male members that have access to ICT are likely to choose consumption-smoothing strategies and are more likely to sell assets rather than reducing or otherwise modifying diets or borrowing in response to shocks. Wealthy households in terms of more physical asset modify their dietary habit in to cope with shocks.

**Table 3.8: Multivariate probit model results for correlates of household shock coping mechanisms based on group participation in Bangladesh, 2012**

Variable	Selling asset (1)	Informal borrowing (2)	Migratory/ off-farm employment (3)	Reducing and modifying diet (4)	Withdrawing children from school (5)
Affected by flood	-0.346* (0.186)	0.260* (0.158)	0.087 (0.200)	0.602*** (0.193)	0.045 (0.228)
Affected by drought	-0.064 (0.193)	0.196 (0.163)	-0.011 (0.206)	0.612*** (0.223)	0.423* (0.228)
Affected by cyclone	-0.272 (0.212)	0.058 (0.178)	0.286 (0.210)	0.317 (0.230)	0.815*** (0.210)
Affected by non-climatic negative shocks	0.412** (0.191)	0.986*** (0.185)	0.620 (0.229)	0.539** (0.239)	0.673** (0.284)
Affected by positive shocks	-0.135 (0.194)	0.010 (0.145)	0.149 (0.195)	0.159 (0.211)	0.336* (0.196)
Male-headed household	-0.098 (0.326)	1.028** (0.416)	0.345 (0.320)	-0.576 (0.377)	-0.741*** (0.275)
HH size	-0.105** (0.044)	0.002 (0.033)	0.016 (0.043)	0.016 (0.052)	-0.055 (0.057)
Male to female ratio	0.044 (0.094)	0.024 (0.077)	0.111 (0.097)	-0.298** (0.126)	0.055 (0.120)
Age of HH head	0.007 (0.008)	-0.012* (0.007)	-0.018** (0.008)	-0.002 (0.009)	-0.005 (0.009)
Years of formal education of HH head	0.017 (0.020)	-0.011 (0.017)	-0.031 (0.021)	-0.026 (0.028)	-0.031 (0.024)
Dependency ratio	0.063 (0.451)	0.814* (0.432)	-1.233*** (0.457)	-0.498 (0.533)	0.318 (0.630)
Experience of HH head	0.005 (0.008)	0.013** (0.006)	-0.011 (0.008)	0.003 (0.010)	0.014* (0.008)
Whether or not HH functionally owns land	0.218 (0.163)	-0.100 (0.131)	-0.088 (0.171)	0.078 (0.209)	0.132 (0.197)
Physical asset index value (leave out village mean)	1.938 (1.475)	1.362 (1.197)	-0.412 (1.496)	4.382*** (1.375)	-1.022 (2.228)
Total livestock in TLU (leave out village mean)	0.046 (0.196)	-0.039 (0.186)	0.042 (0.237)	0.283 (0.255)	0.025 (0.220)
Access to credit	0.188 (0.187)	0.649*** (0.165)	-0.360* (0.192)	0.210 (0.195)	-0.017 (0.199)
Access to extension services	0.062 (0.179)	0.384*** (0.145)	0.539*** (0.197)	-0.059 (0.219)	0.182 (0.219)
Training received by primary HH adult male	0.128 (0.931)	1.037 (0.685)	0.291 (0.928)	-13.244 (9.867)	-1.399 (1.094)
Training received by primary HH adult female	0.042 (0.492)	-0.197 (0.453)	-0.370 (0.816)	0.069 (0.547)	-1.898** (0.739)
Access to ICT by primary HH adult male (index)	0.520** (0.265)	-0.370* (0.215)	-1.008*** (0.252)	0.305 (0.346)	0.062 (0.297)
Access to ICT by primary HH adult female (index)	-0.720 (0.557)	-0.256 (0.396)	0.532 (0.500)	0.204 (0.571)	0.336 (0.580)
Group participation by primary HH adult male	0.095 (0.194)	0.021 (0.147)	-0.127 (0.194)	0.545** (0.228)	0.273 (0.222)
Group participation by primary HH adult female	0.131 (0.221)	-0.169 (0.167)	-0.009 (0.208)	0.304 (0.250)	0.610*** (0.214)
	Rho1	Rho2	Rho3	Rho4	Rho5
Rho1	1				
Rho2	0.049	1			
Rho3	-0.182	-0.105	1		
Rho4	0.132	-0.125	0.331	1	
Rho5	-0.281*	-0.227	-0.092*	-0.069	1
Likelihood ratio test	chi2(10) = 9.58				
Total observations	740	740	740	740	

Notes: Robust standard errors are given in parentheses

\*p < .10. \*\*p < .05. \*\*\*p < .01.

Households with more livestock are more likely to keep their children out of school, possibly because they rely on child labor for caring for their livestock, especially when subject to shocks (Tables A3.9 and A3.10 in the appendix). Social capital of primary household adult males and females have a negative relationship with borrowing from informal sources, selling assets, or withdrawing children from school, which ultimately is likely to have positive long-term impacts on household well-being. Women with greater social and political capital are more likely to engage in migratory or off-farm employment, probably because they have more developed social networks and better access to information about income generating opportunities.

Interestingly, political capital among primary household adult men is positively correlated to borrowing in response to shocks. Men likely benefit from their social status in their community, and as members of a political group they can find more lending sources than those who are not active in political groups especially in the context of Bangladesh. From this analysis of the determinants of coping mechanisms it appears that alternative options to cope are largely independent of each other.

### **3.5. Conclusions**

In this chapter the determinants of long-term adaptation strategies and short-term coping mechanisms among agricultural households in Bangladesh are empirically explored. The results indicate that Bangladeshi farmers (especially those with assets and access to credit, extension services, and ICT; greater female group participation; and more exposed to climate change related shocks) typically already perceive that climate change is occurring, which also supports the previous results based on the baseline data from Thomas et al. (2013) and the qualitative study of Davis and Ali (2014). The latter study also identifies factors that constrain the ability of male and female household heads to adopt adaptation strategies, such as the lack of information about adaptation and climate change, financial shortcomings, the lack of access to inputs, and shortages of water which is in line with our findings.

Participating households choose more crop adaptation strategies rather than strategies for livestock, especially those that participate in social groups, among which male-headed households cope and adopt adaptation strategies more than female-headed households. This may simply be due to the fact that the groups they participate in are more oriented towards crop than livestock production adaptation. Social capital among adult males, which is more than mere group participation, is negatively associated with adopting different crop and livestock adaptation strategies; whereas social capital among adult females and political capital among both adult males and females is positively associated with adoption of adaptive strategies. Social capital among both adult males and females is negatively associated with coping mechanisms such as selling household asset bases, borrowing from informal sources, and taking children out of school as opposed to generating alternative income through seeking migratory or off-farm employment. Households are more likely to engage in coping mechanisms for dealing with idiosyncratic non-climatic shocks rather than for covariate climatic shocks, which supports the findings of Santos et al. (2011), although experiences with the latter form of shocks is associated with the adoption of long-term crop production adaptation strategies. Furthermore, although farmers often choose to adopt a number of complementary adaptation strategies, coping mechanisms are typically pursued independently.

These findings suggest that greater access to information and means of communication can help farmers perceive climate change and adapt by modifying how they manage the production of crops and livestock. Similarly, training opportunities for women could encourage the adoption of livestock production adaptation strategies, which is less common among women in the study area. In addition, given that households primarily cope with climatic shocks by modifying their diets, training opportunities could also help households learn to store food for periods of negative shocks.

Increasing food aid and other relief during times of negative shocks could help household members avoid the need to skip meals or eat less—a practice that is even more prevalent in response to negative non-climatic shocks—while at the same time protecting household asset bases and per capita consumption levels. Given that social capital among women is positively

associated with the adoption of adaptation strategies, awareness campaigns targeting women could be offered by local organizations and broader media outlets on a range of subjects, such as the long-term detrimental impacts of keeping children out of school or reducing food intake.

Participation in social groups by both men and women is an important factor associated with the adoption of crop adaptation strategies, and participation by women is particularly important for enhancing perceptions of climate change, which should be encouraged by the government through appropriate policy. Government policies to improve household access to extension services should be pursued, which would improve and diversify knowledge among farmers about innovative adaptation strategies for both crop and livestock management. Improving opportunities for households to generate off-farm income could provide another strategy for mitigating negative shocks. The analyses do not disaggregate data by gender of farmers who adapt and cope, which might be important for further investigation given the growing contribution of women in agricultural sector in Bangladesh. Future research efforts using panel data and data disaggregated by gender of farmer will improve understanding of the complexities of mitigating climate change and other shocks.



## CHAPTER 4. PROTECTING ASSETS AND ENHANCING WELFARE: THE GENDER-DIFFERENTIATED POTENTIAL OF GROUP-BASED APPROACHES<sup>27</sup>

### 4.1. Introduction

Social capital generated through group membership is an important tool of risk management in developing countries. In particular, group based approaches, which consist of the participation in social groups and political parties (Verba et al. 1978), can serve to increase risk awareness and to offer coping strategies for different types of risk to rural households (Bhattamishra and Barrett 2008), for example related to climatic risk. While studies on the relationship between group participation and household welfare exist, the fact that the participation of men and women in groups may have different impacts has not been explicitly addressed (e.g. Grootaert 1999, Narayan and Pritchett 1999), a gap this chapter attempts to fill. To be precise, factors associated with participation are identified in typically male and typically female groups, and investigate the gender-differentiated impact of social and political capital on household welfare, as well as on the welfare of household heads and their spouses within households, paying particular attention to addressing the endogeneity inherent in the relationship. The result suggests that social capital is beneficial for household welfare in general and particularly so for assets of household heads, and that this effect is not merely driven by the participation in groups but also by other aspects of social capital such as networks.

Group membership offers a way of building capital for those who do not possess or have access to physical and natural capital, or those with low levels of human capital (Anderson et al. 2002). To be precise, participation increases social capital (Godquin and Quisumbing 2008) and some groups provide credit and training that may be used as collateral to invest in other forms of capital. Membership in groups may also be a way of managing natural capital by offering information and technology, of strengthening human capital through trainings and information, and of increasing financial capital, thereby increasing income and, in turn, wealth. Group-based

---

<sup>27</sup> This chapter of the thesis strongly builds on 'Protecting Assets and Enhancing Welfare: The Gender-Differentiated Potential of Group-Based Approaches' a research paper coauthored with Julia Anna Matz.

microfinance programs, for example, often increase the earnings of group participants by investing in assets necessary for small-scale income generating activities such as livestock, sewing machines, and looms (Anderson et al. 2002).

With respect to the characteristics of participants, risk uniformity among group members allows participants to share ex ante measures and information (Stiglitz 1990), whereas asset rich and asset poor members in the same group may pool risk better ex post by offering financial support within groups if needed (Zeller 1998). The importance of group activities therefore extends beyond the purely social aspect, which lays the foundation for this study.

The chapter is structured as follows: the existing literature on the relationship between social and political capital and household welfare are reviewed in the following section and the household survey data used are presented in Section 4.3. The empirical strategy, including discussions of the endogeneity inherent in the relationship and of the results, is presented in Section 4.4. Section 4.5 concludes.

## **4.2. Relation of the Study to the Existing Literature**

Even though there is broad consensus on the concept, there are different definitions of social capital. For Coleman (1990), social capital is given by the mutual relationship between individuals that enables them to achieve common goals. Similarly, Putnam (1995) sees it as a collective form of capital enhancing the collective benefit, while Lin (1999) takes a more individualistic view and defines it as an asset helping individuals to reach their personal goals. Both Coleman (1990) and Putnam (1995) stress trust, personal relations between group members, and social norms as important elements of social capital. In line with this, Putnam (1993) states the importance of considering the nature of participation, and group structure and density, and Narayan and Pritchett (1999) combine group density at the village level, the heterogeneity of groups with respect to income and kin, and the degree of effective group functioning into a social capital index. Grootaert (1999) extends the definition by Narayan and

Pritchett (1999) by adding the costs of participation and the degree of orientation of groups towards community interests.

Besides membership in social groups disseminating knowledge or information on strategies to cope with shocks and to adapt to climate change as mentioned above and by, for example, Adger (1999), Aker (2005), and Schoon (2006), frequent interactions and close physical proximity among group members enable the identification of the most vulnerable among them, which improves targeting of assistance (Bhattamishra and Barrett 2008). In addition, Putnam (1995) mentions that group activities often act to increase trustworthiness within and the well-functioning of groups.

A concept that is related to social capital is that of political capital (Verba et al. 1978), which may complement social capital in strengthening resilience to adverse events. Booth and Richard (1998) define political capital as the commitment to democratic norms, to hold and exercise voting rights, to participate in campaigning activism, and to contact public officials. Birner and Wittmer (2003) take a very similar but slightly broader point of view and define political capital to include electoral power, the ability to organize demonstrations and public rallies, to lobby decision makers and administrative officials, and to influence or create ideologies that may influence public opinion and attract international support. The participation in groups often works as a stimulator to these factors, for example by reinforcing the knowledge of citizen's rights.

Besides the mentioned advantages of group membership, there are also other aspects that need to be considered, for example vertical relationships of power between male and female or poor and affluent members, many groups being informal, membership not guaranteeing the acquisition of social capital, and costs associated with membership. Different levels of power within groups may, for example, hamper the accumulation of social capital and Ostrom (1990) mentions that, if there is a lack of communication and trust or disagreement about the common interest among members, group-based approaches may fail. Similarly, Meinzen-Dick et al. (2012) mention that power structures inherent in communities may be translated to groups,

thereby excluding the already marginalized also from benefits accruing from group membership. Bhattamishra and Barrett (2008) also points out that the poor, women, and members of ethnic minorities are often excluded from participating in groups and the resulting benefits. In line with this, Quisumbing et al. (2008) find that poor people participate in fewer groups and have smaller networks than households with more human and physical capital in the Philippines. Furthermore, groups involve costs, which may contribute to the poor not participating. Besides the direct costs accruing to members in the form of fees, Weinberger (2000) mentions the costs associated with communication, compromising, and cooperation from the point of view of organizations, where, for example, the size of group and their heterogeneity matter.

A more general concern is that investment in adaptive measures may also be discouraged through strong networks with neighbors and friends due to the dissemination of conflicting or confusing information (Di Falco and Bulte 2013). Furthermore, the ability of group-based approaches to influence individual adaptation strategies is limited due to the focus on the encouragement of group-based adaptation through the enforcement of social norms and the practice of collectively oriented strategies (Agarwal and Perrin 2008, Nam 2011). In addition, social funds are often spent on coping with challenges related to, for example, population growth; increasing mobility, and frequent climatic shocks, rather than on ameliorating community-based risk (Bhattamishra and Barrett 2008).

When it comes to factors associated with participation, much of the literature has focused on characteristics of the household rather than the individual (e.g. Grootaert 1999, Bandyopadhyay et al. 2004, Aker 2005, Quisumbing et al. 2008). Bandyopadhyay et al. (2004), for example, find different indicators of economic wellbeing and human capital, the participation rate within the village, and the loss of livestock through wild animals to be positively associated with the participation in community conservation programs. Weinberger (2000), on the other hand, focuses on individual characteristics such as age, education, and a within-household bargaining power index, besides household-level ones such as wealth and household size when investigating group membership.

Paying attention to gender-differences is of importance due to the different roles and responsibilities, and thereby different drivers of group membership, of men and women, however. With respect to formal groups in the Philippines, Godquin and Quisumbing (2008) find wealth and human capital to be positively associated with group membership in general and, to be more specific, education to have a particularly positive effect on the membership of women in groups and relatively poor men to be less likely to participate in productive groups. Furthermore, exposure to shocks tends to increase female participation. Quisumbing (2009) supports the latter finding with data from Bangladesh, with the opposite effect of shocks on the likelihood of men participating. In contrast to the findings of Godquin and Quisumbing (2008) in the Philippines, she also finds poor households, on average, to be more likely to be group members in Bangladesh, and for education and land ownership to positively impact on the participation rates of household heads. In addition, Quisumbing (2009) states that there are more female participants in formal groups founded by non-governmental organizations (NGOs). This, however, may be due to the fact that the data were based on an impact evaluation of the activities of NGOs, which limits the generalizability of the findings and is where this chapter aims to contribute.

Relating social capital to household welfare, Miller et al. (2004) state that group membership may lead to households exiting poverty and becoming more resilient to shocks (cited in Bradshaw 2006). Similarly, Narayan and Pritchett (1999) find a positive association between social capital measured by an index combining the frequency of interactions with groups and characteristics relating to their structure, and household welfare in Tanzania. Grootaert (1999) adds to these results by disaggregating social capital and including a larger number of group and individual characteristics, for example the number of groups a household participates in. The author states social capital to benefit household welfare in the long run through access to credit and an increase in asset accumulation, which differs, however, by whether membership is mandatory as stipulated by the government or voluntary with the latter being more beneficial. Adding to this by including trust within groups, Olawuyi and Oladele (2012) find that distrust among members is widespread and harmful to welfare in Nigeria. Similarly to the current study, Zeller et al. (2001) look at Bangladesh, but focus on group-based financial institutions and do

not pay attention to gender differences apart from controlling for the gender of the household head. They find positive associations of membership with welfare, specifically through better nutrition, health, and children's education.

### **4.3. Data**

The household survey data collected in 2012 among 800 agricultural households is used for this chapter. The earlier round of data from 2010 cannot be used for this study, however, due to the absence of crucial information for this investigation such as details on the participation in groups and on social and political capital. The data collected in 2012, however, includes information on individual membership in groups as well as individual asset ownership besides the rather standard questions on, for example, household structure and characteristics. Basic summary statistics of the characteristics of the households in the sample are presented in Table A4.1 in the appendix. In the remainder of this section we focus on presenting the variables related to group membership and social and political capital, all other variables used in the estimation are presented when the empirical strategy is discussed. Note that the sample exclusively consists of households with male, married heads.

#### **4.3.1. Group Membership**

Household heads and their spouses were directly asked about their membership and extent of participation in formal and informal groups, and in both voluntary and involuntary associations. Furthermore, they were asked detailed questions about the activities, characteristics, costs, and benefits of the two most important groups they participate in. Household heads participate in one to two groups on average, while their spouses are only involved in one as presented in Table A4.1 in the appendix. Table 4.1 displays group membership rates of household heads, spouses, and any household member in different types of groups. It is obvious that farmer

groups, credit groups, and religious groups are the most important ones in terms of relative participation, while the nature of participants differs greatly. While farmer groups appear oriented towards male participation (indicated by 46% of household heads being members), credit groups are much more important for women with 30% of the spouses of household heads being members. The latter is expected because of the large prevalence of credit groups targeted at women, because of these groups having been established, in most cases, by NGOs in Bangladesh, and because women’s assets are more vulnerable to depletion in the presence of adverse events (see e.g. Rakib and Matz 2014). In general, group membership is widespread with 78% of household heads and 43% of their spouses being members of at least one group.

**Table 4.1: Group membership rates of household heads, their spouses, and any household members**

Type of group	HH heads	Spouses	Any household member
Farmer group	46.1	0.3	46.4
Credit group	5.3	30.2	34.7
Religious group	13.6	2.8	16.4
Women’s group	0	5.0	5.1
Political group	5.1	0.2	5.3
Community group	2.8	0.8	3.6
Any group	78.0	43.3	89.4

Notes: All figures are percentages.

Costs of group membership for participants accrue both in the form of cash (registration and membership fees and contributions to group funds measured in Bangladeshi taka), and in labor contribution to group activities (measured in hours per week).<sup>28</sup> While a larger proportion of female respondents pay registration fees, their size is bigger for household heads than for their spouses conditional on payment (see Table 4.2). With respect to the monthly obligatory payment, female respondents are slightly more likely to pay these but they report very similar amounts as their husbands, while the mostly voluntary yearly contribution is higher for household heads, who are also much more likely to pay. On the other hand, household heads

<sup>28</sup> One US-dollar corresponded to 81 Bangladeshi Taka in September 2012 (International Monetary Fund 2012).

are less likely to contribute labor to group activities but, if they do, they spend more time on this than their wives.

**Table 4.2: Costs of participation in the most important group**

Type of costs	HH heads			Spouses		
	Percentage of heads paying/ contributing	Mean	Std. Dev.	Percentage of spouses paying/ contributing	Mean	Std. Dev.
Registration fees in taka	14	339.6	769.8	54	73.2	129.6
Monthly payment in taka	26	97.5	175.8	38	107.0	98.9
Yearly contribution in taka	18	5248.1	41192.9	7	640.2	433.5
Weekly labor hours	51	1.4	1.7	78	1.0	0.9

Table 4.3 presents the perceived benefits of group membership as reported by household heads and spouses in relation to their self-reported most important group. Almost a third of household heads who participate in groups find them to improve household welfare, while less than 14% of spouses mention this. For female respondents, on the other hand, group membership appears to be more important to cope with shocks as almost a quarter of them state this as a main benefit of their most important group. Other main advantages of groups are that they are sources of information and benefit the community, where it has to be noted that these were mainly mentioned by male respondents.

**Table 4.3: The benefits of group membership**

Type of benefit	HH heads	Spouses
Improve current household livelihood	31.15	13.86
Important in times of shocks	16.67	24.14
Source of information	15.26	4.36
Benefits the community	13.24	1.87
Enjoyment or recreation	2.65	1.4
Other benefits	1.09	0.62

Notes: All figures are percentages.



