

Impact of Uganda's National Land Policy on women's ownership, control, and decision-making
rights over agricultural land holdings

by

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Abstract

Property rights can transform individuals' incentives and facilitate economic prosperity, especially in agriculture. For women, these opportunities are invaluable, but often constraints from overlapping legitimizing systems prevent women from realizing the same property rights as their male counterparts. Many governments have implemented land reforms to counteract this issue, yet other invisible infrastructures exert influence over the practice of women's rights, preventing progress. If there is an external change in statutory rights for women, can change subsequently occur in their realized rights, impacting their economic opportunities? To examine this question, I analyze women's land rights in the context of Uganda's National Land Policy (NLP), a set of comprehensive land reforms reinforcing gender equality in statutory property rights, and its accompanying Implementation Action Plan, which initiates programs to enforce the policy, including gender sensitivity programs. If the programs were enacted and legal gender equality was enforced, I would expect women gained additional realized property rights. Using data from the World Bank's Living Standards Measurement Survey in Uganda, I explore this relationship with two different identification strategies. The difference-in-difference model discovers if the treatment had an effect on women's ownership, control, and decision-making rights over agricultural land holdings, while a modified difference-in-difference model examines how these rights changed as the time from policy implementation increased. The results show the treatment had no impact on women's land rights, and increased exposure to treatment had no effect on outcomes as well. Therefore, these findings imply the policy implementation did not make progress towards gender equality in land rights, or the timeline is not long enough to capture the impact from these programs.

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Chapter 1 - Introduction

Sometimes, a piece of paper securing a woman's rights to the land she cultivates can transform her future. Whether a title, certificate of tenure, or law recognizing gender equality, these concrete property rights on paper can impact her incentives and facilitate her decisions in agriculture, improving her ability to escape poverty traps through agricultural development and economic advancement. Yet, this piece of paper can also be completely meaningless. Property rights are not only drawn from statutory laws but a range of coexisting systems legitimizing and enforcing social contracts between individuals. Local customs, social norms, intra-household dynamics, and other organizational frameworks can offer valid bases for claims. The intersection of these overlapping systems, known as legal pluralism, can permit or prohibit individuals from realizing their full rights. Effective interactions can empower individuals to take advantage of resources; however, if the sum of constraints results in an inefficient obstacle, this economic opportunity may be out of reach.

For women, the opportunities property rights offer can enhance their lives and the lives of those around them. Yet, women are especially vulnerable to losing these opportunities when restrictive gender norms interact with other systems. This additional constraint can prevent them from realizing the same property rights as their male counterparts. Many governments have attempted to counteract this phenomenon by passing land reforms with greater protections for women, offering them equal legal standing on paper in the eyes of the national system. Yet, implementing these policies is difficult due to other invisible infrastructures exerting influence over the practice of women's property rights in different social settings. In order to achieve gender equality in property rights, policies must be able to overcome other obstacles within this dynamic and complex network.

If there is an external change in statutory rights for women, can change subsequently occur in their realized rights, impacting their economic opportunities? To examine this relationship, I analyze several bundles of women's land rights in the context of Uganda's National Land Policy (NLP), a set of comprehensive land reforms reinforcing gender equality in statutory property rights. In 2015, the national government's Ministry of Lands published an accompanying Implementation Action Plan to initiate programs to enforce the policy, including gender sensitivity programs. If the programs were enacted and legal gender equality was enforced, then I would expect women gained additional realized property rights.

To explore this potential effect, I employ the World Bank's Living Standards Measurement Survey in Uganda in conjunction with two different identification strategies. First, the difference-in-difference model investigates the overall effect of the treatment on women's land rights. Second, a modified difference-in-difference with treatment exposure term details how impacts change as the months from the Implementation Action Plan increases. For both models, households who received their final survey in March 2015 act as the control group, due to the least potential exposure they likely experience from implementation lag, while all other households interviewed later are considered treated. From this analysis, the results show the policy's implementation had no impact on women's land rights one year later, and increased exposure to treatment had no effect on outcomes as well. These findings imply the policy implementation did not make progress towards achieving gender equality in land rights, or the timeline is not long enough to capture the impact from these programs.

Previous literature reveals the complex and dynamic nature of property rights and the lasting impact they can have on agriculture. Property rights are made of bundles of separate actionable rights an individual has over property, and individuals can claim these rights from a

complex network of human systems, known as legal pluralism (Pradhan, Meinzen-Dick, and Theis 2019; Meinzen-Dick and Pradhan 2002). When these systems work together effectively, farmers can realize their rights to resources, impacting their agricultural investment, production, and economic prosperity as many studies have confirmed (Brasselle, Frederic, and Platteau 2002; Leight 2016; Hornbeck 2010). Depending on the context, the resulting changes in incentives can also impact other human systems intertwined with agriculture. Using qualitative data, Pradhan, Meinzen-Dick, and Theis 2019 point out how several of these systems can overlap to reduce women's realization of rights at different points in life but are unable to quantify their findings due to the complexity of information. Others find land reform policies can initiate changes in rights to spur agricultural development (Banerjee, Gertler, and Ghatak 2002), but they must contend with these other legitimizing systems exerting influence over rights (Goldstein et al. 2015, Hornbeck 2010). While none of these studies specifically look at reforms targeted towards women and gender equality, the potential impacts from these policies hold promise for influencing women's rights in a similar manner.

The result of this analysis matters because many other countries are including these types of policies in land reforms, expecting to see vast improvements in agricultural development with the increase in statutory and realized rights. These rights, however, are only as powerful as the institutions backing them. As Meinzen-Dick and Pradhan (2002) highlight, the legitimizing system with strongest enforcement will tend to hold the most sway over how these rights are realized. If the policies are not implemented with legal pluralism and social contexts in mind, stronger systems with greater influence will hinder progress. It may also take time to impact these systems and change individuals' behaviors. Although the current literature implies statutory land reforms can have significant impacts on agriculture, the reality of complex

coexisting systems means there may be obstacles to slowly overcome on the way to equality for women in property rights.

In addition, this analysis is unique in its scope. Most previous literature explores property rights and their relationships with various aspects of agricultural economics at a macro-level view, comparing countries to other countries or regions to other regions. For these studies, outcomes are difficult to measure below the national or regional level. Capturing detail in impacts becomes nearly impossible. However, this study looks at a specific policy change within the context of a specific country, in this case Uganda. With outcomes measured at the household level, the analysis picks up more detailed, specific changes to rights and creates understanding on how this policy made impacts at the micro-level.