### 4.3.2. Group Membership and Shock Resiliency

Table 4.4 and 4.5 show the percentage of households affected by different types of shocks reported in the base year and in the resurvey year respectively, with respect to the date of becoming member in the very first group. Given shorter recall period and yearly nature of the weather shocks, the respondents were asked how many times in the past five years the listed weather events affected and in which year it was the most devastating in nature. While the recall periods differ between table 4.4 and 4.5 and other underlying factors might influence group membership, we cannot establish any causal relationship.<sup>29</sup> Households involved with groups for longer time seem to be more resilient to negative shocks between 2006 and 2010 reported in 2010 and to shocks between 2011 and 2012 reported in 2012. In the base year, 5 percent of households among those who are affected by flood in last five years have been group members for more than 40 years while 48 percent of the flood affected households became participants after 2000. Similarly, for other negative shocks, the longer period of group membership is positively associated with less exposure of the households to shocks.

**Table 4.4: Percentage of households affected by different types of shocks from 2006 to 2010 reported in the baseline with respect to their year of joining in groups**

Joining period	Climate change shocks			Non-climatic negative shocks		Positive shocks	
	Flood	Drought	Cyclone	Death/illness	Dowry payment	Remittance	Inheritance
From 1960 to 1970	5	2	3	2	0	0	0
From 1971 to 1980	6	8	6	9	16	11	6
From 1981 to 1990	18	12	7	13	5	18	24
From 1991 to 2000	23	26	24	31	21	21	29
From 2001 to 2010	48	52	60	45	58	50	41
Up to February 2011	11	10	9	9	10	18	19

Notes: All figures are percentages.

Households affected by shocks reported in the resurvey year shows similar trend. It is noticeable that, in both tables, remittance and inheritance increased with the latest group

<sup>29</sup> Later in the chapter we analyzed the correlates of group participation and its impact on household welfare in detail.

memberships. Probably, the provisions of immigration increased day by day or alternatively with improvement of internet and communication, the information of migration is more available to mass population.

**Table 4.5: Percentage of households affected by different types of shocks from 2011 to 2012 reported in the resurvey round with respect to their year of joining in groups**

Joining period	Flood	Drought	Cyclone	Death/illness	Dowry payment	Remittance	Inheritance
From 1960 to 1970	2	2	3	2	0	3	4
From 1971 to 1980	4	6	8	6	7	9	8
From 1981 to 1990	13	11	6	8	11	14	19
From 1991 to 2000	20	21	20	25	15	15	8
From 2001 to 2010	41	41	40	42	44	37	27
From 2011 to 2012	5	10	9	9	16	14	23

Notes: All figures are percentages.

### 4.3.3. Social and Political Capital

To measure social and political capital several characteristics of groups and the nature of membership are combined into separate indices for social and political capital, and a combination of the two, using a principal component analysis.<sup>30</sup> To be precise, the nature of the respondent's network,<sup>31</sup> the payment of membership costs, labor contributions to the group, whether a member is an active co-decision maker within the group and whether he attends meetings regularly, whether the individual participates in community-based activities, whether he generally has trust in neighbors and fellow villagers, and whether groups participated in are heterogeneous with respect to wealth and gender are components of the social capital index. Information on whether a respondent votes in national elections, attends local council meetings and protests, mentions local problems to the media or police, and whether he believes his

<sup>30</sup> The social and political capital indices are constructed like the physical asset index used in Rakib and Matz (2014).

<sup>31</sup> Indicator variables such as whether there are close friends and neighbors the respondent can borrow from in times of need, whether somebody would mind the respondent's children if necessary, and whether other people seek help from the respondent if necessary give information on the respondent's informal network.

opinions and decisions are considered and valued by elites, forms the political capital index. Both indices as well as the combined one are normalized to range between zero and one.

Table 4.6 presents average values of the social and political capital indices by different categories of individuals and households. It shows, for example, that the index of social capital takes a value of 0.33 for literate household heads and a value of 0.30 in the case of illiterate ones. It is apparent that male respondents hold more social and political capital, on average, than female ones, and that there is an inverse U-shaped relationship with age. Interestingly, having experienced climatic or other negative shocks is associated with higher social and political capital, which may be due to negatively affected household relying relatively strongly on group-based approaches in coping with adverse events.<sup>32</sup>

Furthermore, while social capital of head increases with wealth measured by both consumption expenditure and household physical asset; this is not the case for spouses or political capital (Table 4.6). Therefore, being in the same household while social or political capital of head increases, spouses' do not which lead us to assume that head and spouse are different entity even though they are members of the same household.

---

<sup>32</sup> The category "non-climatic negative shocks" comprises death or illness of family members and dowry payments. Remittances, inheritances, and the receipts of dowries are classified as "positive shocks". Please see Rakib and Matz (2014) for more detail on the nature of shocks and their effects on asset holdings of household heads and their spouses.

**Table 4.6: Values of the social and political capital indices for household heads and their spouses by binary individual and household characteristics**

	Social capital		Political capital	
	HH heads	Spouses	HH heads	Spouses
<b>Literacy of respondents</b>				
Literate	0.33	0.27	0.50	0.47
Illiterate	0.30	0.26	0.48	0.47
<b>Age of respondents</b>				
25 and below	0.33	0.25	0.45	0.44
26 to 40	0.34	0.28	0.52	0.47
41 to 55	0.36	0.27	0.52	0.48
56 and above	0.34	0.26	0.49	0.47
<b>Prevalence of shocks</b>				
Affected by climatic shocks	0.35	0.28	0.52	0.47
Not affected by climatic shocks	0.32	0.25	0.49	0.47
Experienced non-climatic negative shocks	0.34	0.29	0.51	0.47
Not experienced non-climatic negative shocks	0.34	0.27	0.50	0.47
Experienced positive shocks	0.37	0.30	0.49	0.47
Not experienced positive shocks	0.33	0.26	0.52	0.47
<b>Quintile of household consumption expenditure per capita</b>				
1 <sup>st</sup> quintile	0.28	0.27	0.50	0.47
2 <sup>nd</sup> quintile	0.34	0.28	0.51	0.47
3 <sup>rd</sup> quintile	0.34	0.27	0.50	0.47
4 <sup>th</sup> quintile	0.35	0.28	0.52	0.47
5 <sup>th</sup> quintile	0.39	0.27	0.52	0.47
<b>Quintile of household total physical asset</b>				
1st quintile	0.27	0.27	0.48	0.46
2nd quintile	0.31	0.27	0.49	0.47
3rd quintile	0.31	0.26	0.49	0.46
4th quintile	0.34	0.27	0.51	0.47
5th quintile	0.36	0.25	0.50	0.47

Notes: All figures are average values of the respective index.

#### **4.4. Empirical Findings**

This section begins by examining the factors associated with group membership in general and of male and female respondents separately. We continue by investigating the relationship between group membership, social and political capital, and household welfare, and discuss and address the inherent endogeneity. Throughout, it is allowed for gender-differentiated effects by separating social and political capital as well as welfare of household heads and spouses.

##### **4.4.1. Correlates of Participation in Groups**

The factors associated with group membership with the help of a Probit specification are investigated in which the dependent variables is binary for household-level membership of the household head or his spouse, or for each of them separately at the individual level. The marginal effects corresponding to this exercise are presented in Table 4.7, where columns (1) and (2) investigate household-level participation and columns (3) and (4) look at group membership of household heads and their spouses, respectively.

The result shows that education of the household head is positively associated with their likelihood of participating in groups, which is in line with the findings of Bandyopadhyay et al. (2004), while this is not the case for membership at the household level for spouses. On the other hand, the results indicate that women who are engaged in off-farm employment are more likely to be group members, while the coefficient on the corresponding variable for household heads is statistically insignificant.

Furthermore, a negative correlation between age and membership for both the household head and his spouse in two out of four columns is found, which is in contrast to Weinberger (2000). Household size is negatively and statistically significantly associated with group membership in three out of four columns, which may be due to larger families demanding more time being spent on providing for the family and less time being available for other activities.

**Table 4.7: Marginal effects of factors associated with participation in groups by gender**

	Participation of households		Participation of heads	Participation of spouses
	(1)	(2)	(3)	(4)
Years of schooling of HH head	0.002 (0.003)		0.009** (0.005)	
Years of schooling of spouse		0.004 (0.004)		-0.004 (0.007)
Age of HH head	-0.002** (0.001)		0.000 (0.002)	
Age of spouse		-0.001 (0.001)		-0.006** (0.003)
HH head employed off-farm	0.004 (0.035)		-0.019 (0.051)	
Spouse employed off-farm		0.033 (0.062)		0.230* (0.142)
Household size	-0.011** (0.006)	-0.011* (0.006)	-0.030*** (0.009)	0.002 (0.012)
Male-to-female ratio	0.012 (0.013)	0.012 (0.013)	0.014 (0.020)	-0.018 (0.025)
Household dependency ratio	-0.066 (0.080)	-0.082 (0.079)	-0.016 (0.113)	-0.271* (0.148)
Log of total plot size (square meters)	-0.002 (0.004)	-0.002 (0.004)	0.008 (0.005)	-0.004 (0.007)
Total livestock (TLU)	0.003 (0.034)	0.018 (0.039)	0.032 (0.049)	-0.067 (0.063)
Log of total value of assets	-0.001 (0.005)	0.000 (0.005)	0.010 (0.007)	-0.021** (0.010)
Access to television by HH head	0.007 (0.024)		0.042 (0.034)	
Access to television by spouse		-0.000 (0.026)		0.048 (0.044)
HH ownership of mobile phone	0.018 (0.027)	0.020 (0.026)	0.031 (0.036)	0.016 (0.045)
Affected by climatic shocks	0.030 (0.025)	0.033 (0.025)	-0.008 (0.033)	0.111*** (0.042)
Affected by non-climatic negative shocks	0.044* (0.023)	0.041* (0.023)	0.004 (0.035)	0.115*** (0.043)
Affected by positive shocks	0.043* (0.023)	0.044** (0.023)	0.017 (0.036)	0.174*** (0.046)
Pseudo R-squared	0.060	0.065	0.051	0.063
N	642	642	642	642

Notes: Robust standard errors are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.

Interestingly, the results indicate that the experience of any type of shock, both positive and negative, is positively associated with group participation, but especially so for women.<sup>33</sup> To be precise, having experienced a climatic shock in the past two years increases the likelihood of a household head's spouse being a group member by 11% with the impact of other negative and positive shocks being of similar or larger magnitude. It appears likely that information on coping strategies and support provided by a group is most needed and availed of in times of distress as suggested by the reported benefits of groups presented in Table 4.3. In line with this, a household's value of asset holdings is negatively related to female group membership.

Rather than investigating the factors associated with membership in any type of group, household-level membership in the most important groups are considered according to participation rates in the sample in Table 4.8: farmer groups (columns (1) and (2)), credit groups (columns (3) and (4)), and religious groups (columns (5) and (6)). Recall the gender differences in group participation: farmer groups, for example, mainly have male members, while credit groups mainly have female ones as discussed above.

Table 4.8 adds some interesting insights to the discussion of factors influencing group membership.<sup>34</sup> Education of the household head, for example, is negatively associated with household-level membership in farmer and credit groups, possibly due to less guidance and credit needed, while his and his spouse's education are positively correlated with membership in religious groups.

---

<sup>33</sup> Note that the results are largely robust to using variables indicating that a household has experienced a severe positive or non-climatic negative shock rather than any positive or non-climatic negative shock, with severe shocks being defined as shocks in which the ratio of the amount gained or lost, respectively; to total consumption expenditure is larger than the median value in the sample. Furthermore, note that climatic adverse events are classified as "shocks" only if more than one village of a union was affected.

<sup>34</sup> We have also checked whether household head's education and assets influence wife's group participation and vice versa. Education of head/wife is statistically significantly and positively correlated to group participation of the spouse. Although, wealth of head is positively and significantly associated with wife's group participation, wife's assets do not influence head's group participation.

**Table 4.8: Marginal effects of factors associated with household-level participation in groups by group type**

	Participation in farmer groups		Participation in credit groups		Participation in religious groups	
	(1)	(2)	(3)	(4)	(5)	(6)
Years of schooling of HH head	-0.012** (0.005)		-0.011** (0.005)		0.009** (0.004)	
Years of schooling of spouse		0.000 (0.007)		-0.009 (0.007)		0.009* (0.005)
Age of HH head	-0.003 (0.002)		-0.007*** (0.002)		0.004*** (0.001)	
Age of spouse		-0.003 (0.002)		-0.008*** (0.002)		0.006*** (0.001)
HH head employed off-farm	-0.062 (0.060)		0.042 (0.058)		0.043 (0.049)	
Spouse employed off-farm		-0.377*** (0.078)		0.172 (0.139)		0.196 (0.133)
Household size	-0.040*** (0.012)	-0.033*** (0.012)	0.006 (0.011)	0.004 (0.012)	0.008 (0.008)	0.004 (0.008)
Male-to-female ratio	0.029 (0.025)	0.027 (0.025)	-0.013 (0.023)	-0.010 (0.023)	0.000 (0.018)	0.004 (0.018)
Household dependency ratio	-0.010 (0.137)	-0.130 (0.144)	-0.435*** (0.131)	-0.385*** (0.137)	0.027 (0.094)	0.085 (0.096)
Log of total plot size (square meters)	0.005 (0.007)	0.003 (0.007)	-0.005 (0.006)	-0.006 (0.006)	0.006 (0.005)	0.007 (0.005)
Total livestock (TLU)	0.039 (0.059)	0.056 (0.058)	-0.086 (0.059)	-0.087 (0.059)	0.032 (0.040)	0.031 (0.041)
Log of total value of assets	0.011 (0.010)	0.006 (0.010)	-0.014 (0.009)	-0.015 (0.009)	-0.003 (0.007)	-0.003 (0.007)
Access to television by HH head	0.024 (0.043)		-0.018 (0.041)		-0.001 (0.032)	
Access to television by spouse		0.046 (0.044)		0.006 (0.042)		0.006 (0.032)
HH ownership of mobile phone	-0.053 (0.045)	-0.098** (0.045)	0.088** (0.043)	0.083** (0.042)	-0.013 (0.034)	0.003 (0.032)
Affected by climatic shocks	-0.053 (0.042)	-0.064 (0.042)	0.017 (0.040)	0.018 (0.040)	0.046 (0.028)	0.051* (0.028)
Affected by non-climatic negative shocks	0.065 (0.043)	0.064 (0.043)	0.055 (0.041)	0.046 (0.041)	-0.008 (0.030)	-0.002 (0.030)
Affected by positive shocks	0.035 (0.046)	0.030 (0.046)	0.170*** (0.045)	0.165*** (0.045)	0.024 (0.033)	0.031 (0.033)
Pseudo R-squared	0.035	0.041	0.070	0.066	0.050	0.055
N	642	642	642	642	642	642

Notes: Robust standard errors are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.

Furthermore, the negative association of age in Table 4.7 appears to be driven by the participation in credit groups, whereas higher age appears to increase the likelihood of



participating in religious groups. The negative coefficient on household size is only found for the participation in farmer groups in columns (1) and (2), while a high dependency ratio reduces the likelihood of group membership in credit groups as presented in columns (3) and (4).

In addition, the result shows some evidence for a negative association between ownership of a mobile phone and participation in farmer groups, but evidence of the reverse case for credit groups. Interestingly, having been affected by climatic shocks increases the likelihood of participating in religious groups, while positive shocks such as the receipt of remittances are positively associated with participation in credit groups, possibly due to more collateral becoming available in response to a positive shock.

#### 4.4.2. Group Membership, Social and Political Capital, and Welfare

When investigating the welfare effects of group-based approaches, we begin with a naïve approach that assumes all explanatory variables to be exogenous. To be specific, the following equation using Ordinary Least Squares (OLS) are estimated with heteroskedasticity-robust standard errors:

$$\ln(Y_i) = \alpha + \beta \text{Social capital}_{ij} + \gamma \text{Political capital}_{ij} + \delta \text{Human Capital}_{ij} + \rho \text{Other Physical Capital}_i + \mathbf{Z}_i \boldsymbol{\theta} + \mathbf{X}_i \boldsymbol{\sigma} + \epsilon_{ij} \quad , \quad (1)$$

where two dependent variables are used to measure the economic wellbeing of household  $i$ : the logarithmic value of total asset holdings, including, for example, consumer durables, agricultural goods, jewelry, and vehicles, and the logarithmic value of total monthly per capita expenditure on food and non-food items.<sup>35</sup> While we follow Grootaert (1999), Narayan and Pritchett (1999), and Aker (2005) in choosing consumption expenditure, both asset holdings and

---

<sup>35</sup> Note that the results for asset holdings are replicated with an index of asset holdings constructed with the help of a principal component analysis as used in Rakib and Matz (2014). The findings are largely robust but slightly weaker when using this alternative measurement as presented in columns (1) and (2) of Table A4.2 in the appendix. To be specific, the social and political capital of neither the head nor his spouse yields a statistically significant coefficient here.

expenditure are often-used measures of economic wellbeing as income is difficult to measure and not necessarily representative of the economic well-being of agricultural households.

The main explanatory variables are different sets of capital: social and political, human, and physical capital other than assets, i.e. land and livestock holdings. Apart from the latter due to the inability of accurately separating them by individual ownership, the types of capital are indexed by  $j$  for either being held by the household head or his spouse. To be specific, social and political capital is measured by the aggregate index introduced above, human capital is measured by years of schooling, and other physical capital is given by the logarithmic value of the household's total plot size and total livestock holdings measured in tropical livestock units (TLU).  $Z$  is a vector of individual characteristics of the household head or his spouse such as age and a binary variable for off-farm occupation, and  $X$  is a vector of household-level characteristics including household size, the male-to-female ratio, the dependency ratio, and measures for the exposure to climatic, other negative, and positive shocks. The error term is represented by  $\epsilon_{ij}$ .

A rather obvious challenge with respect to endogeneity arises from this exercise. Firstly, there may be reverse causality or simultaneity between physical wealth and social and political capital, an issue is discussed and addressed in the following section. Secondly, even though existing studies include physical capital when investigating the effect of social capital on consumption expenditure (Grootaert 1999, Narayan and Pritchett 1999, Grootaert 2001), land and livestock holdings may be subject to similar concerns. Note that the results described in the following are largely robust to the exclusion of these variables.

Table 4.9 presents the results of estimating equation (1) with a combined index for social and political capital, while by using separate ones is presented in Table A4.3 in the appendix. It is interesting to see that, while the combined social and political capital of household heads is associated with both physical capital (column (1)) and consumption expenditure (column (3)) in a statistically significant and positive way, the coefficients on the index for the social and political capital of their spouses are statistically insignificant (columns (2) and (4), respectively).

**Table 4.9: Aggregate social and political capital and economic well-being: OLS results**

	log of total assets		log of per capita consumption expenditure	
	(1)	(2)	(3)	(4)
Social and political capital of HH head	1.895** (0.735)		0.700*** (0.224)	
Social and political capital of spouse		-0.302 (0.904)		-0.141 (0.298)
Years of schooling of HH head	0.079*** (0.017)		0.037*** (0.006)	
Years of schooling of spouse		0.145*** (0.023)		0.052*** (0.008)
Age of HH head	-0.014* (0.008)		0.011*** (0.002)	
Age of spouse		-0.003 (0.010)		0.016*** (0.002)
HH head working off-farm	0.019 (0.204)		0.005 (0.061)	
Spouse working off-farm		-0.493 (0.622)		-0.076 (0.154)
Household size	0.032 (0.045)	0.048 (0.047)	-0.074*** (0.014)	-0.073*** (0.014)
Male-to-female ratio	-0.164 (0.107)	-0.165 (0.108)	0.028 (0.031)	0.027 (0.030)
Household dependency ratio	0.479 (0.595)	0.046 (0.639)	0.197 (0.152)	0.116 (0.160)
Log of total plot size (square meters)	0.045* (0.028)	0.046* (0.027)	0.002 (0.008)	0.005 (0.008)
Total livestock (TLU)	1.084*** (0.327)	1.148*** (0.330)	-0.040 (0.064)	-0.013 (0.064)
Affected by climatic shocks	-0.218 (0.171)	-0.180 (0.165)	0.071 (0.047)	0.088* (0.047)
Affected by non-climatic negative shocks	-0.422** (0.185)	-0.403** (0.185)	0.061 (0.048)	0.082* (0.050)
Affected by positive shocks	-0.032 (0.172)	-0.030 (0.172)	0.032 (0.050)	0.041 (0.053)
R- squared	0.112	0.116	0.182	0.160
N	642	642	642	642

Notes: Robust standard errors are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.

Education of both the household head and his spouse yield a statistically significant and positive coefficient in all columns, household size is negatively associated with per capita consumption expenditure, and livestock holdings positively with asset holdings. Surprisingly, having been affected by a climatic shock in the past two years yields a statistically significant and positive coefficient on consumption expenditure, possibly due to disaster relief and the need to buy

more food items than usually and to replace lost physical items. Similarly, while having experienced non-climatic negative shocks yields a negative and statistically significant coefficient for asset holdings, there is some evidence for a positive association with per capita consumption expenditure, which may also be explained by coping mechanisms such as the sale of assets to enhance consumption.

Investigating the results in Table A4.3 in the appendix, it is obvious that the positive association of the aggregate index of social and political capital of household heads is driven by their social capital. A further disaggregation is presented in Tables A4.4 and A4.5 in which the key explanatory variables are central components of social capital: group membership and informal networks, respectively.<sup>36</sup> It is interesting to see that group membership is statistically significantly and positively related to economic well-being for the household head only when these are measured by asset holdings, which indicates that there is more to social capital than simply the membership in groups. Furthermore, group membership of the spouse yields a statistically significant and negative coefficient with asset holdings and consumption expenditure per capita. Investigating Table A4.5, on the other hand, the informal network of both household heads and their spouses are found to play a critical role for household welfare as the coefficients on the informal network are statistically significant and positive in three out of four columns.

#### **4.4.3. Addressing the Endogeneity**

As briefly mentioned above, social and political capital are likely to be endogenous in equation (1). To be specific, membership in groups is not randomly assigned but individuals choose to participate, which may be influenced by economic wellbeing, the dependent variable, or other factors that influence both the membership in groups and wealth, for example education. In order to address this endogeneity, instrumental variables (IV) is used in a two-stage least

---

<sup>36</sup> Group membership is given by an indicator variable and the network is measured with an index computed with the help of a principal component analysis and on the basis of the indicator variables describing networks mentioned in Section 3.2.

squares estimation, the instruments used being the relative engagement of a household in groups, taking initiative in local development actions by that household, and trust in strangers. In the following in favor of the validity of each of these instruments are argued.

The relative engagement in groups is measured as the ratio of the number of groups a household participates in to the number of groups existing in the village the household resides in. While a positive association between this variable and social capital is obvious with social capital being built through the interaction with other individuals, it seems there is no direct and causal relationship with economic wellbeing. The chapter rests on the idea that group membership is beneficial to economic wellbeing but we fail to see why the *relative* engagement in groups should impact on household welfare, which makes this variable a valid instrument. Similarly, Bandopadhyay et al. (2004) use the village-level proportion of participants as an instrument and argue that it is related to household-level participation, but not causally to welfare.

Whether a household head takes initiative in local development steps may be an indicator of the willingness to cooperate with others and appears likely to be strongly positively correlated with the participation in groups and social capital. On the other hand, there appears to be no direct relationship with economic wellbeing in the sample: While it may possibly be understood as the likelihood of household heads to take these steps somewhat increasing with wealth measured by consumption expenditure (even though the increase is non-linear and non-monotonic), there is no linear relationship between economic well-being and the likelihood of spouses taking initiative for local development steps. To be specific, 20% of the spouses of household heads in wealth quintiles 1 and 4 are active in this, while it is 15-16% in quintiles 2 and 3, and 24% in the highest quintile, which shows that it is the spouses of households at the extremes of the distribution of economic wellbeing who are most likely to be active taking local development steps, making this another valid instrument.

**Table 4.10: The first stage**

	Social and political capital of HH head (1)	Social and political capital of spouse (2)
Relative participation	0.574*** (0.060)	0.182*** (0.046)
Initiative in local development steps	0.075*** (0.010)	-0.006 (0.007)
Trust in strangers	0.011*** (0.004)	0.009*** (0.003)
Years of schooling of HH head	0.002** (0.001)	
Years of schooling of spouse		-0.001 (0.001)
Age of HH head	0.000 (0.000)	
Age of spouse		0.000 (0.000)
HH head employed off-farm	0.001 (0.011)	
Spouse employed off-farm		0.039** (0.019)
Household size	0.004* (0.002)	0.000 (0.002)
Male-to-female ratio	-0.008 (0.005)	-0.002 (0.004)
Household dependency ratio	-0.004 (0.026)	-0.019 (0.021)
Log of total plot size (square meters)	0.001 (0.001)	-0.001 (0.001)
Total livestock (TLU)	0.009 (0.011)	0.006 (0.009)
Affected by climatic shocks	0.012 (0.008)	0.015** (0.006)
Affected by non-climatic negative shocks	0.000 (0.008)	0.004 (0.006)
Affected by positive shocks	-0.004 (0.009)	0.020*** (0.007)
First stage F-statistic	65.92	9.95
R- squared	0.305	0.081
N	642	642

Notes: Robust standard errors are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.

In line with much of the existing literature (Narayan and Pritchett 1999, Yusuf 2008, Grootaert 2001, Grootaert and Bastelaer 2001), trust is also used as an instrument for social capital. To be specific, self-reported trust in strangers that is measured with the help of a scale ranging from one to five with one denoting “To a very small extent” and five denoting “To a very large extent”

is used. Generally trusting individuals are likely to have closer ties with other individuals and therefore higher social capital, and trust in people in general increases the chance of ties outside of the village, thereby possibly also increasing social and political capital. On the other hand, we fail to see how trust in strangers could be causally related to welfare. Even though trust in friends and relatives may be related to wealth through experience also in an economic dimension, Narayan and Pritchett (1999) also argue that trust towards outsiders is a different and more general trait.

Table 4.10 displays the results of the first stage, i.e. of regressing the aggregate index for social and political capital on the instruments and additional explanatory variables. It is reassuring to see that there appears to be a strong relationship between all instruments and the endogenous variable as five out of six coefficients on the instruments are statistically significant and, according to expectation, positive.

Furthermore, the F-statistic is almost at a value of 10, the conventional threshold, in column (2) when the variables of the spouse of the household head are used, and significantly larger than that in the case of using individual variables of the household head in column (1), thereby indicating that the instruments are sufficiently correlated with the endogenous regressor, the aggregate index of social and political capital, at least in the case of household heads. In support of the argumentation for the validity of the instruments above, the Sargan statistic of the test for over-identification is statistically insignificant, i.e. there is no evidence of the instrumental variables being correlated with the error term of the second stage. The results of estimating the relationship with the help of an instrumental variables technique as outlined above are presented in Table 4.11.<sup>37</sup>

---

<sup>37</sup> Note that the results for asset holdings are replicated with an index of asset holdings. The findings are stronger with this alternative measurement as presented in columns (3) and (4) of Table A4.2 in the appendix. To be specific, social and political capital of the household head and his spouse both yield a statistically significant coefficient when the asset index is the dependent variable and an instrumental variables estimation technique is used. We still use the logarithmic value of asset holdings and not the asset index in the main specification, however, as the key explanatory variables, social and political capital, are also measured by indices.

**Table 4.11: Aggregate social and political capital and household welfare: IV results**

	Log of total assets		Log of per capita consumption expenditure	
	(1)	(2)	(3)	(4)
Social and political capital of HH head	2.631* (1.528)		0.942** (0.409)	
Social and political capital of spouse		5.683 (5.546)		4.223** (1.700)
Years of schooling of HH head	0.075*** (0.022)		0.036*** (0.006)	
Years of schooling of spouse		0.146*** (0.027)		0.052*** (0.008)
Age of HH head	-0.013** (0.007)		0.011*** (0.002)	
Age of spouse		-0.004 (0.009)		0.015*** (0.003)
HH head employed off-farm	-0.019 (0.250)		0.005 (0.067)	
Spouse employed off-farm		-0.706 (0.577)		-0.232 (0.175)
Household size	0.030 (0.047)	0.051 (0.049)	-0.075*** (0.013)	-0.070*** (0.015)
Male-to-female ratio	-0.161 (0.103)	-0.155 (0.106)	0.030 (0.028)	0.034 (0.032)
Household dependency ratio	0.474 (0.566)	0.166 (0.616)	0.196 (0.151)	0.203 (0.189)
Log of total plot size (square meters)	0.044 (0.027)	0.052* (0.028)	0.001 (0.007)	0.009 (0.009)
Total livestock (TLU)	1.067*** (0.242)	1.095*** (0.249)	-0.046 (0.065)	-0.052 (0.076)
Affected by climatic shocks	-0.234 (0.175)	-0.268 (0.193)	0.066 (0.047)	0.023 (0.059)
Affected by non-climatic negative shocks	-0.429** (0.176)	-0.437** (0.182)	0.059 (0.047)	0.058 (0.056)
Affected by positive shocks	-0.032 (0.185)	-0.163 (0.226)	0.032 (0.050)	-0.056 (0.069)
R- squared	0.110	0.075	0.180	0.081
N	642	642	642	642

Notes: Robust standard errors are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.



It is interesting to see that the hypothesized relationship between social and political capital and household welfare also exists in three out of four columns when the endogeneity inherent in the relationship is addressed.<sup>38</sup> Thus, the positive relationship between social and political capital found in the OLS estimation presented in Table 4.9 is supported. For consumption expenditure as the measure of household welfare, the relationship is also found for spouses of household heads rather than only for the latter as is the case in Table 4.9. Thus, the findings suggest that the social and political capital brought about by group-based approaches has positive effects on the economic wellbeing of households and is in line with Narayan and Pritchett (1999), Grootaert (1999), Aker (2005) and Yusuf (2008) with respect to the positive impact of social capital.

As expected, education is positively related to economic wellbeing, while age is positively associated with consumption, possibly due to dissaving, but negatively with asset holdings in one case. Land and livestock holdings are, unsurprisingly, positively related to wealth, but do not yield a statistically significant coefficient for consumption being the dependent variable. Household size is negatively associated with the latter, while non-climatic negative shocks yield a negative coefficient for asset holdings being the dependent variable.

Table A4.6 in the appendix presents the results of replicating the main findings reported in Table 4.11 with the separate indices for social and political capital rather than the combined one. The results largely support the main ones in Table 4.11 but also confirm a finding from the naïve OLS results to a certain extent: the effects of social and political capital found in the main results appear to be mostly driven by social rather than political capital, especially for consumption expenditure per capita. Consequently, the effects of group membership and informal networks on household welfare is investigated individually also when addressing the discussed inherent endogeneity. In contrast to the OLS results on group membership, there is no evidence of an association between group membership and asset holdings or per capita consumption expenditure here as presented in Table A4.7 in the appendix.

---

<sup>38</sup> Note that the results are largely qualitatively robust but slightly weaker when each of the three instruments is used separately in the estimation.

**Table 4.12: Informal network and household welfare: IV results**

	Log of total assets		Log of per capita consumption expenditure	
	(1)	(2)	(3)	(4)
Informal network of HH head	2.862 (4.028)		3.993*** (1.184)	
Informal network of spouse		1.807 (4.367)		3.832*** (1.280)
Years of schooling of HH head	0.084*** (0.022)		0.034*** (0.006)	
Years of schooling of spouse		0.145*** (0.027)		0.038*** (0.006)
Age of HH head	-0.015** (0.007)		0.010*** (0.002)	
Age of spouse		-0.003 (0.008)		0.010*** (0.002)
HH head employed off-farm	0.042 (0.251)		0.038 (0.074)	
Spouse employed off-farm		-0.490 (0.531)		0.053 (0.075)
Household size	0.034 (0.047)	0.048 (0.047)	-0.078*** (0.014)	-0.072*** (0.014)
Male-to-female ratio	-0.173* (0.103)	-0.171* (0.104)	0.025 (0.030)	0.011 (0.031)
Household dependency ratio	0.440 (0.570)	0.039 (0.594)	0.131 (0.167)	0.162 (0.167)
Log of total plot size (square meters)	0.045 (0.028)	0.047* (0.027)	-0.003 (0.008)	0.006 (0.008)
Total livestock (TLU)	1.123*** (0.239)	1.125*** (0.243)	-0.030 (0.070)	-0.068 (0.072)
Affected by climatic shocks	-0.199 (0.175)	-0.201 (0.176)	0.054 (0.051)	0.051 (0.052)
Affected by non-climatic negative shocks	-0.410** (0.176)	-0.393** (0.177)	0.062 (0.052)	0.090* (0.052)
Affected by positive shocks	-0.057 (0.188)	-0.051 (0.188)	-0.001 (0.055)	0.003 (0.055)
R-squared	0.113	0.116	0.012	0.013
N	642	642	642	642

Notes: Robust standard errors are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.

Considering further disaggregation in types of group main adult male and female of the households are members of, household welfare and merely group membership are not associated with although religious group participation by male is positively associated with household per capita consumption expenditure (see Table A4.8). On the other hand, even

though the OLS results on this (see Table A4.5) are not fully supported, Table 4.12 strongly suggests that informal networks are a driver of the positive association between social and political capital and consumption expenditure.

#### **4.4.4. Gender-disaggregated Welfare**

After investigating the effects of social and political capital and selected aspects of the former on the economic wellbeing of households, we now turn to disaggregating household welfare and focus on individual asset holdings of the household head and his spouse as the dependent variables. Similarly to the main specification, the logarithmic value of the value of asset holdings is used, separated by ownership of the head or his spouse, and the empirical approach outlined above is followed otherwise, i.e. we move from a naïve OLS specification to an instrumental variables technique.<sup>39</sup>

The results of disaggregating household welfare are presented in Table 4.11 with the OLS results in columns (1) and (2) and the IV results in columns (3) and (4).<sup>40</sup> It is striking that social and political capital yield a positive and statistically significant coefficient only when asset holdings of the household head are the dependent variable, while no evidence for an association with wealth of his spouse is found, which illustrates the necessity of disaggregating asset holdings by individual ownership.

Education is also positively associated with the wealth of the head only, while household size yields a statistically significant and negative coefficient with asset holdings of the spouse being the dependent variable. The ratio of males to females within the household is statistically significantly associated only with asset holdings of the spouse, in a positive way. Livestock ownership is consistently positively associated with the asset holdings of both the head and his

---

<sup>39</sup> Note that the results reported in this section are also robust to using indices for individual asset holdings as reported in Table A4.9 in the appendix.

<sup>40</sup> We have checked the spillover effect of spouse's social and political capital on head's assets and head's social and political capital on spouses' assets in OLS and IV regressions, which do not show significant impact of any spouse's social capital on the other spouse's assets.

spouse, while land ownership, which is a male dominated asset, yields a statistically significant and positive coefficient with wealth of the household head only. Non-climatic negative shocks are found to be negatively related only to economic wellbeing of the head, while there is some evidence for a positive association between positive shocks and assets of the spouse of the household head when instrumental variables are used.

**Table 4.13: Aggregate social and political capital and gender-disaggregated welfare**

	OLS		IV	
	Log of total assets of the HH head (1)	Log of total assets of the spouse (2)	Log of total assets of the HH head (3)	Log of total assets of the spouse (4)
Social and political capital of HH head	1.826*** (0.628)		3.159** (1.219)	
Social and political capital of spouse		0.418 (1.995)		-7.089 (9.830)
Years of schooling of HH head	0.070*** (0.016)		0.063*** (0.017)	
Years of schooling of spouse		0.035 (0.050)		0.034 (0.049)
Age of HH head	0.007 (0.006)		0.007 (0.005)	
Age of spouse		-0.041*** (0.015)		-0.039*** (0.015)
HH head employed off-farm	0.128 (0.187)		0.129 (0.199)	
Spouse employed off-farm		0.339 (0.816)		0.606 (1.022)
Household size	0.048 (0.040)	-0.431*** (0.090)	0.044 (0.038)	-0.434*** (0.086)
Male-to-female ratio	0.016 (0.108)	0.442** (0.170)	0.022 (0.082)	0.429** (0.188)
Household dependency ratio	0.085 (0.510)	1.688 (1.071)	0.077 (0.452)	1.538 (1.093)
Log of total plot size (square meters)	0.078*** (0.023)	-0.010 (0.051)	0.075*** (0.022)	-0.018 (0.050)
Total livestock (TLU)	0.421** (0.188)	1.047** (0.455)	0.390** (0.193)	1.114** (0.441)
Affected by climatic shocks	-0.004 (0.150)	0.253 (0.312)	-0.033 (0.140)	0.365 (0.343)
Affected by non-climatic negative shocks	-0.378*** (0.141)	-0.185 (0.322)	-0.389*** (0.141)	-0.143 (0.322)
Affected by positive shocks	0.009 (0.134)	0.526 (0.332)	0.010 (0.148)	0.693* (0.400)
R- squared	0.110	0.088	0.103	0.069
N	642	642	642	642

Notes: Robust standard errors are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.

#### 4.5. Conclusions

This chapter investigates the effect of social and political capital on economic wellbeing of households in Bangladesh, paying particular attention to identifying the causal relationship and to gender differences with respect to social and political capital, and wealth.

As a first step, the determinants of group membership of household heads and their spouses is studied and the result finds that men and women generally take part in different groups due to their different needs and opportunities. Farmer groups, for example, are to the very largest extent made up of male participants (possibly due to their relatively strong involvement in agriculture), while the members of credit groups are mostly women, which is likely due to NGOs encouraging credit use among women in the area and female assets being disproportionately negatively affected by adverse events such as climatic and non-climatic shocks. Furthermore, household heads participate in more groups than their spouses on average, who are more likely to spend time on group activities but devote less time to group activities if they do, possibly due to their workload and widespread involvement within the household.

Turning to the relationship between social and political capital and economic wellbeing, a combined index of social and political capital and separate ones are developed, and particular attention to addressing the endogeneity inherent in the relationship is paid. To be specific, while the prior is that social and political capital has a positive impact on household welfare, causality may not necessarily run in the hypothesized direction if economic wellbeing facilitates group membership, possibly directly through less severe time constraints, or indirectly through education positively impacting on both, for example. Initially a naïve OLS estimation is conducted and subsequently employ an instrumental variables technique using the household's initiative in taking local development steps, the household's relative group membership, and trust in strangers as instruments. Overall, the result suggests a positive impact of social and political capital on household welfare in general, and especially so for asset holdings of household heads. Interestingly, this effect appears to be mainly driven by social capital. To be

more specific, the results suggest that it is not merely group membership but the strength of the informal network that leads to a positive association with household welfare.

Recalling that household heads are more likely to participate in groups to begin with, the finding that social capital is beneficial for especially their economic wellbeing invites the recommendation of policies aiming to increase active female group membership, possibly also in groups that are important for enhancing livelihood outcomes, and not mostly in those that help coping with adverse events. Active participation in these kinds of groups of women and strengthening their informal networks may help to improve their economic position within the household.

## CHAPTER 5. GENERAL CONCLUSIONS AND POLICY IMPLICATIONS

In this dissertation three closely related issues are investigated in Bangladesh, a country that is threatened by the negative effects of climate change: (1) the intra-household asset dynamics in response to a wide variety of shocks among rural agricultural households, (2) the factors that influence the short-term coping mechanisms and long-term adaptation strategies employed by households in response to shocks, and (3) the potential for group-based approaches to enhance household well-being and the factors associated with group participation. These three interrelated issues are analyzed based on a rich two-stage household survey dataset to offer insight into the development of appropriate policies and interventions for enhancing household assets and adaptation strategies, which have potentially large welfare impacts on households that suffer from the adverse impacts of climate change.

The results indicate that male household heads typically have more assets than their spouses, especially with respect to land, while jewelry is traditionally a female-owned asset. Household assets controlled by men and women are degraded differentially depending on the type of shock that is suffered. The physical assets of household heads are negatively affected by climatic shocks, particularly by cyclones, and assets owned jointly by husbands and wives are negatively affected by unexpected negative shocks such as death or illness. Predicted shocks often cause households to sell jointly owned assets. Jointly held assets are also accumulated in anticipation of negative shocks such as drought and dowries, which often represent significant assets to rural agricultural households.

Households probably have more difficulty liquidating jointly owned assets, in part because it is difficult to reach a mutual agreement by couples and also because the most important jointly owned assets are often kept until they are needed most. Disaggregating an asset index revealed a clearer breakdown of which types of assets are used to cope with particular shocks. The findings from the impacts on the overall asset index are supported by the fact that husbands

typically sell durable consumer goods in response to shocks, however, in general husbands protect assets that are used to generate income such as agricultural tools and large livestock.

Shocks and their effects on asset ownership are gender specific and gender issues are important determinants of in household resource allocation. Gender disparity in asset ownership and particularly land need to be directly addressed, in Bangladesh an important measure would be the reformation of national inheritance legislation. This would facilitate women's access to other forms of capital such as credit, because land can be used as collateral for loans. Increasing women's productive assets also has direct impacts on overall household well-being, especially for children. This would also strengthen bargaining power among women. Such a reform of increasing bargaining power would also help to reduce dowry practice, which is considered a major negative economic shock to families due to the enormous financial burden it places on low-income families in Bangladesh. Strict implementation of the existing law is necessary to restrict the practice. Furthermore, taking into account the coping mechanisms of men and women for dealing with shocks in the design of policy and programs that provide training and credit could help protect household assets and might enhance control over critical assets such as livestock.

The available options and associated factors that influence the adoption of long-term adaptation strategies and short-term coping mechanisms, and the perception of climate change among agricultural households in Bangladesh are also investigated. The results indicate that farmers rely on different type of assets for dealing with climatic shocks, and many already perceive the effects of climate change. However, not all farmers who perceive climate change take preventive measures. The lack of information about adaptation and climate change, financial limitations, limited access to agricultural inputs, and water scarcity are major constraints to the adoption of adaptive strategies for the effects of climate change.