Some studies have attempted to look at these relationships at more detailed levels, but due to the complex and dynamic nature of property rights, capturing bundles quantitatively is problematic. Rights are very individualized, and their realization depends heavily on shifting social contexts. Numbers cannot easily encapsulate this reality. For those studies investigating rights on a micro-level, most rely on qualitative methods to measure rights. Researchers are able to gain insight into the relationships with the detail necessary but often cannot confirm these connections without quantitative data. In this study, assigning values to different bundles of rights allows the analysis to attempt to capture the complexity of property rights in a novel way. It also measures changes effectively enough at the household level to explore the pathway from policy to impacts at the micro-level. While many studies have been able to use quantitative approaches at the macro-level and qualitative at the micro-level, this analysis is unique in its combination of both micro-level examination and quantitative methods. With the framework

established here, there is opportunity for further investigation of women's property rights in similar contexts expanding upon this particular approach.

Below, Chapter 2 explores previous literature on property rights and legal pluralism, other relevant invisible infrastructures, and their interactions. The context outlined in Chapter 3 presents background on the National Land Policy and dataset, along with preliminary descriptive statistics. Chapter 4 concerns the methodology leading to the identification strategies, while Chapter 5 displays the analysis and results. Finally, the conclusion in Chapter 6 discusses the results, limitations, and future research.

Chapter 2 - Literature Review

In the context of international development, invisible infrastructures are the human systems used to constrain individual behaviors and impact how people realize economic potential (Page and Pande 2018). Unlike “visible” infrastructures, such as roads or government facilities, these infrastructures are abstract constraints on society. These can include institutions, service systems, and cultural and social norms. When invisible infrastructures impose efficient constraints, individuals have the incentive and mobility to pursue economic prosperity with the added systemic resilience to prevent backsliding towards lower economic states. In conjunction with cash and asset transfers to boost growth, they can help individuals overcome poverty traps. When invisible infrastructures are ineffective, however, these constraints can become obstacles. Individuals are more likely to remain trapped at a constant economic state instead of advancing to other levels. In order to continue to reduce global poverty rates, as Page and Pande (2018) argue, development economists must seek to further understand and address the issues imbedded in invisible infrastructures.

Property rights, an institution at the intersection of multiple invisible infrastructures, has the potential to change an individual’s incentives and enable them to escape poverty traps, especially in agriculture. A fundamental change in an individual’s property rights may increase or decrease access or control over resources. As a consequence, incentives and decisions may shift. Brasselle, Frederic, and Platteau (2002) suggest a change in property rights can impact a farmer’s assurance, realization, and collateralization of resources, in turn changing investment incentives, agricultural output, and economic prosperity. The realization of property rights, however, depends on the various systems they exist within, including other invisible infrastructures. Other systems beyond statutory law may concurrently legitimize an individual’s

claim through their interactions under the concept of legal pluralism. Some interactions may weaken or strengthen the access and power an individual may have to their rights. For women, the opportunities property rights offer can empower them and may enhance their lives (Pradhan, Meinzen-Dick, and Theis 2019). Yet interactions with social and gender norms, intra-household dynamics, legal standing, and other systems may constrain these opportunities for them.

In the following sections, I outline fundamental concepts about the nature of property rights and explore the relationship they have with agricultural development and other invisible infrastructures, including gender norms. Although land rights are the focus of this review, the connections and concepts explored here can also extend to property rights over assets, natural resources, and financial and social capital, all of which can impact a household's economic trajectory.

Property Rights

Property rights are far more complex than the ownership of a resource or asset. Due to the systems they exist within, property rights are better defined as the consensus of relationships between people with respect to valued goods (Pradhan, Meinzen-Dick, and Theis 2019). The term encompasses the range of different rights that “bundled” together make up an individual's privileges for a particular good, recognized or affirmed by others. Because of the multiple systems with influence over a property right, the intersection between these systems can change the nature of the relationship and impact the realized strength of these bundles of rights.

Property rights can be broken down to bundles of rights, the various overlapping privileges an individual may have over a piece of property. An individual can hold all rights, hold a portion of the bundle, or share rights jointly with other individuals. A complete bundle would indicate ownership of a piece of property. Many legal anthropologists recognize several

different categories important in the discussion of land rights; for the purposes of this analysis, I will focus on the five laid out by Pradhan, Meinzen-Dick, and Theis (2019). These include use, fructus, management, alienation, and control. By these authors' definitions, the distinction between use and fructus rights is the difference between access to using property and access and power over the economic benefit. For example, cultivating a plot of land would be considered use rights, while fructus rights would be the ability to make decisions over the production from the land. Management includes the right to make specific decisions over property that may alter its usefulness or productivity, such as planting and fertilization decisions. Alienation allows an individual to sell or give away property. Finally, control refers to rights to make specific decisions, similar to management rights but at a higher level. An example would be the decision to use property as collateral on a loan or rent it out. Collectively, this bundle of five rights comprises the ownership rights an individual receives if their rights are fully realized.

Traditionally, the definition of property rights only recognizes concrete legal or formal rights, extended and protected by state institutions. However, individuals can claim property rights through multiple coexisting systems at different levels of society, whether the state, community, or even household level. In addition to the state, societies may accept religious law, customary law, project law, local societal norms, and other organizational structures as legitimizing frameworks. The overlap and interaction of these frameworks within a social setting is defined as legal pluralism (Meinzen-Dick and Pradhan 2002). Depending on the particular system(s) a right is claimed from, the right may be formal or informal and have greater legitimacy in different settings. Not all rights are necessarily considered equal by different individuals. Some systems, such as statutory law, would likely hold greater weight in most contexts, but customary law or norms might become more relevant at a community or household

level. The relationship and power between individuals can reinforce the importance of one system over another. For example, a legal system may state a woman has equal property rights as her husband in a jointly owned property. Yet, she may not be able to fully realize these rights due to the local norms and intra-household dynamics excluding her from participating (Meinzen-Dick and Pradhan 2002; Pradhan, Meinzen-Dick, and Theis 2019). The actual practice in these relationships can vary from the rules or laws governing them. In this way, the complex interaction of systems creates multifaceted and dynamic property rights, affecting individuals' access and claim as they seek economic prosperity.

Property Rights and Agricultural Investment

As a mechanism for impacting incentives, property rights are an essential economic factor for agricultural development. If farmers gain broader bundles of property rights, they may become more confident in their future access to resources and more willing to invest. This in turn may grow their agricultural output. In addition, a change in rights can increase property values (Alston, Libecap, and Schneider 1996; Lanjouw and Levy 2002). A formal title can also open the door to credit access, allowing farmers to use their land as collateral and grow their business. This is especially true for tenant farmers, who lack substantial claim to their farmland and are subject to the decisions of landowners. With a majority of the poor involved in agriculture, understanding which changes produce growth is extremely important. Many researchers have explored this connection, with varying degrees of success.