Another important finding is that farmers are more likely to adopt adaptation strategies for crop production than for livestock production. Participation in social groups has an important role in the adoption of crop adaptation strategies, which are often chosen as complementary to each



other, and group participation among women in particular improves their perception. It is found that male household heads are more likely to engage in coping and adaptive measures than female household heads. Men and women with greater social capital are more likely to generate income from off-farm activities or migratory labor and are less likely to sell household assets, borrow from informal lenders, and to withdraw children from school as immediate measures for coping with shocks. Whereas long-term adaptive strategies are often considered as complementary, short-term coping measures are generally mutually independent.

Greater access to ICT among men and to training opportunities among women are important for the adoption of crop and livestock production adaptation strategies, as well as for awareness building about short-term coping tools. Campaign activities targeting women might be an effective tool for enhancing their social capital and participation in social groups is positively associated with making the decision to adopt adaptive practices and therefore should be considered by policy makers. Enhancing opportunities to generate off-farm income could be another strategy for dealing with negative shocks so that the poor do not liquidate their limited assets or compromise family diets. Opportunities to access credit during times of shock and food assistance or other forms of relief in times of negative shocks might be effective ways of preventing affected households from taking measures that negatively impact their well-being such as dietary restrictions, which are more prevalent in response to negative non-climatic shocks. These measures would also help to protect household asset bases and per capita consumption levels.

Finally, this research effort provides empirical evidence of the positive welfare impacts of group based approaches, which is broadly treated as social and political capital in disaggregated forms. Gender differentiation is considered in terms of social and political capital and asset ownership. The results suggest that men and women prefer different types of groups depending on the benefits they perceive from group membership. Women mostly participate in credit groups, mainly initiated by NGOs, that provide credit to women and women's groups. The majority of farmer group members are men. It is found that husbands generally participate more actively in

groups in numerical terms (of groups) and the amount of time spent in the most important group.

For the analysis of welfare impacts a comprehensive index was created that combined social and political capital by using a PCA, and also analyzed them separately. The endogeneity inherent in the relationships among welfare and social and political capital was addressed using a set of instruments: household initiatives for local development, household group membership, and trust in strangers. The results suggest that group approaches generally have positive welfare impacts as measured by per capita consumption expenditures and asset holdings of household heads, which is mainly motivated by social capital.

While social capital, human capital, livestock and land ownership, etc. have positive impacts on overall household welfare, these impacts differs for husbands and wives. As discussed above, greater welfare impacts on assets controlled by men are probably due to their more active participation in groups relative to women. Not only group membership but also strong informal networks are positively related with household welfare according to the findings. The positive results of group participation on men's welfare suggest that policy initiatives for active participation in groups by women might benefit the ability of households to cope with shocks and adapt to climate change - the benefit reported by women by participating groups, which would ultimately improve livelihood outcomes. Moreover, strengthening informal networks may help to enhance awareness among women because women are generally busy with household maintenance activities and therefore they are more likely to lack access to information. The study findings suggest that related policies should consider gender specific aspects of group participation because men and women benefit from group participation in different ways: women by receiving information that helps them to cope with shocks while men benefit from group participation by upgrading their means of support.

Household asset dynamics differ by gender based on a broad definition of both shocks and assets. The behavioral patterns of farmers subjected to shocks and the welfare impacts of these behavioral patterns, such as group based approaches were analyzed using a country

representative longitudinal dataset. However, it is also important to understand the gender disaggregated responses to shocks, especially in the case of the long-term adaptation strategies, which should be considered by subsequent research efforts. An economic cost-benefit analysis is needed to determine the advantages and disadvantages of adopting individual adaptation strategies. Moreover, to reveal the long-term welfare impacts of adopting adaptive strategies and group participation it is worthwhile for research efforts to use panel data.

## REFERENCES

- Adato M., M. R. Carter, and J. May., 2006. Exploring Poverty Traps and Social Exclusion in South Africa Using Qualitative and Quantitative Data. *Journal of Development Studies* 42 (2), pp. 226–247.
- Adger W. N., 1999. Social Vulnerability to Climate Change and Extremes in Coastal Vietnam. *World Development*, 27(2), pp. 249–269.
- Adger W. N., S. Huq, K. Brown, D. Conway, and M. Hulme, 2003. Adaptation to Climate Change in The Developing World, *Progress in Development Studies* 3, pp. 179–195.
- Agarwal A., and N. Perrin., 2008. Climate Adaptation, Local Institutions, and Rural Livelihoods. IFRI Working Paper, W081-6. International Forestry Resources and Institutions Program, University of Michigan.
- Ajani E. N., R. N. Mgbenka, and M. N. Okeke, 2013. Use of Indigenous Knowledge as a Strategy for Climate Change Adaptation among Farmers in Sub-Saharan Africa: Implications for Policy. *Asian Journal of Agricultural Extension, Economics & Sociology*, 2(1), pp. 23-40.
- Aker J. C., 2005. Social Networks and Household Welfare in Tanzania: Working Together to Get Out of Poverty, mimeo, Department of Agricultural and Resource Economics, University of California-Berkeley.
- Aktar S., and A. S. M. Abdullah., 2007. A Comparative Study on Hindu Law between Bangladesh and India. *Asian Affairs* 29 (4), pp. 61–95.
- Akter T., 2009. Climate Change and Flow of Environmental Displacement in Bangladesh, Unnayan Onneshan-The Innovators, [www.unnayan.org](http://www.unnayan.org).
- Anderson C. L., L. Locker, and R. Nugent., 2002. Microcredit, Social Capital, and Common Pool Resources. *World Development*, 30(1), pp. 95-100.
- Antonopoulos R., and M. S. Floro., 2005. Asset Ownership along Gender Lines: Evidence from Thailand. Levy Economics Institute Working Paper 418. Dutchess County, NY, US: Levy Economics Institute of Bard College.
- Arens J., 2013. *Women, Land and Power in Bangladesh: Jhagrapur Revisited*. University Press Limited, Dhaka, Bangladesh.
- Babbington A., 1999. Capitals and Capabilities: A Framework for Analyzing Peasant Viability, Rural Livelihoods and Poverty. *World Development* 27 (12), pp. 2021–2044.
- Bandyopadhyay S., M. N. Humavindu, S. Priya, and L. Wang, 2004. Do Households Gain from Community-based Natural Resource Management? An Evaluation of Community Conservancies in Namibia, Directorate of Environmental Affairs Research Discussion Paper No. 68, Namibia.

- Barrett C. B., T. Reardon, and P. Webb., 2001. Nonfarm Income Diversification and Household Livelihood Strategies in Rural Africa: Concepts, Dynamics, and Policy Implications, *Food policy* 26 (4): pp. 315-331.
- Barrett C. B., P. P. Marenja, J. McPeak, B. Minten, F. Murithi, W. Oluoch-Kosura, F. Place, J. C. Randrianarisoa, J. Rasambainarivo, and J. Wangila., 2006. Welfare Dynamics in Rural Kenya and Madagascar. *Journal of Development Studies* 42 (2), pp. 248–277.
- BCAS (Bangladesh Center for Advanced Studies), 2009. Policy Study on the Probable Impacts of Climate Change on Poverty and Economic Growth and the Options of Coping with Adverse Effect of Climate Change in Bangladesh. General Economics Division, Planning Commission; United Nations Development Program, Dhaka, Bangladesh.
- Bhattamishra R. and C. Barrett, 2008. Community-based Risk Management Arrangements: An Overview and Implications for Social Fund Programs, SP Discussion Paper No. 0830. Social Protection & Labor, the World Bank, Washington, DC, USA.
- Birner R., and H. Wittmer, 2003. Using Social Capital to Create Political Capital: How do Local Communities Gain Political Influence? A Theoretical Approach and Empirical Evidence From Thailand. In *The commons in the new millennium: challenges and adaptations* edited by Dolšak, N. and E. Ostrom, pp. 291-334. MIT Press, USA.
- Booth J. A., and P. B. Richard, 1998. Civil society, political capital, and democratization in Central America. *The Journal of Politics*, 60(03), pp. 780-800.
- Bradshaw T. K., 2006. Theories of Poverty and Anti-Poverty Programs in Community Development, Rural Poverty Research Center, Working Paper No. 06-05.
- Brody A., J. Demetriades, and E. Esplen., 2008. Gender and Climate Change: Mapping the Linkages, A Scoping Study on Knowledge and Gaps, Prepared for the UK Department for International Development, BRIDGE, Institute of Development Studies (IDS), UK.
- Brouwer R., S. Akter, L. Brander, and E. Haque, 2007. Socioeconomic Vulnerability and Adaptation to Environmental Risk: A Case Study of Climate Change and Flooding in Bangladesh, *Risk Analysis*, 27(2), pp. 313-326.
- Bryan E., C. Ringler, B. Okoba, C. Roncoli, S. Silvestri, and M. Herrero, 2011. Adapting Agriculture to Climate Change in Kenya: Household and Community Strategies and Determinants. *ILRI report to the World Bank for the Project "Adaptation of Smallholder Agriculture to Climate Change in Kenya"*.
- Bryan E., T. T. Deressa, G. A. Gbetibouo, and C. Ringler, 2009. Adaptation to Climate Change in Ethiopia and South Africa: Options and Constraints. *Environmental Science and Policy* 12 (4), pp. 413–426.
- Carter M. R., and C. Barrett., 2006. The Economics of Poverty Traps and Persistent Poverty: An Asset-based Approach. *Journal of Development Studies* 42 (2), pp. 178–199.
- Carter M. R., and J. May., 2001. One Kind of Freedom: Poverty Dynamics in Post-Apartheid South Africa. *World Development* 29 (12), pp. 198–2006.

- Carter M., P. D. Little, T. Mogue, and W. Negatu., 2007. Poverty Traps and Natural Disasters in Ethiopia and Honduras. *World Development* 35 (5), pp. 835–856.
- Carter T.R., and K. Mäkinen., 2011. Approaches to climate Change Impact, Adaptation and Vulnerability Assessment: Towards a Classification Framework to Serve Decision-making. MEDIATION Technical Report No. 2.1, Finnish Environment Institute (SYKE), Helsinki, Finland.
- Chang I., H. Hwang, M. Hung, M. Lin, and D. Yen. 2007. Factors Affecting the Adoption of Electronic Signature: Executives' Perspective of Hospital Information Department. *Decision Support Systems* 44 (1), pp. 350–359.
- Chowdhury J. A. 2009. Microcredit, Microenterprises, and Self-employment of Women: Experience from the Grameen Bank in Bangladesh. Center for Microfinance and Development Working Paper 0209. University of Dhaka, Bangladesh.
- Coleman J., 1990. *Foundations of Social Theory*. Harvard University Press, USA.
- Davis P. 2007. Discussions among the Poor: Exploring Poverty Dynamics with Focus Groups in Bangladesh. Chronic Poverty Research Centre Working Paper 73. Manchester, UK: Chronic Poverty Research Centre.
- ———. 2011a. Social Exclusion and Adverse Incorporation in Rural Bangladesh: Evidence from a Mixed-methods Study of Poverty Dynamics. Chronic Poverty Research Centre Working Paper 193. Manchester, UK: Chronic Poverty Research Centre.
- ———. 2011b. The Trappings of Poverty: The Role of Assets and Liabilities in Socio-economic Mobility in Rural Bangladesh. Chronic Poverty Research Centre Working Paper 195. Manchester, UK: Chronic Poverty Research Centre.
- Davis P., and S. Ali. 2014. Exploring Local Perceptions of Climate-change Impact and Adaptation in Rural Bangladesh. IFPRI Discussion Paper 01322, International Food Policy Research Institute, Washington, DC, USA.
- Deaton A. 1989. Saving and Liquidity Constraints. NBER Working Paper 3196. National Bureau of Economic Research, Cambridge, MA.
- Deere C., and C. Doss. 2006. The Gender Asset Gap: What Do We Know and Why Does It Matter? *Feminist Economics* 12 (1/2), pp. 1–50.
- Dercon S. 2004. Growth and Shocks: Evidence from Ethiopia. *Journal of Development Economics* 74 (2), pp. 309–329.
- ———. 2010. Risk, Poverty and Human Development: What Do We Know, What Do We Need to Know? In *Risk, Shocks and Human Development on the Brink*, edited by R. Fuentes-Nieva and P. A. Seck, 15–39. Palgrave Macmillan, Basingstoke, UK.
- Dercon S., and P. Krishnan. 2000. In Sickness and in Health: Risk-sharing within Households in Rural Ethiopia. *Journal of Political Economy* 108 (4), pp. 688–727.

- Deressa T. T., R. M. Hassan, T. Alemu, M. Yesuf, C. Ringler., 2008. Analyzing the determinants of farmers' choice of adaptation methods and Perceptions of climate change in the Nile Basin of Ethiopia. IFPRI Discussion Paper, 00798. International Food Policy Research Institute (IFPRI), Washington, DC, USA.
- Deressa T. T., C. Ringler., and R. M. Hassan., 2010. Factors Affecting the Choices of Coping Strategies for Climate Extremes: The Case of Farmers in the Nile Basin of Ethiopia, IFPRI Discussion Paper 01032, November, International Food Policy Research Institute, Washington, DC, USA.
- Di Falco S. and E. Bulte., 2013. The Impact of Kinship Networks on the Adoption of Risk-Mitigating Strategies in Ethiopia. *World Development*, 43, pp. 100–110.
- Dillon A., and E. Quinones., 2011. Gender Differentiated Asset Dynamics in Northern Nigeria. Food and Agriculture Organization of the United Nations ESA Working Paper 11-06. Rome: Food and Agriculture Organization of the United Nations.
- Duflo E., 2003. Grandmothers and Granddaughters: Old Age Pension and Intra-household Allocation in South Africa. *World Bank Economic Review* 17 (1), pp. 1–25.
- Duflo E., and C. Udry., 2004. Intrahousehold Resource Allocation in Côte d'Ivoire: Social Norms, Separate Accounts and Consumption Choices. NBER Working Paper 10498. National Bureau of Economic Research, Cambridge, MA.
- Duval R., J. Elmeskov and L. Vogel, 2007. Structural Policies and Economic Resilience to Shocks, Economics Department Working Paper No. 567, Organization for Economic Co-operation and Development, OECD Publishing, DOI: [10.1787/140152385131](https://doi.org/10.1787/140152385131)
- Easterling W. E., P. R. Crosson, N. J. Rosenberg, M. S. McKenney, L. A. Katz, K. M. Lemon., 1993. Agricultural Impacts of and Responses to Climate Change in the Missouri-Iowa-Nebraska-Kansas (MINK) Region. *Climate Change* 24, pp. 23–61, Kluwer Academic Publishers, the Netherlands.
- Ersado, L., H. Alderman, and J. Alwang., 2003. Changes in Consumption and Saving Behavior Before and After Economic Shocks: Evidence from Zimbabwe. *Economic Development and Cultural Change* 52(1): pp. 187-215.
- Fankhauser S., 1998. The Costs of Adapting to Climate Change, GEF Working paper 16, Global Environment Facility, Washington, DC, USA.
- Filmer D., and L. H. Pritchett., 2001. Estimating Wealth Effects without Expenditure Data—Or Tears: An Application to Educational Enrolments in States of India. *Demography* 38 (1), pp. 115–132.
- Gbetibouo G. A., 2009. Understanding Farmers' Perceptions and Adaptations to Climate Change and Variability: the Case of the Limpopo Basin, South Africa. IFPRI Discussion Paper, 00849, February, International Food Policy Research Institute, Washington, DC, USA.

- Giesbert L., and K. Schindler., 2010. Assets, Shocks, and Poverty Traps in Rural Mozambique. GIGA Working Paper 150, German Institute of Global and Area Studies, Hamburg, Germany.
- Godquin M., and A. Quisumbing., 2008. Separate but Equal? The Gendered Nature of Social Capital in Rural Philippine Communities. *Journal of International Development*, 20, pp. 1–21.
- Goldstein M., 1999. Chop Time, No friends: Intrahousehold and Individual Insurance Mechanisms in Southern Ghana, Manuscript, Department of Agricultural and Resource Economics, University of California, Berkeley.
- Grootaert C., 1999. Social Capital, Household Welfare and Poverty in Indonesia. Local Level Institutions Working Paper No. 6, Social Development Department, The World Bank, Washington, DC, USA.
- ———., 2001. Does Social Capital Help the Poor? A Synthesis of Findings from the Local Level Institutions Studies in Bolivia, Burkina Faso and Indonesia. Local Level Institutions Working Paper No. 10, Social Development Department, The World Bank, Washington, DC, USA.
- Grootaert C., and T. Van Bastelaer., 2001. Understanding and Measuring Social Capital: A Synthesis of Findings and Recommendations from the Social Capital Initiative. Social Capital Initiative Working Paper No. 24, the World Bank, Washington, DC, USA.
- Halvorsen, R. and R. Palmquist., 1980. The Interpretation of Dummy Variables in Semilogarithmic Equations. *The American Economic Review*, 70(3), pp. 474–475.
- Haveman R., and E. Wolff., 2001. Who Are the Asset Poor?: Levels, Trends, and Composition, 1983–1998. IRP Discussion Paper 1227-01. Institute for Research on Poverty, Madison, WI, US.
- ———. 2004. The Concept and Measurement of Asset Poverty: Levels, Trends and Composition for the U.S., 1983–2001. *Journal of Economic Inequality* 2 (2), pp. 145–169.
- Hoddinott J., 2006. Shocks and Their Consequences across and within Households in Rural Zimbabwe. *Journal of Development Studies* 42 (2), pp. 301–321.
- Hoddinott J., and A. Quisumbing., 2003. Methods for Microeconomic Risk and Vulnerability Assessments. Social Protection Discussion Paper 0324, Human Development Network, the World Bank, Washington, DC, USA.
- Hossain M., D. Lewis, M. L. Bose, and A. Chowdhury, 2007. Rice Research, Technological Progress, and Poverty: The Bangladesh Case. In *Agricultural Research, Livelihoods, and Poverty: Studies of Economic and Social Impacts in Six Countries*, edited by M. Adato and R. Meinzen-Dick. Baltimore: Johns Hopkins University Press.
- International Monetary Fund., 2012. Bangladesh, Selected Macroeconomic Indicators November 2012. Washington, DC, USA.



- IPCC (Intergovernmental Panel on Climate Change) 1996. *Climate Change 1995: Economic and Social Dimensions, Contribution of Working Group III to the Second assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press.
- IPCC (Intergovernmental Panel on Climate Change) 2001. *Climate Change 2001. Overview of Impacts, Adaptation, and Vulnerability to Climate Change. IPCC Third Assessment Report*, Cambridge University Press. Downloaded from [www.ipcc.ch](http://www.ipcc.ch).
- ISET (Institute for Social and Environmental Transition) 2008. *Enabling Adaptation to Climate Change for Poor Populations in Asia through Research, Capacity Building and Innovation*, Report from the Adaptation Study Team to the International Development Research Centre, Coordinated by ISET, Published by ISET-Nepal at Format Graphics, Kathmandu, July.
- Jacobi H. G. and Mansuri G., 2006. *Incomplete Contracts and Investment: A Study of Land Tenancy in Pakistan*, World Bank Policy Research Working Paper 3826, Development Research Group, World Bank, Washington DC, USA.
- Jacoby H. G. and E. Skoufias, 1997. Risk, Financial Markets, and Human Capital in a Developing Country, *Review of Economic Studies*, 64, pp. 311-335.
- Jalan J., and M. Ravallion., 2002. *Household Income Dynamics in Rural China*. World Institute for Development Economic Research Discussion Paper 2002/10. World Institute for Development Economic Research, Helsinki, Finland.
- Jinnah S., 2013. *Land and Property Rights of Rural Women in Bangladesh*. Unpublished manuscript. <http://www.ohchr.org/>.
- Kaiser H. F., 1974. An Index of Factorial Simplicity. *Psychometrika* 39 (1), pp. 31–36.
- Kim K., and Y. M. Kim., 2013. Asset Poverty in Korea: Levels and Composition Based on Wolff's Definition. *International Journal of Social Welfare* 22 (2), pp. 175–185.
- Kolstad C., D. Kelly, and G. Mitchell., 1999. *Adjustment Costs from Environmental Change Induced by Incomplete Information and Learning*. Department of Economics Working Paper 10–99, University of California, Santa Barbara.
- Kumar N., and A. Quisumbing. 2011. *Gendered Impacts of the 2007–08 Food Price Crisis Evidence Using Panel Data from Rural Ethiopia*. IFPRI Discussion Paper 01093. International Food Policy Research Institute, Washington, DC, USA.
- Lau P. Y. F. 2012. Rethinking Asset-based Community Development Strategies in Post-earthquake China: The Role of Social Capital. *Poverty & Public Policy* 4 (3), pp. 35–48.
- Lin N., 1999. Building a network theory of social capital. *Connections*, 22(1), pp. 28-51.
- Lybbert T., C. Barrett, S. Desta, and D. Coppock., 2004. Stochastic Wealth Dynamics and Risk Management among a Poor Population. *Economic Journal* 114 (498), pp. 750–777.