Overall, most studies confirm a positive association between property rights and agriculture (Jacoby, Li, and Rozelle 2002; Banerjee, Gertler, and Ghatak 2002; Leight 2016; and Hornbeck 2010). Several find limited or no impact from interventions on rights (Goldstein et al. 2015; Brasselle, Frederic, and Platteau 2002). Most studies do not break down property rights

into individual bundles but instead look at the overall concept and its connections. Some researchers explore the established pathway between formal and informal rights while alluding to the distinction signaling creates for rights (Goldstein et al. 2015, Hornbeck 2010, de Janvry et al. 2012). Their analyses do not isolate the relationship under these categories. There is also an endogeneity issue only Brasselle, Frederic, and Platteau (2002) and Leight (2016) address in their studies. As explored below, each one establishes important evidence for the relationship between property rights and agriculture.

Jacoby, Li, and Rozelle (2002) use OLS and hazard analysis to understand how expropriation risk for tenant farmers under a land distribution system impacts the use of organic fertilizer. In China, farmers in the Hebel and Liaoning regions are subject to periodic land redistribution at the discretion of village leaders. This high uncertainty environment makes investing less likely for farmers, as their realized property rights are tentative. Their model confirms this result. It also implies policy meant to increase tenant property rights could trickle down to agricultural investment and increase productivity. However, their view of agricultural investment is narrowed down to a single technology, when there are multiple decisions that could be affected. Expanding outcomes to encompass other investment decisions would increase their validity.

Changes in property rights can affect a wide range of investments, including crop decisions, seed quality sourcing, and technology use, as Goldstein et al. (2015) explores. For this study, the researchers employ an external statutory change to identify the pathway from rights to investment. One of the only randomized control trials (RCT) completed for land rights, 40 rural communities in Benin underwent formalized land demarcation and titling registration, with treatment clustered at the village level. Researchers then compare the impacts of the improved

tenure security on treated individuals to the control. They discover a shift in farmers planting choices towards long-term, investment heavy crops. Although the study studies multiple aspects of agricultural investment, there were no other significant impacts. However, the heterogeneity analysis reveals women responded differently than men to formalization; with the increase in property rights, they are more likely to fallow land and shift focus towards less secure perimeter land. These results are short term, with the endline survey occurring immediately after the program was completed, and further insights could occur in follow-up assessments.

To examine the next step from investment to agricultural production, Banerjee, Gertler, and Ghatak (2002) evaluate a different statutory reform focused on tenancy and its impact on rice yields per acre. Operation Barga enforced tenant's contracts and increased tenure security in the West Bengal region of India starting in the 1970s. Utilizing nearby Bangladesh as a control, the authors use a difference-in-difference model to learn the change in policy did increase agricultural productivity. They hypothesize the increase in yields occurred due to secured investments and guarantees of realization from realized use, fructus, and access rights. It's novel to see this limited transfer of rights studied and to note it has a similar impact to full ownership transfers in other studies. In addition, the impact of this particular policy reveals the nature of legal pluralism. Rights are only as powerful as the institutions backing the claim. These tenant farmers already had these rights to the land they cultivated but were unable to fully realize them due to the influence of other factors diminishing their security. The policy enforced these rights by exerting enough influence to hold power over the social contracts between individuals affirming these rights. Since many countries are implementing these types of land reforms to further development, it's promising to see positive results in agriculture within these complex and dynamic systems.

There is one inherent issue in the causal pathway between property rights and agriculture many studies have failed to address. Endogeneity can exist between property rights and investment. As Brasselle, Frederic, and Platteau (2002) point out, individuals may invest in a plot in order to protect their claim, such as planting trees or hedgerows, or seek further rights from legitimizing frameworks to protect previous investments. Using survey data from the Houet region of Burkina Faso, the authors employ machine learning techniques and a variation of instrument variable models to extrapolate the endogeneity and determine true causality. Once they control for the bias, tenure security's influence on land investment diminishes, going against conventional results. This relationship did not change for established or new settlements, nor for tenant settlements. Overall, the authors' novel econometric decisions seem to avoid previous literature pitfalls and create a framework for future research. In spite of this, their measure of property rights might not accurately represent the outcomes described, and their data captures a static system. There is no external shock causing changes to property rights, which could potentially resolve the issue. It is possible their results would change in a different setting.

A more recent article uses a different framework to both address the endogeneity issue and capture a dynamic system, developing an argument for opposing results. Returning back to the tenure system in China, Leight (2016) examines how the risk of expropriation changes farmers' decisions when faced with possible reallocation. Instead of the single outcome measurement in Jacoby et al (2002), the author uses a wider definition of investment and production, acquiring data necessary to show the full relationship from property right security to investment to output. Village leaders are expected to assign plots irrespective of previous investment or time since a household experienced reallocation, but this bias can still exist. To avoid endogeneity and isolate tenure security for a household over time, Leight exploits

household fixed effects and interaction terms. Although this method is less complex than the previous model, it is effective in this dynamic context. The results show the threat of reallocation changes household behavior—the higher the risk, the less likely a household will invest in land and increase output. Even small changes in security have meaningful impacts for farmers.

The purpose of more secure property rights goes beyond just investment and outcome. When the results are combined, this invisible infrastructure can change not only the economic trajectory of agriculture but of entire regions. One example comes from the Great Plains of the U.S. during settlement and expansion (Hornbeck 2010). Farmers travelled west to lay claim to virgin land and start practicing agriculture. Although the federal government issued formal titles to these individuals, the law was not well enforced in the wilds. These pieces of paper could do little to prevent other farmers or their livestock from crossing borders and causing damage to crops. However, legal pluralism offered other frameworks from which individuals could also claim their rights. Settlers could install fences to signal and enforce their rights, but before 1880, wooden fences were costly to install without nearby woodlands to harvest timber from. The advent of inexpensive barbed wire transformed the landscape. Within a few decades, “counties with the least woodland experienced large increases” in agricultural production, especially in crops previously at risk to livestock destruction. The difference-in-difference model’s results are robust to other explanations of prosperity and expansion, such as railroad networks and regional distance from established population centers. As seen in this historical example, visible methods of confirming land rights support agriculture beyond initial investment. As Hornbeck remarks, the development frontiersmen experienced is most likely due in part to farmer’s ability to protect land from expropriation by other settlers, in addition to delineating land borders. This in turn aided investment in agriculture and helped transform the types of crop and livestock systems,

leading towards intensification and commercialization. In theory, these initial steps to secure land rights may lead to similar results in developing economies in the future.

Property Rights and Invisible Infrastructure

Property rights can also indirectly affect agriculture through other invisible infrastructures. While some rights derive from these human systems, property rights can also turn and influence those same invisible infrastructures by altering incentives. Individuals may adjust decisions to maximize their benefits from these changes, initiating a cascade of effects on human capital and social systems. In addition, the overlapping legitimizing frameworks from legal pluralism may come into conflict instead of working together efficiently. Statutory policy can have major impacts as seen previously, but if it diverges from other systems, the rights individuals realize will be different than the ideal. Both of these types of interactions impact realization on downstream outcomes intertwined with agriculture, including other invisible infrastructures. Researchers have found evidence of impacts from property rights on migration, power, education, intra-household dynamics, and gender. Each of these can influence agriculture both positively and negatively, as de Janvry et al. (2012), Goldstein and Udry (2008), Goldstein et al. (2008), and Pradhan, Meinzen-Dick, and Theis (2019) find in their results. These findings illustrate some of the differences individuals can experience at the intersection of property rights and invisible infrastructures.