- Maddison D., 2007. The Perception of and Adaptation to Climate Change in Africa. World Bank Policy Research Working Paper, 4308. The World Bank, Washington, DC, USA.
- Meinzen-Dick, R., J. A. Behrman, L. Pandolfelli, A. Peterman, and A. Quisumbing., 2014. Gender and Social Capital for Agricultural Development. In *Gender in Agriculture: Closing the Knowledge Gap*, edited by A. R. Quisumbing, R. Meinzen-Dick, T. Raney, A. Croppenstedt, J. A. Behrman, and A. Peterman, chapter 10. Dordrecht, Netherlands: Springer; Rome: Food and Agriculture Organization of the United Nations.
- Meinzen-Dick R., Q. Bernier, E. Haglund, H. Markelova, and K. Moore., 2012. Identifying the Institutions for Climate-Smart Agriculture. In *International Research Workshop on Institutions for Inclusive Climate-Smart Agriculture*, Nairobi, Kenya.
- Meinzen-Dick R., R., N. Jonshon, A. Quisumbing, J. Njuki, J. Behrman, D. Rubin, A. Peterman, and E. Waithanji., 2011. Gender, Assets, and Agricultural Development Programs: A Conceptual Framework. CAPRI Working Paper 99, International Food Policy Research Institute, Washington, DC, USA.
- Miller M. L., M. Mastuera, M. Chao, & K. Sadowski., 2004. *Pathways Out of Poverty: Early Lessons of the Family Independence Initiative*. Family Independence Initiative, Oakland.
- MoEF (Ministry of Environment and Forest), 2005. Bangladesh National Adaptation Programme of Action (NAPA), Dhaka, Bangladesh.
- Mogue T., 2006. Shocks, Livestock Asset Dynamics and Social Capital in Ethiopia. Development Strategy and Governance Division (DSGD) discussion papers 38, International Food Policy Research Institute, Washington, DC, USA.
- Morduch J., 1999. Between the State and the Market: Can Informal Insurance Patch the Safety Net, *The World Bank Research Observer*, 14(2), pp. 187-207.
- Moser, C., 2007. Assets and Livelihoods: A Framework for Asset-Based Social Policy, in *Assets, Livelihoods, and Social Policy* edited by Moser, C. and Dani, A., World Bank, Washington, DC, USA.
- Moser C., and A. Felton., 2007. The Construction of an Asset Index Measuring Asset Accumulation in Ecuador. Chronic Poverty Research Centre working paper 87. Paper was presented at the CPRC Workshop on Concepts and Methods for Analyzing Poverty Dynamics and Chronic Poverty, 23-25 October 2006, University of Manchester, UK.
- Nam P.K., 2011. Social Capital and Private Adaptation to Climate Change : Evidence from the Mekong River Delta in Vietnam. In *Institute for International Economic Policy (IIEP) conference on "the Economics of Adaptation to Climate Change"* at George Washington University, Washington, DC, USA.
- Nam Y., J. Huang, and M. Sherraden., 2008. Assets, Poverty, and Public Policy: Challenges in Definition and Measurement. A Report in the Series Poor Finances: Assets and Low-income Household, Center for Social Development, Washington University in Saint Louis, December.

- Narayan D. and L. Pritchett., 1999. Cents and Sociability: Household Income and Social Capital in Rural Tanzania. *Economic Development and Cultural Change*, 47 (4), pp. 871-897.
- Nhemachena C., R.M. Hassan., 2007. Micro-level Analysis of Farmers' Adaptation to Climate Change in Southern Africa. IFPRI Discussion Paper, 714. International Food Policy Research Institute (IFPRI), Washington, DC, USA.
- Olawuyi S.O. and S. E. Oladele., 2012. Social Capital and Rural Households Welfare in Surulere Local Government Area, Oyo State, Nigeria. *Interdisciplinary Journal of Contemporary Research in Business*, 3(11), pp. 388-405.
- Ostrom E., 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press, USA.
- Putnam R., 1993. *Making Democracy Work: Civic Traditions in Modern Italy*. Princeton University Press, Princeton, USA.
- Putnam R., 1995. Bowling Alone: America's Declining Social Capital. *Journal of Democracy*, 6(1), pp. 65–78.
- Qian N., 2008. Missing Women and the Price of Tea in China: The Effect of Sex-specific Earnings on Sex Imbalance. *Quarterly Journal of Economics* 123 (3), pp. 1251–1285.
- Quisumbing A. R., 2009. Beyond The Bari, Gender, Groups, and Social Relations in Rural Bangladesh. CAPRI Working Paper No. 96, International Food Policy Research Institute, Washington, DC, USA.
- ———. 2011. Do Men and Women Accumulate Assets in Different Ways? Evidence from Rural Bangladesh. IFPRI Discussion Paper No. 1096, International Food Policy Research Institute, Washington, DC, USA.
- Quisumbing, A. R., R. Meinzen-Dick, T. L. Raney, A. Croppenstedt, J. A. Behrman, A. Peterman., 2014. Closing the Knowledge Gap on Gender in Agriculture. In *Gender in Agriculture: Closing the Knowledge Gap* edited by Quisumbing, A. R., R. Meinzen-Dick, T. L. Raney, A. Croppenstedt, J. A. Behrman, A. Peterman. Dordrecht, Netherlands: Springer; Rome: Food and Agriculture Organization of the United Nations.
- Quisumbing A. R., and S. McNiven, 2010. Moving Forward, Looking Back: The Impact of Migration and Remittances on Assets, Consumption, and Credit Constraints in the rural Philippines. *Journal of Development Studies*, 46 (1), pp. 91–113.
- Quisumbing A. R., M. Scott, and G. Marie., 2008. Shocks, Groups, and Networks in Bukindon, Philippines. CGIAR System-wide Program on Property Rights and Collective Action Working Paper 84, International Food Policy Research Institute, Washington, DC, USA.
- Quisumbing A. R., and B. Baulch., 2009. Assets and Poverty Traps in Rural Bangladesh. Chronic Poverty Research Centre Working Paper 143. Chronic Poverty Research Centre, Manchester, UK.

- Quisumbing A. R., and J. Maluccio., 2003. Resources at Marriage and Intra Household Allocation: Evidence from Bangladesh, Ethiopia, Indonesia, and South Africa. *Oxford Bulletin of Economics and Statistics* 65 (3), pp. 283–328.
- Quisumbing A. R., N. Kumar, and J. Behrman., 2011. Do Shocks Affect Men’s and Women’s Assets Differently? A Review Literature and New Evidence from Bangladesh and Uganda. IFPRI Discussion Paper 01113, International Food Policy Research Institute, Washington, DC, USA.
- Rakib M. and Matz. J., 2014. The Impact of Shocks on Gender-differentiated Asset Dynamics in Bangladesh. IFPRI Discussion Paper 01356, June, International Food Policy Research Institute, Washington, D.C, USA.
- Reardon, T., C. Delgado, and P. Matlon., 1992. Determinants and Effects of Income Diversification amongst Farm Households in Burkina Faso. *The Journal of Development Studies* 28 (2): pp. 264-296.
- Rosenzweig C., Parry M. L., 1994. Potential Impacts of Climate Change on World Food Supply. *Nature*, 367: pp. 133–138.
- Santos I., Sharif I., Rahman H. Z., Zaman H., 2011. How Do the Poor Cope with Shocks in Bangladesh? Evidence from Survey Data. Policy Research Working Paper 5810. The World Bank, South Asia Region, Social Protection Unit, September.
- Schoon I., 2006. *Risk and Resilience: Adaptations in \_Changing Times*. Cambridge University Press, Cambridge, UK.
- Sherraden M., 1991. *Assets and the Poor: A New American Welfare Policy*. Armonk, NY: M.E. Sharpe.
- Smith L., U. Ramakrishnan, A. Ndiaye, L. Haddad, and R. Martorell., 2003. The Importance of Women’s Status for Child Nutrition in Developing Countries. IFPRI Research Report 131. International Food Policy Research Institute, Washington, DC, USA.
- Sraboni E., A. R. Quisumbing, A. U. Ahmed., 2013. The Women’s Empowerment in Agriculture Index: Results from the 2011-2012 Bangladesh Integrated Household Survey, Project report submitted to the US Agency for International Development. International Food Policy Research Institute, Dhaka, Bangladesh.
- Stiglitz J., 1990. Peer Monitoring and Credit Markets. *World Bank Economic Review*, 4(3), pp. 351-366.
- Taylor A., K. Harris, and C. Ehrhart., 2010. Adaptation Key Terms, *Tiempo*, A bulletin on climate and development, 77, pp. 10-13, October.
- Thakur S., C. Arnold, and T. Johnson. 2009. Social Protection, Poverty Reduction and Pro-poor Growth. Organization for Economic Co-operation and Development Background papers, [www.oecd.org](http://www.oecd.org).
- Thomas T. S., K. Mainuddin, C. Chiang, A. Rahman, A. Haque, N. Islam, S. Quasem, and Y. Sun. 2013. Agriculture and Adaptation in Bangladesh Current and Projected Impacts of

Climate Change. IFPRI Discussion Paper 01281. International Food Policy Research Institute, Washington, DC, USA.

- Townsend R. M., 1995. Consumption Insurance: An Evaluation of Risk-Bearing Systems in Low-Income Economies, *The Journal of Economic Perspectives*, 9(3): 83-102.
- Udry C., 1994. Risk and Insurance in a Rural Credit Market: An Empirical Investigation in Northern Nigeria, *Review of Economic Studies*, 60, pp. 495-526.
- Verba S., N. Norman and J. Kim, 1978. *Participation and Political Equality*, Cambridge University Press, Cambridge UK.
- Weinberger K., 2000. *Women's Participation: An Economic Analysis in Rural Chad and Pakistan*, Peter Lang, Band 15, edited by F. Heidhues and J. von Braun, Frankfurt am Main, Germany.
- World Bank, Food and Agriculture Organization, and International Fund for Agricultural Development, 2009. *Gender and Agriculture Sourcebook*. World Bank/FAO/IFAD, Washington, DC, USA.
- Yu W. H., M. Alam, A. Hassan, A. S. Khan, A. C. Ruane, C. Rosenzweig, D. C. Major, and J. Thurlow., 2010. *Bangladesh - Climate change risks and food security in Bangladesh*. World Bank, Washington, DC, USA.
- Yusuf S. A., 2008. Social Capital and Household Welfare in Kwara State, Nigeria. *Journal of Human Ecology*, 23 (3), pp. 219-229.
- Zeller M., 1998. Determinants of Repayment Performance in Credit Groups: The Role of Program Design, Intragroup Risk Policy and Social Cohesion. *Economic Development and Cultural Change*, 46(3), pp. 599-620.
- Zeller M., M. Sharma, A. U. Ahmed, S. Rashid, 2001. *Group-Based Financial Institutions for the Rural Poor in Bangladesh - An Institutional and Household-Level Analysis*, Research Report 120, International Food Policy Research Institute, Washington, DC, USA.
- Zimmerman F. J., and M. R. Carter. 2003. Asset Smoothing, Consumption Smoothing and the Reproduction of Inequality under Risk and Subsistence Constraints. *Journal of Development Economics*, 71 (2), pp. 233-260.

## APPENDIX

### Appendix A2: Supplementary Tables

**Table A2.1: Types of assets used in the construction of the physical asset index**

Agricultural Goods	Consumer Goods		Housing Materials and Amenities
Tractor	Radio	Sewing machine	Toilet
Pump	Refrigerator	Jewelry	Walls
Deep tube well	TV	Tube well	Roof
Shallow tube well	Phone/cell phone	Cycle	Electricity
Fishing net	Iron	Rickshaw	Cooking fuel
Boat	Fan	Motorcycle	
Thresher	CD player	Other vehicles	
Plough		Other	

**Table A2.2: Summary statistics of disaggregated physical asset ownership**

	N	Mean	Std. dev.	Minimum	Median	Maximum
<b>2010</b>						
Consumer goods (husband)	678	4,056	11,600.29	0	1,263	179,945
Consumer goods (wife)	678	382	2,809.65	0	0	51,000
Consumer goods (joint)	678	914	5,127.86	0	0	116,450
Jewellery (husband)	678	5,147	22,030.71	0	0	297,500
Jewellery (wife)	678	4,566	14,475.67	0	0	180,000
Jewellery (joint)	678	4,398	17,423.64	0	0	150,000
Vehicle (husband)	678	4,542	31,071.29	0	0	510,000
Vehicle (wife)	678	180	2,427.46	0	0	42,500
Vehicle (joint)	678	154	1,946.26	0	0	38,250
Poultry (husband)	678	1,014	6,376.33	0	0	102,000
Poultry (wife)	678	571	2,101.33	0	0	42,500
Poultry (joint)	678	233	2,530.22	0	0	42,840
Cattle (husband)	678	14,346	29,511.31	0	0	455,000
Cattle (wife)	678	2,344	17,930.90	0	0	425,000
Cattle (joint)	678	1,044	6,953.63	0	0	80,000
Agricultural tools (husband)	678	5,084	33,431.38	0	200	608,600
Agricultural tools (wife)	678	264	2,908.59	0	0	59,585
Agricultural tools (joint)	678	211	2,657.68	0	0	51,000
<b>2012</b>						
Consumer goods (husband)	678	4,034	8,892.58	0	1,500	102,128
Consumer goods (wife)	678	264	1,515.05	0	0	27,455
Consumer goods (joint)	678	918	3,227.56	0	0	38,250
Jewellery (husband)	678	5,815	29,291.24	0	0	425,000
Jewellery (wife)	678	6,519	23,305.11	0	0	320,000
Jewellery (joint)	678	5,858	23,560.41	0	0	300,000
Vehicle (husband)	678	2,604	14,238.43	0	0	221,000
Vehicle (wife)	678	495	8,602.70	0	0	212,500
Vehicle (joint)	678	265	3,667.66	0	0	85,000
Poultry (husband)	678	973	6,438.21	0	0	120,000
Poultry (wife)	678	616	2,248.22	0	0	46,750
Poultry (joint)	678	179	1,884.25	0	0	47,000
Cattle (husband)	678	15,884	28,042.96	0	829	285,000
Cattle (wife)	678	1,248	6,465.13	0	0	77,000
Cattle (joint)	678	957	7,648.67	0	0	150,000
Agricultural tools (husband)	678	4,136	20,730.88	0	300	400,000
Agricultural tools (wife)	678	128	1,466.35	0	0	25,500
Agricultural tools (joint)	678	112	1,717.73	0	0	42,500

**Table A2.3: Summary statistics of household characteristics**

Household characteristics	N	Mean	Std. dev.	Minimum	Median	Maximum
<b>2010</b>						
Household size in 2010	678	4.99	1.94	2	5	15
Male-to-female ratio in 2010	678	1.20	0.85	0.14	1	5
Age of the household head 2010	678	46.30	13.42	17	45	95
Years of schooling of household head in 2010	678	3.68	4.17	0	2	17
Household dependency ratio in 2010	678	0.67	0.15	0.2	0.67	1
Use of credit in 2010	678	0.42	0.49	0	0	1
Use of extensions in 2010	678	0.27	0.44	0	0	1
Total plot size in 2010 (in square meters)	678	2,911	4,0493.251	0	1,230	27,836
Total land value in taka in 2010	678	560,906	771,283.70	0	276,000	4,918,100
Livestock value in taka in 2010	678	19,551	34,775.96	0	5,975	455,200
Livestock in TLU in 2010	678	0.77	0.94	0	0.5	7.90
Total non-land assets in taka in 2010	678	50,531	79,584.26	0	28,519	772,590
<b>2012</b>						
Household size in 2012	678	4.91	1.90	1	5	14
Male-to-female ratio in 2012	678	1.21	0.85	0.17	1	5
Age of the household head 2012	678	48.70	13.22	21	48	97
Years of schooling of household head in 2012	678	3.67	4.19	0	2	17
Household dependency ratio in 2012	678	0.67	0.15	0.17	0.7	1
Use of credit in 2012	678	0.47	0.50	0	0	1
Use of extensions in 2012	678	0.28	0.45	0	0	1
Total plot size in 2012 (in square meter)	678	3,193	4,658.79	0	1,520	38,053
Total land value in taka in 2012	678	598,938	797,277.60	0	321,000	4,471,000
Livestock value in taka in 2012	678	19,857	29,639.97	0	6,630	287,900
Livestock in TLU in 2012	678	0.82	0.92	0	0.6	6.20
Total non-land assets in taka in 2012	678	50,415	68,564.15	0	29,867	573,900

Notes: TLU denotes tropical livestock units.



**Table A2.4: The impact of shocks on land, non-land physical, and livestock assets (ordinary least squares estimates)**

	Land (square meters)			Physical assets (index)			Livestock (TLU)		
	Husband (1)	Wife (2)	Joint (3)	Husband (4)	Wife (5)	Joint (6)	Husband (7)	Wife (8)	Joint (9)
Flood	0.199 (0.199)	0.005 (0.079)	0.204** (0.092)	0.009 (0.008)	0.010*** (0.003)	0.012** (0.006)	-0.005 (0.057)	-0.019 (0.047)	-0.031 (0.027)
Drought	0.378* (0.198)	0.040 (0.071)	0.268*** (0.100)	0.009 (0.008)	0.002 (0.003)	0.005 (0.006)	0.115** (0.055)	-0.003 (0.050)	0.008 (0.027)
Cyclone	0.514*** (0.197)	-0.011 (0.077)	0.264** (0.110)	-0.004 (0.008)	-0.002 (0.003)	0.006 (0.006)	0.178*** (0.060)	0.091* (0.052)	0.015 (0.027)
Death/illness	-0.120 (0.197)	-0.030 (0.067)	-0.009 (0.080)	-0.008 (0.007)	-0.002 (0.003)	-0.003 (0.006)	-0.049 (0.051)	-0.029 (0.043)	-0.008 (0.024)
Dowry payment	-0.239 (0.457)	-0.095 (0.095)	-0.140 (0.123)	0.016 (0.018)	0.011 (0.008)	0.007 (0.013)	-0.030 (0.110)	0.088 (0.093)	-0.007 (0.057)
Remittance	-0.406* (0.243)	0.062 (0.084)	0.011 (0.098)	0.006 (0.010)	0.009** (0.004)	-0.001 (0.007)	0.102 (0.066)	0.202*** (0.058)	0.046 (0.036)
Inheritance/dowry receipt	-0.105 (0.418)	-0.118 (0.119)	-0.189* (0.109)	0.010 (0.017)	-0.007 (0.006)	0.009 (0.013)	-0.087 (0.109)	-0.088 (0.090)	-0.051 (0.059)
Age of household head	0.024*** (0.007)	0.001 (0.002)	-0.006** (0.003)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.002 (0.002)	-0.001 (0.001)	-0.002*** (0.001)
Household size	0.047 (0.047)	-0.021 (0.014)	0.011 (0.019)	0.007*** (0.002)	-0.001 (0.001)	0.011*** (0.002)	0.013** (0.006)	-0.001 (0.005)	0.006 (0.004)
Male-to-female ratio	0.115 (0.096)	-0.100*** (0.024)	-0.036 (0.053)	0.000 (0.004)	0.003* (0.002)	-0.002 (0.003)	0.067*** (0.016)	0.021 (0.012)	0.029*** (0.008)
Dependency ratio	1.051 (0.643)	0.223 (0.200)	0.044 (0.263)	0.006 (0.024)	0.028** (0.012)	-0.019 (0.018)	0.033 (0.028)	0.037 (0.024)	-0.013 (0.010)
Years of schooling of head	0.110*** (0.023)	0.007 (0.007)	0.007 (0.009)	0.008*** (0.001)	0.002*** (0.000)	0.007*** (0.001)	-0.038 (0.165)	-0.101 (0.133)	-0.125 (0.079)
Year2010	-0.155 (0.172)	-0.034 (0.057)	-0.020 (0.074)	-0.019*** (0.007)	-0.008*** (0.003)	-0.015*** (0.005)	-0.085* (0.047)	-0.045 (0.039)	-0.007 (0.023)
Constant	3.168*** (0.663)	0.165 (0.202)	0.228 (0.302)	0.122*** (0.024)	0.075*** (0.012)	0.061*** (0.018)	0.078 (0.163)	0.321** (0.128)	0.128* (0.072)
Household fixed effects	No	No	No	No	No	No	No	No	No
R-squared	0.035	0.011	0.017	0.095	0.053	0.014	0.041	0.140	0.024
N	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356

Note: Robust standard errors are given in parentheses.

\* $p < 0.10$ . \*\* $p < 0.05$ . \*\*\* $p < 0.01$

**Table A2.5: The impact of shocks on land, non-land physical, and livestock assets (weather shocks reported by community, fixed effects estimates)**

	Land (square meters)			Physical assets (index)			Livestock (TLU)		
	Husband	Wife	Joint	Husband	Wife	Joint	Husband	Wife	Joint
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Flood	0.130 (0.215)	-0.082 (0.069)	0.023 (0.080)	-0.019** (0.007)	-0.039*** (0.007)	-0.004 (0.004)	-0.087** (0.041)	-0.049 (0.046)	0.005 (0.024)
Drought	-0.048 (0.207)	-0.020 (0.077)	-0.021 (0.124)	0.002 (0.007)	0.022*** (0.009)	-0.004 (0.005)	-0.006 (0.047)	-0.012 (0.046)	-0.034 (0.022)
Cyclone	-0.376 (0.247)	0.027 (0.068)	0.238** (0.116)	0.005 (0.007)	-0.008 (0.007)	0.016*** (0.004)	-0.100* (0.055)	0.027 (0.060)	0.008 (0.031)
Death/illness	-0.035 (0.239)	0.065 (0.076)	0.039 (0.101)	-0.004 (0.007)	0.009 (0.008)	0.008 (0.005)	-0.001 (0.041)	-0.015 (0.041)	-0.004 (0.023)
Dowry payment	-0.401 (0.590)	-0.005 (0.047)	-0.025 (0.183)	-0.002 (0.017)	-0.005 (0.016)	0.003 (0.010)	-0.171 (0.109)	-0.058 (0.129)	-0.113** (0.058)
Remittance	-0.914*** (0.269)	0.031 (0.085)	-0.364*** (0.133)	0.013 (0.009)	0.020** (0.010)	-0.003 (0.005)	0.056 (0.062)	0.165** (0.068)	0.037 (0.027)
Inheritance/dowry receipt	1.084** (0.536)	-0.176 (0.221)	0.058 (0.185)	-0.030* (0.018)	-0.003 (0.016)	0.019** (0.009)	0.103 (0.106)	0.000 (0.113)	0.025 (0.023)
Age of household head	-0.015 (0.022)	0.005 (0.012)	0.006 (0.009)	0.004*** (0.001)	0.008*** (0.002)	-0.001** (0.001)	0.006* (0.003)	-0.001 (0.003)	-0.002 (0.002)
Household size	-0.117 (0.133)	0.043 (0.040)	0.000 (0.077)	-0.001 (0.004)	-0.008* (0.005)	0.007*** (0.003)	0.009 (0.029)	-0.008 (0.032)	-0.003 (0.018)
Male-to-female ratio	0.285 (0.281)	-0.076 (0.053)	0.234 (0.199)	-0.001 (0.009)	0.014 (0.011)	0.004 (0.006)	0.052 (0.069)	-0.042 (0.073)	0.024 (0.033)
Dependency ratio	0.942 (1.208)	-0.036 (0.290)	0.000 (0.471)	-0.035 (0.034)	0.017 (0.039)	-0.009 (0.024)	-0.369 (0.229)	-0.348* (0.193)	-0.061 (0.128)
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.029	0.010	0.023	0.063	0.160	0.038	0.029	0.020	0.013
N	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356

Note: Standard errors are clustered at the household level and given in parentheses.

\* $p < 0.10$ . \*\* $p < 0.05$ . \*\*\* $p < 0.01$

**Table A2.6: The impact of shocks on monetary values of land, non-land physical, and livestock assets (fixed effects estimates)**

	Log(value of land)			Log(value of physical assets)			Log(value of livestock)		
	Husband	Wife	Joint	Husband	Wife	Joint	Husband	Wife	Joint
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Flood	-0.119 (0.557)	-0.208 (0.138)	0.532* (0.310)	-0.460* (0.271)	0.498 (0.311)	0.076 (0.233)	-1.138*** (0.397)	-0.173 (0.389)	0.034 (0.229)
Drought	0.382 (0.493)	-0.058 (0.152)	0.357 (0.324)	-0.057 (0.226)	0.956*** (0.313)	0.302 (0.211)	-0.198 (0.418)	1.022*** (0.355)	0.522** (0.227)
Cyclone	0.964** (0.449)	-0.276 (0.168)	0.676** (0.332)	-0.390* (0.222)	-0.447* (0.253)	-0.361* (0.194)	0.116 (0.386)	-0.657** (0.341)	-0.392* (0.209)
Death/illness	-0.345 (0.410)	0.106 (0.131)	0.108 (0.181)	0.230 (0.165)	0.142 (0.226)	0.086 (0.165)	-0.174 (0.295)	-0.130 (0.257)	0.048 (0.140)
Dowry payment	-1.181 (0.959)	0.034 (0.057)	0.051 (0.353)	0.117 (0.383)	-0.956** (0.475)	-0.150 (0.481)	-0.888 (0.768)	-0.134 (0.652)	-0.455 (0.315)
Remittance	-1.499*** (0.495)	0.003 (0.151)	-0.551** (0.227)	0.485*** (0.170)	1.146*** (0.246)	0.451** (0.198)	-0.376 (0.319)	1.372*** (0.331)	0.320** (0.164)
Inheritance/dowry receipt	1.929** (0.932)	-0.330 (0.364)	0.028 (0.344)	-0.206 (0.357)	-0.716 (0.551)	-0.260 (0.272)	0.124 (0.611)	-0.747 (0.615)	0.137 (0.197)
Age of household head	-0.034 (0.043)	0.013 (0.024)	0.012 (0.017)	0.027* (0.015)	0.017 (0.019)	-0.005 (0.017)	0.017 (0.018)	-0.015 (0.021)	-0.009 (0.017)
Household size	-0.191 (0.228)	0.091 (0.079)	-0.028 (0.137)	0.163* (0.100)	-0.020 (0.130)	0.157* (0.091)	0.060 (0.171)	0.109 (0.168)	0.125 (0.099)
Male-to-female ratio	0.477 (0.471)	-0.144 (0.110)	0.342 (0.354)	-0.143 (0.168)	-0.717** (0.302)	-0.008 (0.188)	0.058 (0.305)	-0.543 (0.335)	-0.018 (0.128)
Dependency ratio	1.704 (2.181)	-0.241 (0.540)	-0.060 (0.859)	-0.986 (0.759)	-0.248 (0.946)	0.289 (0.666)	-0.025 (1.365)	-1.135 (1.244)	0.005 (0.731)
Household fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.035	0.015	0.027	0.032	0.081	0.027	0.020	0.066	0.037
N	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356

Note: Standard errors are clustered at the household level and given in parentheses.

\*p < 0.10. \*\*p < 0.05. \*\*\*p < 0.01

## Appendix A3: Supplementary Tables

**Table A3.1: Sample household summary statistics**

Variable	Obs.	Mean	Min	P50	Std. Dev.	Max
Gender of HH head	740	0.89	0	1	0.31	1
HH size	740	4.80	1	4	2.04	20
Male to female ratio	740	1.12	0	1	0.83	5
Age of HH head	740	48	20	47	13.49	97
Years of formal education of HH head	740	3.52	0	2	4.20	17
HH dependency ratio	740	0.68	0	0.71	0.19	1
Experience of HH head	740	22	0	20	14.18	65
Whether or not HH functionally owns land	740	0.44	0	0	0.50	1
Total value of HH physical assets	740	57315	17	34863	83341	772591
Total value of HH physical assets (leave out village mean)	740	57315	18005	55310	19899	117404
Physical asset index value	740	0.26	0	0.28	0.17	1
Physical asset index value (leave out village mean)	740	0.26	0.17	0.25	0.06	0.42
Total HH plot size	740	3076	0	1214	4550	38053
Total HH plot size (leave out village mean)	740	4107	802	3743	1908	8138
Total livestock in TLU	740	0.82	0	0.55	0.92	6.2
Total livestock in TLU (leave out village mean)	740	0.96	0.27	0.90	0.37	1.95
Access to credit	740	0.70	0	1	0.46	1
Access to extension services	740	0.35	0	0	0.48	1
Training received by primary HH adult male	740	0.10	0	0.07	0.14	1
Training received by primary HH adult female	740	0.03	0	0.02	0.07	1
Access to ICT by primary HH adult male	740	0.52	0	0.57	0.34	1
Access to ICT by primary HH adult female	740	0.47	0	0.44	0.17	1
Social capital of primary HH adult male	740	0.33	0	0.32	0.18	1
Social capital of primary HH adult male (leave out village mean)	740	0.36	0.24	0.36	0.05	0.54
Social capital of primary HH adult female	740	0.26	0	0.24	0.12	1
Social capital of primary HH adult female (leave out village mean)	740	0.26	0.20	0.26	0.03	0.32
Political capital of primary HH adult male	740	0.39	0	0.38	0.22	1
Political capital of primary HH adult male (leave out village mean)	740	0.46	0.32	0.44	0.06	0.63
Political capital of primary HH adult female	740	0.19	0	0.17	0.09	1
Political capital of primary HH adult female (leave out village mean)	740	0.20	0.16	0.19	0.02	0.26
Affected by flood	740	0.34	0	0	0.47	1
Affected by drought	740	0.52	0	1	0.50	1
Affected by cyclone	740	0.25	0	0	0.43	1
Affected by climatic shocks	740	0.94	0	1	0.24	1

**Table A3.2: Farmer perceptions of climate change based on group participation in Bangladesh**

Variable	Probit model results			
	Temperature increase (1)	Precipitation decrease (2)	Temperature increase (3)	Precipitation decrease (4)
Male-headed household	-0.015 (0.042)	-0.059** (0.028)	-0.011 (0.043)	-0.059** (0.028)
Age of HH head	0.002 (0.001)	0.000 (0.001)	0.001 (0.001)	0.000 (0.001)
Years of formal education of HH head	0.004 (0.003)	-0.001 (0.003)	0.003 (0.003)	-0.001 (0.003)
Experience of HH head	0.000 (0.001)	0.000 (0.001)	0.001 (0.001)	0.000 (0.001)
Whether or not HH functionally owns land	-0.016 (0.027)	0.034 (0.023)	-0.006 (0.026)	0.038* (0.024)
Physical asset index value (leave out village mean)	0.154 (0.188)	0.225 (0.170)		
Total livestock in TLU (leave out village mean)	0.067** (0.035)	0.084*** (0.031)		
Physical asset index value			0.024 (0.071)	-0.047 (0.070)
Total livestock in TLU			-0.022 (0.014)	0.002 (0.014)
Access to credit	-0.057** (0.025)	-0.021 (0.023)	-0.062** (0.025)	-0.024 (0.023)
Access to extension services	-0.025 (0.030)	0.035 (0.024)	-0.017 (0.029)	0.040* (0.024)
Affected by climatic shocks	0.045* (0.027)	0.023 (0.023)	0.049* (0.027)	0.025 (0.024)
Access to ICT by primary HH adult male	0.153*** (0.039)	0.094*** (0.036)	0.163*** (0.039)	0.099*** (0.036)
Access to ICT by primary HH adult female	0.032 (0.075)	0.066 (0.073)	0.020 (0.076)	0.071 (0.073)
Group participation by primary HH adult male	-0.036 (0.031)	0.018 (0.024)	-0.036 (0.031)	0.016 (0.025)
Group participation by primary HH adult female	0.059** (0.029)	0.065*** (0.023)	0.064** (0.028)	0.070*** (0.023)
Pseudo R-squared	0.063	0.063	0.061	0.050
Wald chi2(28)				
Total observations	740	740	740	740

Notes: Robust standard errors are given in parentheses

\*p < .10. \*\*p < .05. \*\*\*p < .01.

**Table A3.3: Farmer perceptions of climate change based on social and political capital in Bangladesh**

Variable	Probit model results			
	Temperature increase (1)	Precipitation decrease (2)	Temperature increase (3)	Precipitation decrease (4)
Male-headed household	-0.012 (0.040)	-0.050* (0.028)	-0.027 (0.046)	-0.019 (0.043)
Age of HH head	0.002 (0.001)	0.000 (0.001)	0.001 (0.001)	0.000 (0.001)
Years of formal education of HH head	0.003 (0.003)	-0.001 (0.003)	0.003 (0.003)	-0.001 (0.003)
Experience of HH head	0.000 (0.001)	0.000 (0.001)	0.001 (0.001)	0.000 (0.001)
Whether or not HH functionally owns land	-0.029 (0.027)	0.022 (0.023)	-0.014 (0.027)	0.035 (0.024)
Physical asset index value (leave out village mean)	0.283 (0.247)	0.472** (0.238)		
Total livestock in TLU (leave out village mean)	0.041 (0.037)	0.102*** (0.033)		
Physical asset index value			0.021 (0.072)	-0.040 (0.072)
Total livestock in TLU			-0.020 (0.014)	0.003 (0.015)
Access to credit	-0.048* (0.025)	-0.004 (0.024)	-0.054** (0.026)	-0.014 (0.024)
Access to extension services	-0.026 (0.030)	0.035 (0.024)	-0.024 (0.030)	0.043* (0.024)
Affected by climatic shocks	0.024 (0.026)	0.022 (0.024)	0.052* (0.027)	0.026 (0.024)
Access to ICT by primary HH adult male	0.128*** (0.037)	0.076** (0.036)	0.157*** (0.039)	0.113*** (0.036)
Access to ICT by primary HH adult female	0.104 (0.073)	0.078 (0.073)	0.029 (0.075)	0.071 (0.072)
Social capital of primary HH adult male (leave out village mean)	-0.514** (0.231)	-0.909*** (0.197)		
Social capital of primary HH adult female (leave out village mean)	-1.176** (0.499)	-0.136 (0.471)		
Political capital of primary HH adult male (leave out village mean)	0.954*** (0.242)	0.065 (0.202)		
Political capital of primary HH adult female (leave out village mean)	-0.495 (0.744)	-0.597 (0.612)		
Social capital of primary HH adult male			-0.045 (0.080)	-0.106 (0.071)
Social capital of primary HH adult female			-0.015 (0.110)	0.232** (0.105)
Political capital of primary HH adult male			0.040 (0.082)	-0.066 (0.072)
Political capital of primary HH adult female			-0.145 (0.134)	0.010 (0.123)
Pseudo R-squared	0.084	0.084	0.049	0.051
Total observations	740	740	740	740

Notes: Robust standard errors are given in parentheses  
\*p < .10. \*\*p < .05. \*\*\*p < .01.

**Table A3.4: Farmer perceptions of climate change based on social and political capital in Bangladesh (Results of seemingly unrelated biprobit model)**

Seemingly unrelated biprobit model results				
Variable	Temperature increase (1)	Precipitation decrease (2)	Temperature increase (3)	Precipitation decrease (4)
Male-headed household	-0.058 (0.207)	-0.352 (0.234)	-0.130 (0.247)	-0.096 (0.264)
Age of HH head	0.008 (0.006)	0.000 (0.006)	0.005 (0.005)	-0.003 (0.006)
Years of formal education of HH head	0.017 (0.016)	-0.010 (0.018)	0.015 (0.016)	-0.008 (0.018)
Experience of HH head	0.002 (0.006)	-0.003 (0.005)	0.004 (0.006)	0.001 (0.005)
Whether or not HH functionally owns land	-0.144 (0.136)	0.135 (0.135)	-0.065 (0.127)	0.196 (0.136)
Physical asset index value (leave out village mean)	1.386 (1.251)	2.748** (1.414)		
Total livestock in TLU (leave out village mean)	0.197 (0.187)	0.585*** (0.197)		
Physical asset index value			0.091 (0.338)	-0.225 (0.399)
Total livestock in TLU			-0.092 (0.064)	0.019 (0.081)
Access to credit	-0.258* (0.144)	-0.017 (0.141)	-0.267* (0.141)	-0.072 (0.139)
Access to extension services	-0.119 (0.144)	0.220 (0.154)	-0.108 (0.137)	0.267* (0.148)
Affected by climatic shocks	0.118 (0.124)	0.124 (0.130)	0.248** (0.121)	0.145 (0.125)
Access to ICT by primary HH adult male	0.651*** (0.190)	0.455** (0.209)	0.767*** (0.187)	0.651*** (0.202)
Access to ICT by primary HH adult female	0.516 (0.358)	0.469 (0.432)	0.135 (0.359)	0.393 (0.403)
Social capital of primary HH adult male (leave out village mean)	-2.585** (1.170)	-5.316*** (1.148)		
Social capital of primary HH adult female (leave out village mean)	-6.000** (2.529)	-0.724 (2.738)		
Political capital of primary HH adult male (leave out village mean)	4.947*** (1.263)	0.418 (1.150)		
Political capital of primary HH adult female (leave out village mean)	-2.412 (3.752)	-3.380 (3.475)		
Social capital of primary HH adult male			-0.245 (0.378)	-0.625 (0.391)
Social capital of primary HH adult female			-0.084 (0.527)	1.252** (0.590)
Political capital of primary HH adult male			0.181 (0.391)	-0.385 (0.397)
Political capital of primary HH adult female			-0.650 (0.643)	0.153 (0.704)
Wald chi2(32)	80.62***		58.05**	
Total observations	740		740	

Notes: Robust standard errors are given in parentheses  
\*p < .10. \*\*p < .05. \*\*\*p < .01.

**Table A3.5: Marginal effects estimated for determinants of household crop adaptation strategies in Bangladesh, 2012**

variable	Probit model results					
	Crop cycle timing	Change in fertilizer use	Change crop	Irrigation use	Changes in field management practices	Seek migratory/off-farm employment
	(1)	(2)	(3)	(4)	(5)	(6)
Male-headed household	0.040 (0.071)	0.099* (0.061)	0.075 (0.069)	0.079 (0.075)	-0.028 (0.075)	-0.208*** (0.077)
HH size	0.002 (0.010)	0.019** (0.008)	-0.003 (0.009)	-0.028*** (0.010)	0.020** (0.010)	0.008 (0.006)
Male to female ratio	-0.007 (0.022)	0.002 (0.016)	-0.010 (0.020)	0.020 (0.023)	-0.008 (0.023)	-0.024* (0.014)
Age of HH head	-0.003 (0.002)	0.000 (0.001)	-0.001 (0.001)	-0.002 (0.002)	-0.002 (0.002)	-0.001 (0.001)
Years of formal education of HH head	0.001 (0.005)	0.003 (0.004)	0.001 (0.004)	-0.003 (0.005)	0.012** (0.005)	-0.004 (0.003)
Dependency ratio	-0.343*** (0.112)	-0.184** (0.086)	-0.087 (0.101)	-0.125 (0.118)	-0.130 (0.114)	-0.188*** (0.070)
Work experience of HH head	0.000 (0.002)	0.002* (0.001)	0.003** (0.001)	0.000 (0.002)	0.005*** (0.002)	0.001 (0.001)
Whether or not HH functionally owns land	0.115*** (0.039)	0.027 (0.028)	0.059* (0.032)	0.071* (0.040)	-0.079** (0.039)	-0.096*** (0.025)
Physical asset index value (leave out village mean)	0.933** (0.391)	-0.370 (0.294)	0.126 (0.351)	-0.478 (0.426)	-0.131 (0.415)	-0.295 (0.267)
Total livestock in TLU (leave out village mean)	0.116** (0.054)	-0.018 (0.042)	0.048 (0.049)	0.079 (0.059)	0.048 (0.058)	-0.021 (0.036)
Access to credit	-0.019 (0.042)	-0.028 (0.029)	-0.063* (0.034)	-0.063 (0.043)	-0.021 (0.042)	0.011 (0.027)
Access to extension services	0.036 (0.043)	0.018 (0.032)	0.073** (0.037)	0.195*** (0.041)	0.112** (0.044)	0.019 (0.031)
Affected by climatic shocks	0.137*** (0.037)	0.122*** (0.033)	0.158*** (0.036)	0.156*** (0.041)	0.075* (0.040)	0.105*** (0.023)
Training received by primary HH adult male	0.152 (0.241)	7.049*** (1.381)	-0.028 (0.254)	-0.114 (0.255)	0.651** (0.281)	0.028 (0.163)
Training received by primary HH adult female	0.028 (0.130)	0.111 (0.115)	0.510*** (0.177)	0.087 (0.148)	0.089 (0.145)	-0.004 (0.107)
Access to ICT by primary HH adult male (index)	0.016 (0.061)	0.136*** (0.045)	0.086* (0.052)	0.068 (0.062)	-0.007 (0.062)	0.032 (0.038)
Access to ICT by primary HH adult female (index)	-0.021 (0.113)	0.038 (0.085)	-0.196** (0.101)	-0.018 (0.119)	-0.079 (0.119)	0.157** (0.080)
Social capital of primary HH adult male (leave out village mean)	-1.313*** (0.404)	-0.228 (0.273)	-0.818** (0.331)	-2.236*** (0.414)	0.487 (0.389)	0.217 (0.266)
Social capital of primary HH adult female (leave out village mean)	2.079*** (0.758)	0.299 (0.564)	0.485 (0.651)	1.556** (0.796)	0.186 (0.773)	0.364 (0.484)
Political capital of primary HH adult male (leave out village mean)	-1.019*** (0.331)	0.441* (0.255)	-0.108 (0.308)	-0.577 (0.358)	-0.507 (0.358)	0.972*** (0.240)
Political capital of primary HH adult female (leave out village mean)	2.486*** (0.950)	-0.364 (0.753)	0.850 (0.903)	-1.410 (1.017)	-0.480 (1.022)	0.952 (0.648)
Pseudo R-squared	0.106	0.115	0.117	0.153	0.051	0.152
Total observations	740	740	740	740	740	740

Notes: Robust standard errors are given in parentheses  
\*p < .10. \*\*p < .05. \*\*\*p < .01.