In Mexico, de Janvry et al. (2012) find shifts from informal (land-use ownership) to formal property rights (certificate) impacted migration patterns. The increased security for titled households translated into a higher probability of having a migrant in the family, a lower community population, and more youth members leaving the area for work. Individuals did not have to be present to defend their stake in their land. The heterogeneity analysis reveals these

changes had the greatest impact on land-poor farmers over large-scale landowners and hinged on the lands' relative productivity. In addition, migration reduced the amount of land in agriculture slightly, unless there was a market to sell or lease the land to other farmers.

Goldstein and Udry (2008) investigate how the hierarchy of societal power impacts land fertility management in Akwapim, Ghana through property rights. Here, land is owned by the chieftaincy and distributed for use to individuals based on political power or need, similar to a traditional community level tenancy. The hierarchy of power can act as informal property rights for an individual by increasing the consequences for another attempting to expropriate their land. In this case, social hierarchy is acting as an additional legitimizing framework within the customary system, enforcing and affirming individuals' rights to land. Their results show individuals with higher social and political power have more secure informal property rights and are therefore more likely to invest in land fertility. Individuals on the outside of power, including women, are more likely to be exploited and lose their property rights.

Another study observes a connection to education and intra-household dynamics in Ghana, where insecure inheritance of property rights had previously encouraged families to compensate the next generation with increased education (La Ferrara and Milazzo 2014). Using a difference-in-difference model and new land succession policy, the results show males who finished school before the law was implemented had higher educational attainment than males who entered or were in school after. With higher security, education was no longer a necessary alternative, possibly affecting future social mobility. Because the law affected male succession specifically, it had no impact on females. There are, however, multiple studies that indicate property rights have different effects on women and men depending on the invisible infrastructures at play.

Gender dynamics is a crucial invisible infrastructure to consider. When household dynamics and local gender norms limit a women's access or decision authority over resources, her ability to pursue economic success can diminish as a result. Pradhan, Meinzen-Dick, and Theis (2019) recently released a study exploring this interaction. They interviewed women across Nepal to determine factors affecting their rights to property across various life identities. They found an individual's social location has the greatest impact on realized property rights. As her position, household structure, and social capital changes, her rights also shift. Unfortunately, they are unable to capture quantitative data in their interviews, but their results still reveal important connections. In addition, Goldstein and Udry (2008), Goldstein et al. (2015), and Lanjouw and Levy (2002) all note signaling formal property rights, and in some cases informal property rights, gives women higher power and reduces their likelihood of losing land or being exploited. This change enables them to make decisions that would normally put them at greater risk or would counter a previously upheld right.

Overall, changes in property rights have consequences on human capital as well as agriculture, with both desirable and undesirable tradeoffs. The multiple interlocking frameworks exerting influence over rights can empower or disempower individuals to seek economic prosperity. The interaction of these factors also produces heterogeneous effects for different populations. As Pradhan et al (2019) assert, any analysis of property rights, especially women's rights, must take social factors (invisible infrastructures) into account.

Chapter 3 - Context and Data

As institutions at the intersection of multiple invisible infrastructures, property rights can have far reaching influences over agriculture through incentives, investment, and other invisible infrastructures. As seen in the literature, farmers can securely invest in their land and reap the benefits of increased output and agricultural development from an efficient sum of these influences. However, individuals can experience different realized rights based on the systems exerting authority in a given social setting, losing these opportunities for advancement. Women are especially vulnerable to this phenomenon due to gender norms and other social systems. To resolve this issue, many countries have implemented policies enforcing gender equality in property rights, hoping to replicate the positive impacts on agriculture from other policies working within other invisible infrastructures. Yet, these statutory changes must first overcome obstacles from this complex and dynamic system to see results. If there is an external change in statutory rights for women, can change subsequently occur in their realized rights, impacting their economic opportunities?

To explore this question, I turn to a recent policy change in Uganda. In 2013, the Parliament of Uganda passed the National Land Policy (NPL), a comprehensive framework for land reforms meant to “articulate the role of land in national development” (Uganda: National Land Policy, 2013). The policy clarified and condensed previous policy and addressed multiple long-term issues, including inequality in property rights for women and other vulnerable groups. It explicitly reaffirms gender equality in land rights, as originally stated in both the 1995 Constitution and 1998 Land Act. In March 2015, the Ministry of Lands, Housing, and Urban Development released the NLP Implementation Action Plan with further detail on the implementing programs and their timelines for completion. Meant to help bridge the gap

between law and implementation, the plan initiated gender sensitivity programs among the wide breadth of land reforms to attain the statutory ideal of national gender equality.

For Ugandans, land is a cultural, economic, and social cornerstone with multiple systems offering a basis for claims under legal pluralism. Statutory land law comprises policies and laws reaching all the way back to the 1995 Constitution. This comprehensive set of rules, regulations, and rights present the legal framework from which individuals can claim rights to land. Recognizing a gender imbalance in security of rights, the national government has set forth over the last few decades additional specific protections for women and other vulnerable groups. Some discrepancies within the law, however, hinder women from fully utilizing the courts to protect their interests. In addition, the government recognizes four land tenure systems within Uganda: freehold, mailo, leasehold, and customary (Uganda Consortium on Corporate Accountability 2018). Freehold and leasehold confirm ownership and tenant rights on titled land, respectively, while clans or extended families own customary land based on societal or community traditions. Centered in the middle of the country, mailo tenancy draws from a historic colonial treaty with the Burganda Kingdom, offering specific generational protections to those tenants. Each of these adds a layer of framework of both specific statutory rules and customary norms. These latter customary or cultural expectations act as another legitimizing system, normally taking precedence over statutory regulations in practice. Communities and families are responsible for affirming rights of individuals, and women may be denied rights due to long-standing customs and balances of power (Uganda Ministry of Lands Housing and Urban Development 2019). Social and gender norms overlap in these contexts, adding additional constraints. The interactions of these interlocking systems create a complex, fluctuating reality for women and make it difficult to address issues with property rights.

Previously, Ugandan statutory law equalizing men and women in property rights existed but held little sway. Cultural systems or local customs strongly dictated actual practice in rights. A large gap existed between statutory law and implementation, preventing progress in land reforms and development, especially for women. The National Land Policy itself would only perpetuate this problem by creating more policy without action. From interviews and other resources, this seems to be true, as very little enactment occurred directly after the policy was passed. The later Implementation Action Plan, however, enabled the central government to start implementing the programs meant to enact the changes.