**Table A3.6: Marginal effects estimated for determinants of household crop adaptation strategies in Bangladesh, 2012 (Results of multivariate probit model)**

Variable	Multivariate probit model results					
	Change crop cycle timing (1)	Changes in fertilizer use (2)	Change crop (3)	Irrigation use (4)	Changes in field management practices (5)	Seek migratory/off-farm employment (6)
Male-headed household	0.110 (0.201)	0.337* (0.194)	0.229 (0.210)	0.203 (0.191)	-0.061 (0.194)	-0.745*** (0.226)
HH size	0.006 (0.027)	0.074** (0.029)	-0.006 (0.028)	-0.067** (0.027)	0.054** (0.027)	0.034 (0.032)
Male to female ratio	-0.008 (0.061)	0.006 (0.063)	-0.025 (0.066)	0.054 (0.061)	-0.015 (0.060)	-0.119* (0.074)
Age of HH head	-0.006 (0.005)	0.000 (0.005)	-0.004 (0.005)	-0.007 (0.005)	-0.005 (0.005)	-0.003 (0.006)
Years of formal education of HH head	0.003 (0.014)	0.013 (0.015)	0.000 (0.015)	-0.008 (0.014)	0.031** (0.013)	-0.020 (0.016)
Dependency ratio	-0.908*** (0.308)	-0.801** (0.338)	-0.414 (0.356)	-0.433 (0.323)	-0.326 (0.294)	-0.852** (0.352)
Experience of HH head	0.000 (0.005)	0.010** (0.005)	0.010** (0.005)	0.000 (0.005)	0.013*** (0.005)	0.007 (0.006)
Whether or not HH functionally owns land	0.286*** (0.109)	0.087 (0.113)	0.221** (0.112)	0.205* (0.109)	-0.204** (0.104)	-0.466*** (0.135)
Physical asset index value (leave out village mean)	2.249** (1.077)	-0.805 (1.157)	1.344 (1.203)	-1.016 (1.133)	-0.186 (1.087)	-1.591 (1.365)
Total livestock in TLU (leave out village mean)	0.287* (0.152)	0.056 (0.162)	0.267* (0.157)	0.276* (0.161)	0.142 (0.154)	-0.119 (0.185)
Access to credit	-0.067 (0.112)	-0.087 (0.118)	-0.178 (0.121)	-0.143 (0.121)	-0.052 (0.109)	0.050 (0.140)
Access to extension services	0.100 (0.117)	0.104 (0.125)	0.241* (0.133)	0.542*** (0.120)	0.294** (0.114)	0.063 (0.153)
Affected by climatic shocks	0.392*** (0.110)	0.426*** (0.112)	0.477*** (0.111)	0.399*** (0.107)	0.195* (0.107)	0.596*** (0.146)
Training received by primary HH adult male	0.529 (0.686)	20.446*** (6.413)	0.026 (0.940)	-0.298 (0.779)	1.681** (0.723)	0.131 (0.993)
Training received by primary HH adult female	0.061 (0.367)	0.454 (0.465)	2.127*** (0.698)	0.363 (0.404)	0.268 (0.389)	0.014 (0.532)
Access to ICT by primary HH adult male	0.094 (0.167)	0.425** (0.178)	0.262 (0.178)	0.164 (0.164)	-0.024 (0.162)	0.182 (0.189)
Access to ICT by primary HH adult female	-0.070 (0.304)	0.314 (0.323)	-0.517 (0.350)	0.157 (0.327)	-0.178 (0.311)	0.760* (0.410)
Social capital of primary HH adult male (leave out village mean)	-3.328*** (1.082)	-1.201 (1.070)	-2.971*** (1.121)	-5.981*** (1.096)	1.293 (1.022)	0.986 (1.305)
Social capital of primary HH adult female (leave out village mean)	5.777*** (2.121)	1.240 (2.178)	0.907 (2.229)	3.895* (2.186)	0.220 (2.002)	1.567 (2.455)
Political capital of primary HH adult male (leave out village mean)	-2.687*** (0.913)	1.436 (1.001)	-0.591 (1.049)	-1.770* (0.964)	-1.329 (0.946)	4.900*** (1.233)
Political capital of primary HH adult female (leave out village mean)	6.392** (2.718)	-1.130 (2.995)	3.826 (3.084)	-3.250 (2.736)	-1.332 (2.673)	4.847 (3.250)
Rho1	1					
Rho2	0.571***	1				
Rho3	0.446***	0.418***	1			
Rho4	0.463***	0.507***	0.385***	1		
Rho5	0.246***	0.197***	0.135***	0.063	1	
Rho6	0.150**	0.135**	0.182**	0.124**	0.276***	1
Likelihood ratio test	chi2(15) = 271.429***					
Total observations	740					

Notes: Robust standard errors are given in parentheses

\*p < .10. \*\*p < .05. \*\*\*p < .01.

**Table A3.7: Marginal effects estimated from probit model of correlates of household livestock production adaptation strategies in Bangladesh, 2012**

Variable	Probit model results			Multivariate probit model results		
	Veterinary intervention (1)	Change livestock feed (2)	Change livestock (3)	Veterinary intervention (4)	Change livestock feed (5)	Change livestock (6)
Male-headed household	0.057 (0.072)	0.014 (0.072)	-0.041 (0.050)	0.162 (0.203)	0.004 (0.212)	-0.266 (0.249)
HH size	-0.003 (0.010)	0.015* (0.009)	0.008* (0.005)	-0.007 (0.026)	0.045* (0.027)	0.053 (0.034)
Male to female ratio	-0.033 (0.024)	-0.001 (0.022)	-0.001 (0.012)	-0.096 (0.066)	-0.002 (0.065)	-0.005 (0.076)
Age of HH head	-0.004** (0.002)	-0.003* (0.002)	-0.001 (0.001)	-0.011** (0.005)	-0.008 (0.006)	-0.010 (0.007)
Years of formal education of HH head	-0.007 (0.005)	-0.005 (0.005)	-0.001 (0.003)	-0.018 (0.014)	-0.017 (0.014)	-0.008 (0.016)
Dependency ratio	-0.055 (0.117)	-0.208** (0.109)	-0.038 (0.060)	-0.195 (0.312)	-0.584* (0.321)	-0.146 (0.375)
Experience of HH head	0.003** (0.002)	0.002 (0.002)	0.000 (0.001)	0.008* (0.005)	0.007 (0.005)	0.002 (0.006)
Whether or not HH functionally owns land	0.116*** (0.040)	0.071** (0.037)	0.026 (0.022)	0.303*** (0.106)	0.241** (0.107)	0.171 (0.139)
Physical asset index value (leave out village mean)	-0.728* (0.411)	0.612 (0.388)	0.429** (0.196)	-2.124** (1.094)	1.901* (1.148)	2.947** (1.308)
Total livestock in TLU (leave out village mean)	0.135** (0.056)	0.136** (0.053)	0.042 (0.030)	0.371** (0.150)	0.401** (0.159)	0.276 (0.201)
Access to credit	-0.008 (0.043)	-0.022 (0.040)	0.022 (0.021)	-0.027 (0.116)	-0.054 (0.116)	0.150 (0.150)
Access to extension services	0.070 (0.044)	0.049 (0.041)	0.049* (0.026)	0.187* (0.116)	0.128 (0.117)	0.281* (0.147)
Affected by climatic shocks	0.178*** (0.037)	0.069* (0.037)	0.065*** (0.019)	0.494*** (0.109)	0.212* (0.114)	0.479*** (0.154)
Training received by primary HH adult male	-0.048 (0.281)	-0.197 (0.232)	0.131 (0.139)	-0.052 (0.709)	-0.461 (0.640)	0.930 (0.912)
Training received by primary HH adult female	0.167 (0.147)	0.339** (0.139)	0.070 (0.067)	0.431 (0.402)	0.933** (0.385)	0.536 (0.443)
Access to ICT by primary HH adult male	0.018 (0.062)	0.202*** (0.057)	0.093*** (0.032)	0.039 (0.168)	0.585*** (0.166)	0.544*** (0.209)
Access to ICT by primary HH adult female	-0.037 (0.118)	-0.149 (0.107)	0.030 (0.062)	-0.087 (0.316)	-0.387 (0.310)	0.216 (0.398)
Social capital of primary HH adult male (leave out village mean)	-1.985*** (0.411)	-1.152*** (0.391)	0.295 (0.203)	-5.299*** (1.071)	-3.577*** (1.131)	1.399 (1.308)
Social capital of primary HH adult female (leave out village mean)	1.874** (0.778)	1.052 (0.742)	0.644* (0.395)	5.269** (2.124)	2.575 (2.216)	3.221 (2.530)
Political capital of primary HH adult male (leave out village mean)	0.961*** (0.362)	-0.349 (0.329)	0.029 (0.179)	2.557*** (0.981)	-1.060 (0.969)	0.017 (1.167)
Political capital of primary HH adult female (leave out village mean)	-1.299 (0.987)	0.292 (0.923)	1.107** (0.522)	-3.084 (2.645)	1.398 (2.716)	6.868** (3.362)
Rho1				1		
Rho2				0.585***	1	
Rho3				0.318***	0.269***	1
Likelihood ratio test				chi2(3) = 127.683***		
Pseudo R-squared	0.121	0.089	0.147			
Total observations	740	740	740	740		

Notes: Robust standard errors are given in parentheses

\*p < .10. \*\*p < .05. \*\*\*p < .01.

**Table A3.8: Marginal effects estimated from probit model of household coping mechanism correlates based on group participation in Bangladesh, 2012**

Variable	Selling assets (1)	Informal borrowing (2)	Seeking migratory/ off-farm employment (3)	Reducing and modifying diet (4)	Withdrawing kids from school (5)
Affected by flood	-0.025** (0.012)	0.042 (0.028)	0.005 (0.013)	0.023** (0.012)	0.000 (0.009)
Affected by drought	-0.005 (0.015)	0.029 (0.026)	-0.001 (0.013)	0.019** (0.008)	0.014* (0.008)
Affected by cyclone	-0.018 (0.013)	0.009 (0.030)	0.020 (0.017)	0.011 (0.012)	0.048*** (0.018)
Affected by non-climatic negative shocks	0.028** (0.012)	0.126*** (0.019)	0.034*** (0.010)	0.015** (0.007)	0.021*** (0.007)
Affected by positive shocks	-0.009 (0.014)	0.001 (0.023)	0.010 (0.015)	0.005 (0.008)	0.015 (0.011)
Male-headed household	-0.005 (0.028)	0.096*** (0.018)	0.017 (0.012)	-0.029 (0.029)	-0.046 (0.032)
HH size	-0.008** (0.003)	0.000 (0.005)	0.001 (0.003)	0.001 (0.002)	-0.002 (0.002)
Male to female ratio	0.003 (0.007)	0.003 (0.012)	0.007 (0.006)	-0.010* (0.005)	0.002 (0.004)
Age of HH head	0.001 (0.001)	-0.002* (0.001)	-0.001** (0.001)	0.000 (0.000)	0.000 (0.000)
Years of formal education of HH head	0.001 (0.002)	-0.002 (0.003)	-0.002 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Dependency ratio	0.005 (0.034)	0.129* (0.067)	-0.079** (0.035)	-0.017 (0.019)	0.015 (0.023)
Experience of HH head	0.000 (0.001)	0.002* (0.001)	-0.001 (0.001)	0.000 (0.000)	0.001* (0.000)
Whether or not HH functionally owns land	0.017 (0.013)	-0.015 (0.021)	-0.005 (0.011)	0.003 (0.007)	0.005 (0.008)
Physical asset index (leave out village mean)	0.136 (0.112)	0.230 (0.190)	-0.027 (0.095)	0.134** (0.064)	-0.039 (0.083)
Total livestock in TLU (leave out village mean)	0.004 (0.015)	-0.004 (0.029)	0.001 (0.015)	0.010 (0.008)	0.003 (0.008)
Access to credit	0.014 (0.013)	0.088*** (0.019)	-0.025* (0.016)	0.007 (0.006)	0.001 (0.007)
Access to extension services	0.005 (0.014)	0.065** (0.026)	0.041** (0.018)	-0.003 (0.007)	0.008 (0.010)
Training received by primary HH adult male	0.010 (0.072)	0.161 (0.110)	0.017 (0.060)	-0.414 (0.277)	-0.061 (0.054)
Training received by primary HH adult female	0.002 (0.038)	-0.031 (0.071)	-0.027 (0.053)	-0.001 (0.020)	-0.081** (0.036)
Access to ICT by primary HH adult male (index)	0.040* (0.021)	-0.059* (0.034)	-0.063*** (0.017)	0.008 (0.012)	0.001 (0.011)
Access to ICT by primary HH adult female (index)	-0.056 (0.043)	-0.040 (0.063)	0.036 (0.034)	0.006 (0.019)	0.015 (0.022)
Group participation by primary HH adult male	0.007 (0.016)	0.003 (0.024)	-0.008 (0.011)	0.020* (0.012)	0.011 (0.010)
Group participation by primary HH adult female	0.011 (0.020)	-0.026 (0.023)	-0.002 (0.013)	0.014 (0.014)	0.032 (0.020)
Pseudo R-squared	0.096	0.166	0.157	0.140	0.183
Total observations	740	740	740	740	740

Notes: Robust standard errors are given in parentheses

\*p < .10. \*\*p < .05. \*\*\*p < .01.

**Table A3.9: Marginal effects estimated from probit model for household coping mechanism correlates, based on social and political capital indices in Bangladesh, 2012**

Variable	Sale of assets	Informal borrowing	Migratory/ off-farm employment	Reducing and modifying diet	Withdrawing children from school
	(1)	(2)	(3)	(4)	(5)
Affected by flood	-0.020* (0.011)	0.025 (0.026)	0.002 (0.010)	0.020* (0.011)	0.005 (0.009)
Affected by drought	-0.008 (0.015)	0.038 (0.025)	0.007 (0.010)	0.020** (0.009)	0.010 (0.008)
Affected by cyclone	-0.018 (0.012)	-0.005 (0.028)	0.012 (0.012)	0.010 (0.012)	0.038** (0.015)
Affected by non-climatic negative shocks	0.026** (0.011)	0.113*** (0.019)	0.024*** (0.008)	0.014** (0.007)	0.021*** (0.008)
Affected by positive shocks	-0.005 (0.014)	0.018 (0.025)	0.011 (0.013)	0.010 (0.009)	0.022* (0.013)
Male-headed household	-0.003 (0.026)	0.088*** (0.018)	0.014* (0.008)	-0.013 (0.018)	-0.031 (0.025)
HH size	-0.007** (0.003)	0.000 (0.005)	0.001 (0.002)	0.000 (0.002)	-0.002 (0.002)
Male to female ratio	0.004 (0.007)	0.005 (0.012)	0.005 (0.005)	-0.009* (0.005)	0.002 (0.005)
Age of HH head	0.000 (0.001)	-0.002* (0.001)	-0.001** (0.000)	0.000 (0.000)	0.000 (0.000)
Years of formal education of HH head	0.001 (0.001)	-0.002 (0.003)	-0.002 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Dependency ratio	0.008 (0.034)	0.089 (0.068)	-0.054** (0.027)	-0.025 (0.019)	0.018 (0.023)
Experience of HH head	0.000 (0.001)	0.002** (0.001)	0.000 (0.000)	0.000 (0.000)	0.001* (0.000)
Whether or not HH functionally owns land	0.015 (0.013)	-0.013 (0.020)	-0.002 (0.008)	0.003 (0.007)	0.004 (0.008)
Physical asset index value (leave out village mean)	0.214* (0.123)	0.024 (0.227)	-0.095 (0.088)	0.092 (0.067)	0.048 (0.081)
Total livestock in TLU (leave out village mean)	0.019 (0.018)	-0.034 (0.033)	0.003 (0.012)	0.005 (0.009)	0.018** (0.009)
Access to credit	0.015 (0.012)	0.082*** (0.019)	-0.026** (0.013)	0.007 (0.006)	0.005 (0.007)
Access to extension services	0.004 (0.013)	0.058** (0.025)	0.021* (0.011)	-0.003 (0.007)	0.007 (0.009)
Training received by primary HH adult male	-0.005 (0.069)	0.230** (0.106)	0.010 (0.045)	-0.435 (0.278)	-0.060 (0.053)
Training received by primary HH adult female	0.009 (0.036)	-0.040 (0.074)	-0.025 (0.042)	-0.005 (0.023)	-0.066** (0.031)
Access to ICT by primary HH adult male (index)	0.038* (0.021)	-0.059* (0.034)	-0.050*** (0.016)	0.008 (0.012)	-0.003 (0.011)
Access to ICT by primary HH adult female (index)	-0.051 (0.041)	-0.016 (0.061)	0.031 (0.027)	0.012 (0.020)	0.013 (0.022)
Social capital of primary HH adult male (leave out village mean)	-0.349*** (0.122)	0.057 (0.195)	-0.023 (0.086)	-0.005 (0.067)	-0.233** (0.098)
Social capital of primary HH adult female (leave out village mean)	-0.116 (0.261)	-0.983** (0.429)	0.255* (0.154)	-0.072 (0.110)	-0.138 (0.133)
Political capital of primary HH adult male (leave out village mean)	0.034 (0.094)	0.702*** (0.195)	0.088 (0.077)	0.117 (0.076)	-0.019 (0.063)
Political capital of primary HH adult female (leave out village mean)	-0.089 (0.291)	0.215 (0.528)	0.647*** (0.217)	-0.024 (0.164)	-0.044 (0.170)
Pseudo R-squared	0.114	0.198	0.223	0.139	0.201
Total observations	740	740	740	740	740

Notes: Robust standard errors are given in parentheses

\*p < .10. \*\*p < .05. \*\*\*p < .01.

**Table A3.10: Marginal effects estimated from the multivariate probit model for correlates of household shock coping mechanisms in Bangladesh, 2012**

Variable	Selling assets (1)	Informal borrowing (2)	Migratory / off-farm employment (3)	Reducing and modifying diet (4)	Withdrawing children from school (5)
Affected by flood	-0.293* (0.180)	0.173 (0.162)	0.053 (0.228)	0.487** (0.197)	0.137 (0.224)
Affected by drought	-0.105 (0.198)	0.270* (0.166)	0.158 (0.230)	0.584*** (0.211)	0.257 (0.222)
Affected by cyclone	-0.289 (0.216)	-0.031 (0.186)	0.233 (0.206)	0.297 (0.239)	0.696*** (0.212)
Affected by non-climatic negative shocks	0.403** (0.194)	0.920*** (0.193)	0.681*** (0.258)	0.461* (0.243)	0.721*** (0.278)
Affected by positive shocks	-0.074 (0.199)	0.124 (0.147)	0.225 (0.217)	0.252 (0.192)	0.517*** (0.191)
Male-headed household	-0.037 (0.330)	0.968** (0.396)	0.424 (0.321)	-0.290 (0.317)	-0.511* (0.274)
HH size	-0.095** (0.043)	0.002 (0.034)	0.018 (0.042)	0.009 (0.048)	-0.051 (0.055)
Male to female ratio	0.057 (0.097)	0.038 (0.077)	0.112 (0.105)	-0.267* (0.143)	0.064 (0.129)
Age of HH head	0.006 (0.008)	-0.013* (0.007)	-0.024*** (0.008)	-0.003 (0.008)	-0.008 (0.009)
Years of formal education of HH head	0.018 (0.020)	-0.011 (0.018)	-0.036* (0.022)	-0.017 (0.029)	-0.034 (0.026)
Dependency ratio	0.121 (0.476)	0.592 (0.448)	-1.158** (0.481)	-0.735 (0.554)	0.476 (0.638)
Experience of HH head	0.005 (0.008)	0.014** (0.007)	-0.010 (0.008)	0.003 (0.009)	0.016** (0.008)
Whether or not HH functionally owns land	0.199 (0.164)	-0.104 (0.132)	-0.064 (0.170)	0.059 (0.199)	0.131 (0.206)
Physical asset index value (leave out village mean)	3.033* (1.757)	-0.042 (1.504)	-2.055 (1.860)	2.996* (1.567)	1.250 (2.207)
Total livestock in TLU (leave out village mean)	0.258 (0.253)	-0.240 (0.223)	0.105 (0.250)	0.178 (0.252)	0.469** (0.242)
Access to credit	0.222 (0.188)	0.630*** (0.169)	-0.455** (0.192)	0.233 (0.214)	0.146 (0.197)
Access to extension services	0.047 (0.177)	0.362** (0.146)	0.405** (0.192)	-0.122 (0.220)	0.205 (0.225)
Training received by primary HH adult male	-0.082 (0.959)	1.550** (0.698)	0.080 (0.997)	-13.570 (9.133)	-1.583 (1.310)
Training received by primary HH adult female	0.115 (0.507)	-0.250 (0.493)	-0.538 (0.917)	-0.113 (0.625)	-1.799** (0.810)
Access to ICT by primary HH adult male (index)	0.511* (0.278)	-0.399* (0.231)	-1.151 (0.288)	0.213 (0.332)	-0.117 (0.306)
Access to ICT by primary HH adult female (index)	-0.715 (0.561)	-0.123 (0.402)	0.701 (0.543)	0.356 (0.578)	0.455 (0.595)
Social capital of primary HH adult male (leave out village mean)	-4.827*** (1.677)	0.346 (1.308)	-0.681 (1.867)	-0.692 (1.753)	-6.550** (2.557)
Social capital of primary HH adult female (leave out village mean)	-1.665 (3.565)	-6.412** (2.674)	5.577* (3.233)	-1.424 (2.994)	-4.111 (3.638)
Political capital of primary HH adult male (leave out village mean)	0.403 (1.296)	4.659*** (1.333)	1.891 (1.587)	3.191 (1.983)	-0.518 (1.685)
Political capital of primary HH adult female (leave out village mean)	-1.316 (4.003)	1.508 (3.468)	14.188*** (4.274)	-0.454 (4.778)	-1.153 (4.831)
Rho1	1				
Rho2	-0.220**	1			
Rho3	-0.182	-0.101	1		
Rho4	0.211	-0.145	0.246*	1	
Rho5	0.017	-0.197	-0.165	0.023	1
Likelihood ratio test	chi2(10) = 8.09				
Total observations	740				

Notes: Robust standard errors are given in parentheses, \*p < .10. \*\*p < .05. \*\*\*p < .01.