Following the reforms outlined in the policy, this plan established the timeline and measurable goals for the programs, including harmonizing and strengthening legal protections for women and initiating gender sensitization for both communities and implementation staff. These changes emphasize working within other invisible infrastructures with influence on property rights, such as customary law and tenure systems, to create positive changes for women. If these programs were implemented as outlined, the theory of change suggests the population would experience greater gender sensitivity, enhanced and clarified legal enforcement of women's rights to land, improved protections in customary practice and tenure for women, and increased support and education from implementation staff. As a result, the greater enforcement of gender equality should have narrowed the gap between policy and action and empowered women to claim greater concrete rights.

The purpose of this study is to explore the impact of the NLP Implementation Action Plan on women's realized property rights. With the data available, the identification strategies can uncover changes to rights within one year of the external shock. If the theory of change follows expectations and the programs are implemented correctly, I would expect to see a

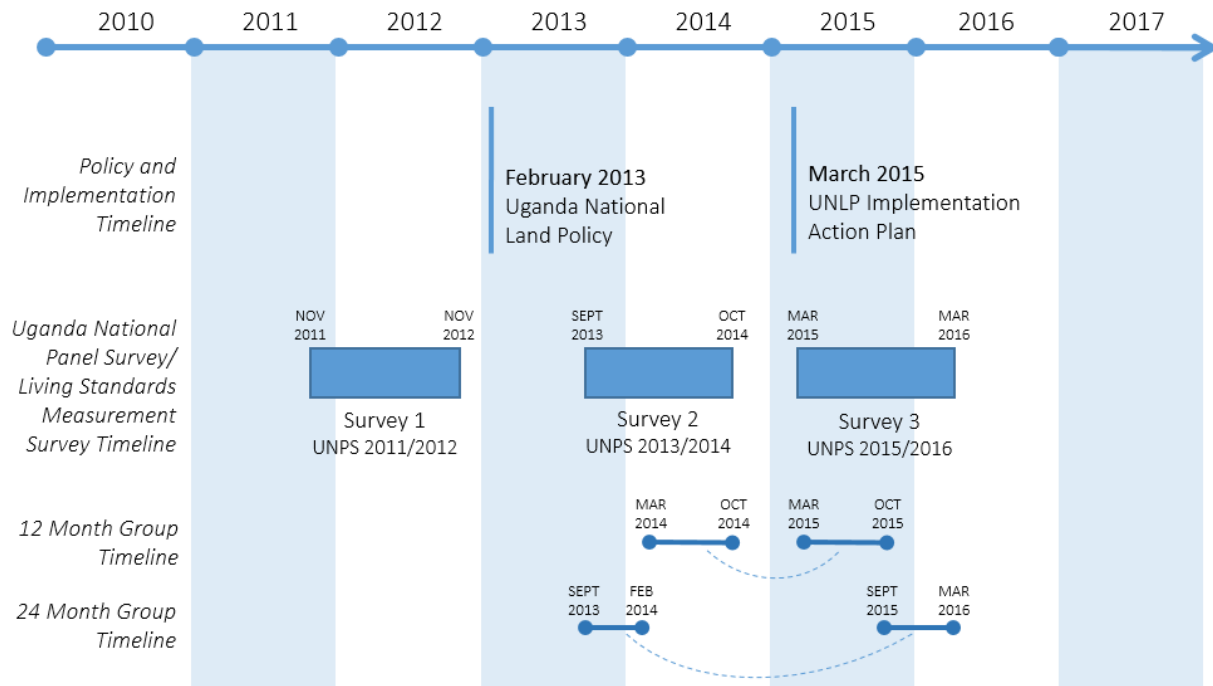
positive change in property rights for women across different bundles of rights as a result of the greater enforcement and influence of legal gender equality through policy change and programs.

Data

In order to examine this relationship, I employ three of the World Bank's Living Standards Measurement Surveys in Uganda from the 2011/2012, 2013/2014, and 2015/2016 waves. This comprehensive national panel survey represents households across all major regions of Uganda, broken down to the district and sub-region levels. This dataset is one of the few complete national surveys available to the public covering a range of topics including household welfare, income and economic activities, community and markets, and agriculture.

One of the unique features of this survey is the interview timing. Survey interviews took roughly 12 months to collect over the wave's two-year span. For the 2013/2014 survey, interviews began September 2013 and ended in October 2014. The month of interview for this survey wave appears fairly random due to the consistent distribution of households across regions within each month and lack of correlation with outcomes. For the following 2015/2016 survey, the Ugandan Bureau of Statistics made considerable effort to complete household interviews in the same month as the previous survey. As a result, households received this survey almost exactly 12 to 24 months after the first, starting in March 2015 and ending in March 2016. Although there is no documentation for the reason behind this administrative decision, the timing appears fairly random. The data spans from September 2013 to March 2016, with only a four-month break between survey waves. This variation in survey timing will be exploited later to examine the program effects. Figure 3.1 shows the interview timelines for all three surveys, along with the relevant corresponding dates for the National Land Policy changes.

Figure 3.1: Survey Timeline



With exception of household demographics, most of the data for this study comes from the agriculture section of the survey. At initial contact, enumerators asked households if they participated in any agricultural or livestock production. Those who did would receive additional questions about their owned and rented land, investment and labor, yields and income, and market information for the last two seasons preceding the questionnaire. Any land the household has rights to is recorded initially at the parcel level. To gain more detail about individual's production of specific crops, production and management information is broken down to the plot level, with one or multiple plots identified on each parcel. Within the agriculture section, the surveys ask respondents about the distribution of property rights between household members. These questions correspond to bundles of rights in ownership, alienation and control, and management/decision making on owned property parcels.

Outcomes

These bundles of rights represent the three categories of outcomes measured in this study, based on the bundles described by Pradhan, Meinzen-Dick, and Theis (2019). First, the ownership outcomes are drawn from the question “Who has ownership rights to this parcel,” which encompasses the full bundle of ownership rights. The second category of outcomes comes from household’s response to “Who can decide whether or not to sell this parcel or use it as collateral,” another parcel-level question. The first part of the question deals with the sale of property, corresponding to alienation, while the second asks who can make higher level management decisions about the property, the equivalent to control rights. These responses make up the controller rights category. Finally, the last outcomes encompass management and decision-making rights. Unlike the two previous categories, this category of rights is initially measured at the plot level, the unit of measurement below the parcel level, and references the question “Who can make decisions about cropping...,” or agriculture management decisions in the first season surveyed. Households can list up to two members for each bundle of rights per unit of land (either parcel or plot). Although there is information on rented land, the questions about rights are limited in scope; therefore, I focus on the richer information available on bundles for owned land. These three categories are as follows:

- Ownership (complete rights to land)
- Alienation and Control (sale or collateralization of land)
- Management/ Decision Making (decisions made about land and agriculture)

The ownership outcomes here are slightly more nuanced than they might initially seem. In the 2013/2014 wave, the survey underwent extensive revisions based on researchers’ feedback on previous waves, leading to structural changes in many sections, including property rights.

Instead of asking only “who owns this parcel of land” as in the 2011/2012 and previous versions, the enumerators first asked respondents if the property had a formal title or certificate of ownership. If there was a formal record, the enumerator would record up to two names listed on the certificate. The majority of households, however, did not have a title or certificate, and the respondent would answer with up to two household members as a separate response. As a result, these different types of ownership are listed independently. To simplify the analysis, I combine these two ownership variables into one for both the 2013/2014 and 2015/2016 surveys. This results in outcomes similar to the single ownership question from previous survey waves but with some minor distinction between them.

Within each category, I then create three sub-categories. The first, Included, indicates if a woman was included as any of the members. The second focuses on if a woman is listed first for a specific right, contained in the First sub-category. The third set, Sole, shows if a woman is the sole individual listed, controlling all of the right for the parcel or plot. In theory, it is impossible to discern if sole rights are better than jointly shared rights or if first rights are better than second listed rights. However, some rights better than none. With these sub-categories of outcomes, there is greater detail to decipher the potency of an individual’s rights. The sub-categories are as follows:

- Included (Is a female member included as a rights holder?)
- First (Is a female member listed as the first rights holder?)
- Sole (Is a female member listed as the sole rights holder?)

The final outcomes are measured at the household level in two different measures. It would be ideal to compare individual parcels across survey waves as a panel; however, the documentation and acreage changes each year, making it impossible to correctly match parcels.

Instead, outcomes are first tallied for each parcel and then collapsed to the household level¹. Here, I assess outcomes first as a dummy indicator: if a woman has the outcome for any parcel owned by the household, the variable will return a one. These outcomes measure the incidence of rights but cannot reveal the amount of land a woman has rights to within the same sub-category of rights. To enhance the detail on these rights, I add an additional measure in inverse hyperbolic sine (IHS) acres, indicating the number of acres from all the parcels women in the household have the outcome over. The parcel acres come from the enumerator's GPS measurement or the farmer's estimation if the GPS is not available. However, while most of the households only own a few acres of land, several households with large land holdings may skew the results high. To deal with outliers, I use the inverse hyperbolic sine equation, or $\log(y_i + (y_i^2 + 1)^{1/2})$, to transform the acres into the finalized measure. The result is similar to a log-transformed variable but defined at zero, keeping some variation that might otherwise be lost. The dummy and final IHS acres measures at the household level will be able to show both changes in incidence and amount, creating more detail in how the policy impacted women.

In total, there are 15 outcomes on women's property rights on owned land, split into three categories in ownership, alienation and control, and management/decision making. These are listed in Table 3.1.

¹ In the case of management/decision-making outcomes, which are initially measured at the plot level, I collapse them up to the parcel level before totaling them at the household level. The plots listed do not have acres attached to them, making it more difficult to capture the final outcomes at higher levels. To resolve this, I only use the dummy measure to indicate if a woman experiences the outcome in any plot of the parcel. These three outcomes are included in the final results. If the First or Sole indicator is present in all of the plots for a parcel, then I can return to both measures for a separate set of outcomes originally measured at the parcel level. The outcomes and their results from the analysis are included in Appendix A.

Table 3.1: List of Outcomes

Outcome Categories	Outcome Sub-Categories	Question	Final Outcome
Ownership	Included Owner	Is a female member included as an owner in HH Land?	Dummy IHS Acres
	First Owner	Is a female member listed as the first owner of HH land?	Dummy IHS Acres
	Sole Owner	Is a female member listed as the sole owner of HH land?	Dummy IHS Acres
Alienation and Control	Included Controller	Is a female member included as an alienator and controller in HH land?	Dummy IHS Acres
	First Controller	Is a female member listed as the first alienator and controller of HH land?	Dummy IHS Acres
	Sole Controller	Is a female member listed as the sole alienator and controller of HH land?	Dummy IHS Acres
Management/ Decision Making	Included Decision Maker	Is a female member included as a decision maker in HH land?	Dummy
	First Decision Maker	Is a female member listed as the first decision maker of HH land?	Dummy
	Sole Decision Maker	Is a female member listed as the sole decision maker of HH land?	Dummy

Descriptive Statistics

Before diving into analysis, I would like to establish a foundation of the household demographics and pre-existing trends within the outcomes described above through exploration of some descriptive statistics.

First, due to the human factor of property rights, it is important to understand who encompasses the households represented in these surveys, especially the female members represented in the sample. The variation in realized rights can be significantly different for women based on their circumstances and life status, tracing back to intersectionality (Pradhan, Meinzen-Dick, and Theis 2019). In addition, understanding the rest of the household can determine who else is competing for land rights. Therefore, I present the household responses to demographic questions in both the 2013/2014 and 2015/2016 survey waves in Table 3.2. To

compare, Table 3.3 and 3.4 specify the demographics of all households' property right holders, split between the 2013/2014 and 2015/2016 surveys

In Table 3.2, the panel's 1718 agriculture households with owned land are split between general household and member characteristics. Indicative of the sampling procedure, these households represent equally the four major regions of Uganda (Central, Eastern, Northern, and Western). Although the majority are rural, both rural and urban households participate in agriculture, with the majority both growing crops and raising livestock. In this panel, very few households only own livestock. The average amount of acres the household owns is a little over a hectare, but the median is about an acre smaller at 1.8 acres. The range in size of land holdings increases with a few major outliers in 2015/2016, even though the quartile range remains stable. There are roughly 6 members per household, with a slight decline overtime. Most are nuclear (head, spouse, and children of head), but there are some multi-generational and extended households. For marital status, the statistic on "never married" includes individuals under 10 years old, explaining the high percentage. Marriages are normally monogamous, although about 6 percent are polygamous.