## Appendix A4: Supplementary tables

**Table A4.1: Household summary statistics**

Variable	Obs.	Mean	Min	P50	Std. Dev.	Max
HH head participating in groups	642	0.78	0	1	0.41	1
Spouse participating in groups	642	0.43	0	0	0.50	1
Number of groups the HH head participates in	642	1.58	0	2	1.21	7
Number of groups the spouse participates in	642	0.92	0	0	1.28	7
Year of schooling of HH head	642	3.47	0	2	4.24	17
Year of schooling of spouse	642	2.98	0	1	3.46	15
Age of HH head	642	49	22	48	13.03	97
Age of spouse	642	40	18	39	11.49	75
HH head employed off-farm	642	0.13	0	0	0.34	1
Spouse employed off-farm	642	0.03	0	0	0.16	1
Household size	642	4.97	2	5	1.93	14
Male-to-female ratio	642	1.16	0.17	1	0.82	5
Household dependency ratio	642	0.66	0	0.70	0.16	1
Per capita monthly food expenditure	642	698	108	619	370	3217
Per capita monthly non-food expenditure	642	1007	59	583	1485	16721
Total value of assets	642	57072	0	37565	79910	772591
Total value of assets of HH head	642	45073	0	23090	80626	855930
Total value of assets of spouse	642	11772	0	2000	27691	321500
Total plot size (square meters)	642	3255	0	1618	4701	38053
Total livestock (TLU)	642	0.86	0	1	0.35	1
Affected by climatic shocks	642	0.63	0	1	0.48	1
Affected by non-climatic negative shocks	642	0.32	0	0	0.47	1
Affected by positive shocks	642	0.27	0	0	0.45	1
Relative participation	642	0.09	0	0.11	0.07	0.39
Initiative in local development steps	642	0.27	0	0	0.41	1
Trust in strangers	642	2.68	0	3	1.02	5

**Table A4.2: Aggregate social and political capital and the asset index: OLS and IV results**

	Asset index			
	OLS		IV	
	(1)	(2)	(3)	(4)
Social and political capital of HH head	0.068 (0.047)		0.172* (0.093)	
Social and political capital of spouse		-0.016 (0.062)		1.208*** (0.408)
Years of schooling of HH head	0.012*** (0.002)		0.011*** (0.001)	
Years of schooling of spouse		0.016*** (0.002)		0.016*** (0.002)
Age of HH head	0.000 (0.000)		0.001 (0.000)	
Age of spouse		0.002*** (0.001)		0.001** (0.001)
HH head working off-farm	0.003 (0.016)		0.009*** (0.003)	
Spouse working off-farm		-0.008 (0.020)		-0.051 (0.042)
Household size	0.009*** (0.003)	0.009*** (0.003)	0.005 (0.006)	0.010*** (0.004)
Male-to-female ratio	0.004 (0.007)	0.005 (0.007)	0.010 (0.034)	0.007 (0.008)
Household dependency ratio	0.010 (0.034)	-0.019 (0.037)	0.003 (0.015)	0.006 (0.045)
Log of total plot size (square meters)	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)	0.000 (0.002)
Total livestock (TLU)	0.001 (0.012)	0.005 (0.012)	-0.001 (0.015)	-0.006 (0.018)
Affected by climatic shocks	-0.003 (0.010)	-0.001 (0.010)	-0.005 (0.011)	-0.020 (0.014)
Affected by non-climatic negative shocks	-0.003 (0.011)	0.000 (0.011)	-0.004 (0.011)	-0.007 (0.013)
Affected by positive shocks	-0.002 (0.011)	0.000 (0.012)	-0.002 (0.011)	-0.028* (0.017)
R- squared	0.147	0.135	0.140	0.315
N	642	642	642	642

Notes: Robust standard errors are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.

**Table A4.3: Social and political capital separately and household welfare: OLS results**

	Log of total assets				Log of per capita consumption expenditure			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Social capital of HH head	1.814*** (0.620)				0.758*** (0.165)			
Social capital of spouse		-0.074 (0.703)				-0.007 (0.189)		
Political capital of HH head			0.684 (0.786)				0.130 (0.233)	
Political capital of spouse				-0.258 (0.822)				-0.242 (0.353)
Years of schooling of HH head	0.078*** (0.016)		0.087*** (0.017)		0.037*** (0.006)		0.041*** (0.006)	
Years of schooling of spouse		0.145*** (0.023)		0.146*** (0.023)		0.052*** (0.008)		0.051*** (0.008)
Age of HH head	-0.014** (0.008)		-0.014** (0.008)		0.010*** (0.002)		0.011*** (0.002)	
Age of spouse		-0.003 (0.010)		-0.003 (0.010)		0.016*** (0.002)		0.016*** (0.002)
HH head working off-farm	0.032 (0.206)		0.013 (0.206)		0.011 (0.061)		0.004 (0.062)	
Spouse working off-farm		-0.501 (0.622)		-0.499 (0.623)		-0.081 (0.154)		-0.077 (0.156)
Household size	0.032 (0.045)	0.048 (0.047)	0.037 (0.045)	0.047 (0.047)	-0.074*** (0.014)	-0.073*** (0.014)	-0.072*** (0.014)	-0.073*** (0.015)
Male-to-female ratio	-0.164 (0.107)	-0.165 (0.108)	-0.171 (0.108)	-0.165 (0.108)	0.029 (0.030)	0.027 (0.030)	0.026 (0.030)	0.027 (0.030)
Household dependency ratio	0.534 (0.596)	0.048 (0.644)	0.466 (0.599)	0.060 (0.642)	0.220 (0.151)	0.118 (0.160)	0.196 (0.150)	0.125 (0.160)
Log of total plot size (square meters)	0.043 (0.028)	0.046* (0.027)	0.049* (0.028)	0.046* (0.027)	0.001 (0.008)	0.005 (0.008)	0.003 (0.008)	0.005 (0.008)
Total livestock (TLU)	1.102*** (0.332)	1.145*** (0.331)	1.112*** (0.327)	1.150*** (0.332)	-0.035 (0.063)	-0.014 (0.064)	-0.027 (0.064)	-0.010 (0.064)
Affected by climatic shocks	-0.204 (0.168)	-0.183 (0.165)	-0.190 (0.172)	-0.183 (0.166)	0.075 (0.047)	0.086* (0.048)	0.084* (0.048)	0.086* (0.048)
Affected by non-climatic negative shocks	-0.404** (0.185)	-0.404** (0.185)	-0.416** (0.188)	-0.406** (0.185)	0.068 (0.048)	0.081* (0.050)	0.065 (0.049)	0.080 (0.049)
Affected by positive shocks	-0.068 (0.171)	-0.034 (0.175)	-0.020 (0.174)	-0.037 (0.170)	0.017 (0.050)	0.038 (0.053)	0.034 (0.051)	0.038 (0.052)
R-squared	0.113	0.116	0.104	0.116	0.190	0.160	0.167	0.161
N	642	642	642	642	642	642	642	642

Notes: Robust standard errors are given in parentheses.

\*p &lt; .10. \*\*p &lt; .05. \*\*\*p &lt; .01.



**Table A4.4: Group participation and household welfare: OLS results**

	Log of total assets		Log of per capita consumption expenditure	
	(1)	(2)	(3)	(4)
HH head participated in groups	0.324* (0.199)		0.009 (0.053)	
Spouse participated in groups		-0.326* (0.182)		-0.080* (0.046)
Years of schooling of HH head	0.086*** (0.016)		0.041*** (0.006)	
Years of schooling of spouse		0.144*** (0.023)		0.051*** (0.008)
Age of HH head	-0.014* (0.008)		0.010*** (0.002)	
Age of spouse		-0.004 (0.010)		0.016*** (0.002)
HH head employed off-farm	0.023 (0.205)		0.005 (0.062)	
Spouse employed off-farm		-0.431 (0.624)		-0.063 (0.154)
Household size	0.048 (0.047)	0.047 (0.047)	-0.072*** (0.014)	-0.073*** (0.014)
Male-to-female ratio	-0.176* (0.108)	-0.169 (0.108)	0.025 (0.030)	0.026 (0.030)
Household dependency ratio	0.489 (0.595)	-0.031 (0.647)	0.201 (0.149)	0.098 (0.161)
Log of total plot size (square meters)	0.046* (0.028)	0.045* (0.027)	0.003 (0.008)	0.004 (0.008)
Total livestock (TLU)	1.110*** (0.337)	1.118*** (0.331)	-0.025 (0.064)	-0.021 (0.064)
Affected by climatic shocks	-0.173 (0.168)	-0.148 (0.164)	0.087* (0.048)	0.094** (0.048)
Affected by non-climatic negative shocks	-0.406** (0.186)	-0.367** (0.188)	0.067 (0.049)	0.091* (0.049)
Affected by positive shocks	-0.038 (0.172)	0.017 (0.176)	0.032 (0.051)	0.051 (0.053)
R-squared	0.107	0.121	0.166	0.164
N	642	642	642	642

Notes: Robust standard errors are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.

**Table A4.5: Informal network and household welfare: OLS results**

	Log of total assets		Log of per capita consumption expenditure	
	(1)	(2)	(3)	(4)
Informal network of HH head	2.560*** (0.842)		0.984*** (0.249)	
Informal network of spouse		0.857 (0.971)		0.488* (0.277)
Years of schooling of HH head	0.084*** (0.017)		0.039*** (0.006)	
Years of schooling of spouse		0.145*** (0.023)		0.051*** (0.008)
Age of HH head	-0.015* (0.008)		0.010*** (0.002)	
Age of spouse		-0.003 (0.010)		0.016*** (0.002)
HH head employed off-farm	0.039 (0.203)		0.013 (0.061)	
Spouse employed off-farm		-0.497 (0.619)		-0.078 (0.153)
Household size	0.034 (0.045)	0.048 (0.047)	-0.073*** (0.014)	-0.073*** (0.014)
Male-to-female ratio	-0.173 (0.108)	-0.168 (0.108)	0.025 (0.030)	0.025 (0.030)
Household dependency ratio	0.445 (0.595)	0.046 (0.638)	0.184 (0.150)	0.115 (0.160)
Log of total plot size (square meters)	0.045* (0.028)	0.047* (0.027)	0.002 (0.008)	0.005 (0.008)
Total livestock (TLU)	1.123*** (0.332)	1.136*** (0.329)	-0.026 (0.063)	-0.020 (0.064)
Affected by climatic shocks	-0.197 (0.168)	-0.192 (0.165)	0.078* (0.047)	0.081* (0.048)
Affected by non-climatic negative shocks	-0.409** (0.185)	-0.399** (0.185)	0.065 (0.048)	0.084* (0.050)
Affected by positive shocks	-0.054 (0.170)	-0.044 (0.171)	0.024 (0.050)	0.034 (0.052)
R-squared	0.113	0.116	0.185	0.163
N	642	642	642	642

Notes: Robust standard errors are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.

**Table A4.6: Social and political capital separately and household welfare: IV results**

	Log of total assets				Log of per capita consumption expenditure			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Social capital of HH head	2.275 (1.525)				0.934** (0.406)			
Social capital of spouse		1.741 (2.841)				1.457* (0.799)		
Political capital of HH head			3.251* (1.991)				0.983* (0.537)	
Political capital of spouse				7.406 (9.102)				4.268 (2.736)
Years of schooling of head	0.076*** (0.022)		0.080*** (0.021)		0.036*** (0.006)		0.039*** (0.006)	
Years of schooling of spouse		0.145*** (0.027)		0.150*** (0.028)		0.051*** (0.008)		0.054*** (0.008)
Age of HH head	-0.014** (0.007)		-0.012* (0.007)		0.010*** (0.002)		0.011*** (0.002)	
Age of spouse		-0.002 (0.008)		-0.008 (0.011)		0.017*** (0.002)		0.013*** (0.003)
HH head employed off-farm	0.036 (0.249)		-0.007 (0.253)		0.012 (0.066)		-0.003 (0.068)	
HH head employed off-farm		-0.570 (0.543)		-0.641 (0.572)		-0.137 (0.153)		-0.160 (0.172)
Household size	0.030 (0.047)	0.044 (0.048)	0.034 (0.048)	0.072 (0.057)	-0.075*** (0.013)	-0.076*** (0.014)	-0.073*** (0.013)	-0.059*** (0.017)
Male-to-female ratio	-0.161 (0.103)	-0.160 (0.104)	-0.165 (0.104)	-0.164 (0.106)	0.030 (0.028)	0.031 (0.029)	0.028 (0.028)	0.027 (0.032)
Household dependency ratio	0.545 (0.567)	0.159 (0.620)	0.377 (0.577)	-0.161 (0.666)	0.224 (0.151)	0.208 (0.175)	0.167 (0.156)	-0.004 (0.200)
Log of total plot size (square meters)	0.041 (0.028)	0.049* (0.028)	0.050* (0.028)	0.046* (0.028)	0.000 (0.007)	0.007 (0.008)	0.004 (0.007)	0.004 (0.008)
Total livestock (TLU)	1.096*** (0.240)	1.151*** (0.240)	1.053*** (0.246)	1.012*** (0.296)	-0.037 (0.064)	-0.010 (0.067)	-0.046 (0.066)	-0.091 (0.089)
Affected by climatic shocks	-0.211 (0.173)	-0.221 (0.182)	-0.244 (0.179)	-0.203 (0.178)	0.072 (0.046)	0.054 (0.051)	0.066 (0.048)	0.074 (0.054)
Affected by non-climatic negative shocks	-0.403*** (0.176)	-0.430** (0.181)	-0.454** (0.181)	-0.363** (0.188)	0.068 (0.047)	0.060 (0.051)	0.052 (0.049)	0.105* (0.056)
Affected by positive shocks	-0.076 (0.187)	-0.100 (0.212)	0.031 (0.192)	-0.030 (0.191)	0.014 (0.050)	-0.015 (0.060)	0.051 (0.052)	0.042 (0.057)
R-squared	0.113	0.107	0.088	0.058	0.188	0.090	0.143	0.098
N	642	642	642	642	642	642	642	642

Notes: Robust standard errors are given in parentheses.

\*p &lt; .10. \*\*p &lt; .05. \*\*\*p &lt; .01.

**Table A4.7: Group participation and household welfare: IV results**

	Log of total assets		Log of per capita consumption expenditure	
	(1)	(2)	(3)	(4)
HH head participated in groups	0.410 (0.290)		0.098 (0.078)	
Spouse participated in groups		0.384 (0.676)		0.041 (0.182)
Years of schooling of HH head	0.085*** (0.021)		0.040*** (0.006)	
Years of schooling of spouse		0.147*** (0.027)		0.052*** (0.007)
Age of HH head	-0.014** (0.007)		0.010*** (0.002)	
Age of spouse		-0.001 (0.009)		0.016*** (0.002)
HH head employed off-farm	0.024 (0.250)		0.006 (0.067)	
Spouse employed off-farm		-0.589 (0.556)		-0.090 (0.150)
Household size	0.051 (0.048)	0.049 (0.048)	-0.069*** (0.013)	-0.073*** (0.013)
Male-to-female ratio	-0.177* (0.103)	-0.160 (0.104)	0.024 (0.028)	0.027 (0.028)
Household dependency ratio	0.488 (0.568)	0.151 (0.624)	0.201 (0.153)	0.129 (0.168)
Log of total plot size (square meters)	0.046* (0.027)	0.048* (0.027)	0.003 (0.007)	0.005 (0.007)
Total livestock (TLU)	1.106*** (0.240)	1.178*** (0.247)	-0.029 (0.065)	-0.011 (0.067)
Affected by climatic shocks	-0.172 (0.172)	-0.227 (0.189)	0.087* (0.046)	0.081 (0.051)
Affected by non-climatic negative shocks	-0.406** (0.176)	-0.449** (0.194)	0.067 (0.048)	0.076 (0.052)
Affected by positive shocks	-0.039 (0.186)	-0.100 (0.218)	0.030 (0.050)	0.031 (0.059)
R-squared	0.106	0.097	0.163	0.155
N	642	642	642	642

Notes: Robust standard errors are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.

**Table A4.8: Group participation by types of group and household welfare: IV results**

	Log of total assets			Log of per capita consumption expenditure		
	Farmer group by male (1)	Credit group by female (2)	Religious group by male (3)	Farmer group by male (4)	Credit group by female (5)	Religious group by male (6)
HH head participated in groups	0.289 (0.498)		2.292 (1.674)	0.084 (0.134)		0.969** (0.487)
Spouse participated in groups		-0.309 (1.273)			-0.318 (0.356)	
Years of schooling of HH head	0.093*** (0.021)		0.070*** (0.026)	0.043*** (0.006)		0.034*** (0.007)
Years of schooling of spouse		0.142*** (0.031)			0.049*** (0.009)	
Age of HH head	-0.015** (0.007)		-0.024** (0.010)	0.011*** (0.002)		0.007** (0.003)
Age of spouse		-0.006 (0.012)			0.014*** (0.003)	
HH head employed off-farm	0.000 (0.252)		-0.122 (0.281)	0.007 (0.068)		-0.043 (0.082)
Spouse employed off-farm		-0.520 (0.570)			-0.030 (0.159)	
Household size	0.058 (0.051)	0.059 (0.048)	0.029 (0.053)	-0.072*** (0.014)	-0.075*** (0.013)	-0.083*** (0.015)
Male-to-female ratio	-0.190* (0.105)	-0.177* (0.104)	-0.178 (0.111)	0.023 (0.028)	0.024 (0.029)	0.027 (0.032)
Household dependency ratio	0.378 (0.572)	-0.149 (0.681)	0.300 (0.616)	0.242 (0.154)	0.081 (0.190)	0.209 (0.179)
Log of total plot size (square meters)	0.049* (0.028)	0.046 (0.028)	0.047 (0.030)	0.003 (0.007)	0.002 (0.008)	0.001 (0.009)
Total livestock (TLU)	1.122*** (0.242)	1.129*** (0.262)	1.135*** (0.259)	-0.021 (0.065)	-0.034 (0.073)	-0.018 (0.075)
Affected by climatic shocks	-0.181 (0.180)	-0.199 (0.176)	-0.207 (0.190)	0.108** (0.048)	0.107** (0.049)	0.099* (0.055)
Affected by non-climatic negative shocks	0.044 (0.181)	0.043 (0.179)	0.083 (0.194)	-0.069 (0.049)	-0.071 (0.050)	-0.054 (0.056)
Affected by positive shocks	-0.135 (0.256)	-0.157 (0.276)	-0.147 (0.275)	-0.040 (0.069)	-0.009 (0.077)	-0.046 (0.080)
R-squared	0.096	0.113	0.038	0.158	0.107	0.131
N	642	642	642	642	642	642

Notes: Robust standard errors are given in parentheses.

\*p &lt; .10. \*\*p &lt; .05. \*\*\*p &lt; .01.

**Table A4.9: Aggregate social and political capital and gender-disaggregated asset indices: OLS and IV results**

	OLS		IV	
	Asset index of the HH head (1)	Asset index of the spouse (2)	Asset index of the HH head (3)	Asset index of the spouse (4)
Social and political capital of HH head	0.113** (0.051)		0.274*** (0.087)	
Social and political capital of spouse		0.005 (0.026)		0.155 (0.124)
Years of schooling of HH head	0.008*** (0.001)		0.007*** (0.001)	
Years of schooling of spouse		0.004*** (0.001)		0.004*** (0.001)
Age of HH head	0.000 (0.000)		0.000 (0.000)	
Age of spouse		0.000 (0.000)		0.000 (0.000)
HH head employed off-farm	-0.012 (0.014)		-0.012 (0.014)	
Spouse employed off-farm		0.018 (0.024)		0.012 (0.013)
Household size	0.006* (0.003)	-0.003*** (0.001)	0.005* (0.003)	-0.003** (0.001)
Male-to-female ratio	-0.001 (0.006)	0.006*** (0.002)	0.000 (0.006)	0.006** (0.002)
Household dependency ratio	0.018 (0.029)	0.022* (0.012)	0.017 (0.032)	0.025* (0.014)
Log of total plot size (square meters)	0.001 (0.002)	0.000 (0.001)	0.001 (0.002)	0.001 (0.001)
Total livestock (TLU)	0.010 (0.014)	0.004 (0.005)	0.006 (0.014)	0.002 (0.006)
Affected by climatic shocks	-0.005 (0.010)	-0.001 (0.004)	-0.008 (0.010)	-0.004 (0.004)
Affected by non-climatic negative shocks	-0.030*** (0.010)	-0.006 (0.004)	-0.031*** (0.010)	-0.007* (0.004)
Affected by positive shocks	-0.009 (0.011)	0.004 (0.004)	-0.008 (0.011)	0.001 (0.005)
R- squared	0.120	0.105	0.101	0.053
N	642	642	642	642

Notes: Robust standard errors are given in parentheses.

\*p < .10. \*\*p < .05. \*\*\*p < .01.