For rights holders, the distribution of rights is centered in a few specific individuals, as shown in Table 3.3 and 3.4. First or sole right holders tend to be the head of the household and rarely other individuals. On the other hand, second right holders tend to be the spouse of the head but occasionally may be the son or daughter of the head. About 75 percent of the time the first or sole holder is male, while the second holder is female over 80 percent of the time. Married individuals are most likely to hold rights. Widowed and divorced individuals are generally first rights holders. Interestingly, the decision makers have a more varied distribution than the similar owner and controller rights holders. The difference between genders is not as severe for the first

Table 3.2: Household Demographics, 2013/2014 and 2015/2016

	2013/2014	2015/2016		2013/2014	2015/2016
Total Households	(N=1718)	(N=1718)	Total Membership	(N=10528)	(N=10244)
Region of Residence			Members per Household	6.128055879	5.962747381
Central	353 (20.5%)	353 (20.5%)	Sex		
Eastern	424 (24.7%)	424 (24.7%)	Male	5183 (49.2%)	5046 (49.3%)
Northern	481 (28.0%)	481 (28.0%)	Female	5345 (50.8%)	5198 (50.7%)
Western	460 (26.8%)	460 (26.8%)	Relationship to Head of Household		
Rural or Urban			Head	1719 (16.3%)	1711 (16.7%)
Rural	1531 (89.1%)	1529 (89.0%)	Spouse	1240 (11.8%)	1225 (12.0%)
Urban	187 (10.9%)	189 (11.0%)	Son of head	2905 (27.6%)	2828 (27.6%)
Total Owned Household Acres			Daughter of head	2602 (24.7%)	2568 (25.1%)
Mean (SD)	2.75 (3.58)	2.88 (8.74)	Grand Child	1254 (11.9%)	1198 (11.7%)
Median (Q1, Q3)	1.8 (0.9, 3.4)	1.8 (0.9, 3.2)	Other relatives	685 (6.5%)	652 (6.4%)
Min, Max	0.01, 48.5	0.01, 300.0	Non relative	123 (1.2%)	56 (0.5%)
Agriculture			Current Marital Status		
Only Crops	365 (21.2%)	397 (23.1%)	Married monogamously	2156 (20.5%)	2045 (20.0%)
Only Livestock	3 (0.2%)	1 (0.1%)	Married polygamously	605 (5.7%)	601 (5.9%)
Both Crops and Livestock	1350 (78.6%)	1320 (76.8%)	Divorced / Separated	269 (2.6%)	283 (2.8%)
			Widow/Widower	349 (3.3%)	357 (3.5%)
			Never married	7149 (67.9%)	6958 (67.9%)

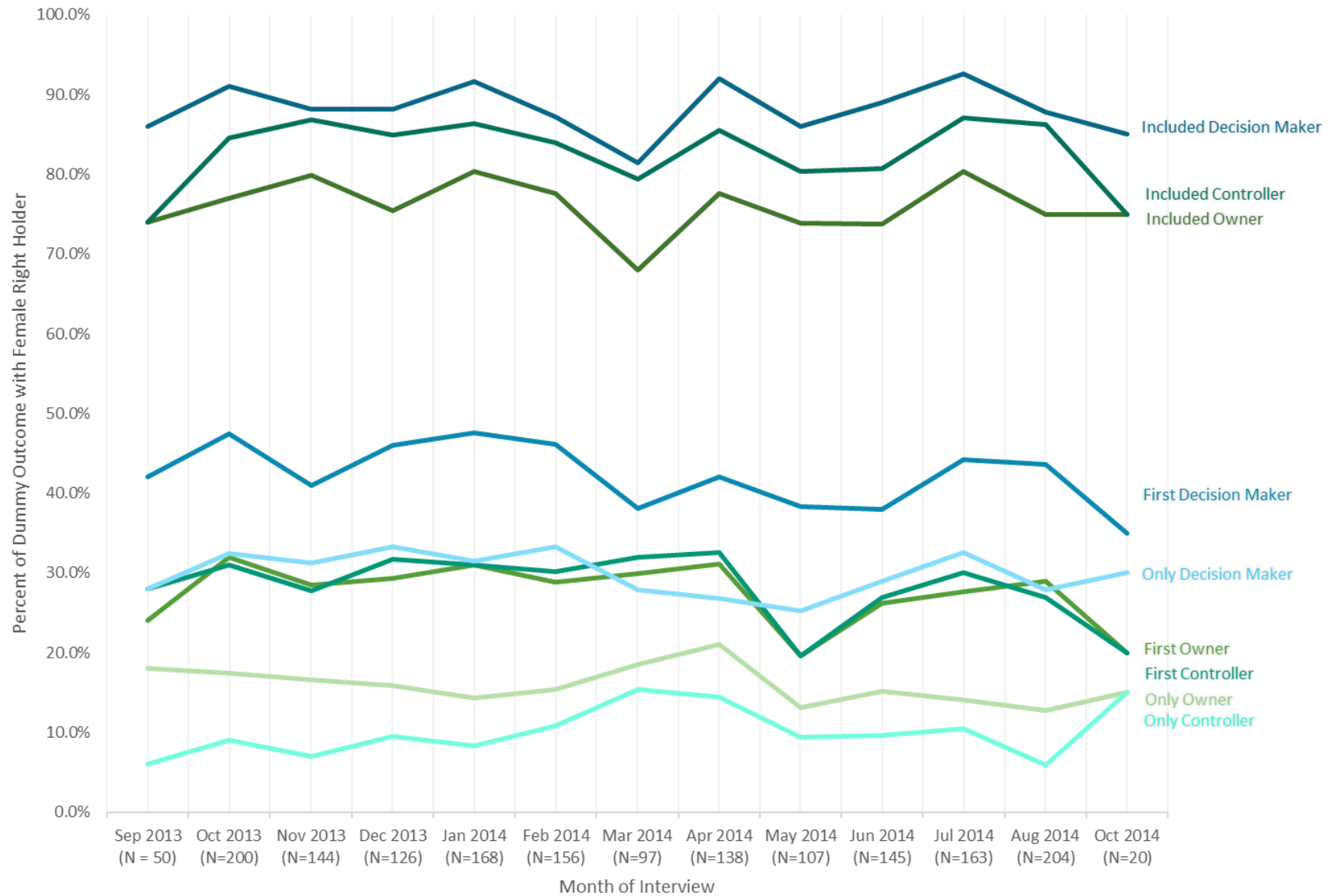
Table 3.3: Household Property Right Holders Demographics, 2013/2014

	2013/2014					
	Owner 1	Owner2	Controller 1	Controller 2	Decision Maker 1	Decision Maker 2
Totals (N)	3463	2306	3442	2729	5759	3603
Measurement Level	Parcel	Parcel	Parcel	Parcel	Plot	Plot
Sex						
Male	2568 (74.2%)	418 (18.1%)	2544 (73.9%)	516 (18.9%)	3609 (62.6%)	505 (14.0%)
Female	895 (25.8%)	1888 (81.9%)	898 (26.1%)	2213 (81.1%)	2188 (38.0%)	3098 (86.0%)
Relationship to Head of Household						
Head	3218 (92.9%)	175 (7.5%)	3164 (91.9%)	221 (8.1%)	4947 (85.9%)	382 (10.6%)
Spouse	189 (5.5%)	1683 (72.9%)	195 (5.7%)	1917 (70.2%)	757 (13.1%)	2915 (80.9%)
Son/daughter of head	36 (1.0%)	360 (15.6%)	62 (1.8%)	491 (18.0%)	71 (1.2%)	220 (6.1%)
Other relatives	20 (0.6%)	88 (3.8%)	21 (0.6%)	100 (3.7%)	21 (0.4%)	84 (2.4%)
Non relative	-	-	-	-	-	2 (0.1%)
Current Marital Status						
Married monogamously	2041 (59.0%)	1547 (68.0%)	2024 (59.2%)	1742 (65.3%)	3407 (59.1%)	2663 (74.1%)
Married polygamously	681 (19.7%)	348 (15.3%)	660 (19.3%)	441 (16.5%)	1159 (20.1%)	673 (18.7%)
Divorced / Separated	192 (5.5%)	34 (1.5%)	189 (5.5%)	42 (1.6%)	351 (6.1%)	45 (1.3%)
Widow/Widower	479 (13.8%)	36 (1.6%)	471 (13.8%)	40 (1.5%)	791 (13.7%)	47 (1.3%)
Never married	70 (2.0%)	341 (15.0%)	98 (2.9%)	464 (17.3%)	2217 (38.5%)	175 (4.8%)

Table 3.4: Household Property Right Holders Demographics, 2015/2016

	2015/2016					
	Owner 1	Owner2	Controller 1	Controller 2	Decision Maker 1	Decision Maker 2
Totals (N)	3314	1947	3295	1907	5953	3274
Measurement Level	Parcel	Parcel	Parcel	Parcel	Plot	Plot
Sex						
Male	2009 (73.6%)	265 (13.6%)	2435 (73.9%)	307 (16.1%)	3638 (61.9%)	329 (10.0%)
Female	720 (26.4%)	1682 (86.4%)	860 (26.1%)	1600 (83.9%)	2270 (38.1%)	2945 (90.0%)
Relationship to Head of Household						
Head	2576 (94.4%)	113 (5.8%)	3070 (93.2%)	125 (6.6%)	5052 (84.9%)	214 (6.5%)
Spouse	125 (4.6%)	1554 (79.8%)	180 (5.5%)	1477 (77.5%)	771 (13.0%)	2818 (86.1%)
Son/daughter of head	13 (0.5%)	217 (11.1%)	26 (0.8%)	252 (13.2%)	89 (1.5%)	172 (5.3%)
Other relatives	15 (1.5%)	56 (2.8%)	19 (0.6%)	52 (2.7%)	35 (0.6%)	61 (1.9%)
Non relative	-	6 (0.3%)	-	-	2 (0.0%)	9 (0.3%)
Current Marital Status						
Married monogamously	1649 (59.6%)	1385 (71.1%)	1976 (60.2%)	1314 (69.8%)	3429 (57.6%)	2412 (74.3%)
Married polygamously	499 (19.0%)	311 (16.0%)	627 (19.1%)	312 (16.6%)	1180 (19.8%)	638 (19.6%)
Divorced / Separated	139 (5.3%)	27 (1.4%)	174 (5.3%)	36 (1.9%)	375 (6.3%)	75 (2.3%)
Widow/Widower	395 (14.1%)	34 (1.7%)	453 (13.8%)	33 (1.8%)	839 (14.1%)	34 (1.0%)
Never married	51 (1.9%)	190 (9.7%)	65 (5.5%)	212 (11.2%)	130 (2.2%)	115 (3.5%)

Figure 3.2: Outcomes and Interview Timing, 2013/2014



right holders, and there is greater diversity in the marital and relationship statuses represented. While we can see some slight changes across years, these tables do not explain how the outcomes of interest change nor if these changes are caused by the shock.

Next, the distribution of outcomes across interview timing before any households receive exposure to the Implementation Action Plan may shape the analysis. If there are major differences within the initial survey, other seasonal trends or interactions between the timing decisions and the outcomes may bias the final results. This phenomenon would void any model utilizing the timing to better understand the impact of the shock without a control for pre-existing trends. In order to identify any of these trends, Figure 3.2 presents the all of the outcomes broken down by the month of interview completion for the 2013/2014 survey.

From this figure, it is clear to see flat trends overtime in the nine dummy outcomes. While there is some minor variation across months, the lack of major changes indicates the pre-existing trends should not bias the results, even if a control is not included in the analysis. In addition, when there is variation, many of the outcomes move in the same direction, suggestive of similar trends between outcomes. This figure will become essential in establishing the methodology later.

Finally, it helpful to see if there are any differences in outcomes between survey waves before undertaking a more extensive analysis. To explore this, Table 3.5 details the average values of all outcomes before and after the Implementation Action Plan, with t-test to identify any significant changes across survey waves.

It is interesting to note the changes in several outcomes despite the lack of change in total household acres between years in Table 3.5. There are several discernable differences in Sole Owner, Included Controller, Sole Controller, and Sole Decision Maker outcomes. While women

Table 3.5: Average Value of Outcomes, 2013/2014 and 2015/2016

	2013/2014	2015/2016	T-Tests	
			Difference in Means	T-Statistic
	(N = 1718)	(N = 1718)		
Total Household Acres			0.1306	0.5728
Mean (SD)	2.75 (3.58)	2.88 (8.74)		
Median (Q1, Q3)	1.8 (0.9, 3.4)	1.8 (0.9, 3.2)		
Min, Max	0.01, 48.5	0.01, 300.0		
Total Household Acres, IHS			-0.0233	-0.8720
Mean (SD)	1.41 (0.78)	1.38 (0.78)		
Median (Q1, Q3)	1.4 (0.8, 1.9)	1.3 (0.8, 1.9)		
Min, Max	0.009, 4.6	0.009, 6.4		
Outcomes				
Included Owner, Dummy	1315 (76.5%)	1276 (74.3%)	-0.0227	-1.5451
First Owner, Dummy	490 (28.5%)	499 (29.0%)	0.0052	0.3390
Sole Owner, Dummy	271 (15.8%)	352 (20.5%)	0.0471	3.5923 ***
Included Controller, Dummy	1445 (84.1%)	1265 (73.6%)	-0.1048	-7.5827 ***
First Controller, Dummy	499 (29.0%)	502 (29.2%)	0.0017	0.1126
Sole Controller, Dummy	165 (9.6%)	328 (19.1%)	0.0949	8.0035 ***
Included Decision Maker, Dummy	1527 (88.9%)	1505 (87.6%)	-0.0128	-1.1651
First Decision Maker, Dummy	744 (43.3%)	760 (44.2%)	0.0093	0.5501
Sole Decision Maker, Dummy	520 (30.3%)	596 (34.7%)	0.0442	2.7709 ***
Included Owner, IHS Acres			-0.0613	-2.0698 **
Mean (SD)	1.03 (0.87)	0.97 (0.87)		
Median (Q1, Q3)	1.0 (0.1, 1.6)	0.9 (0.0, 1.6)		
Min, Max	0.0, 4.6	0.0, 5.8		
First Owner, IHS Acres			-0.0018	-0.0807
Mean (SD)	0.33 (0.65)	0.33 (0.64)		
Median (Q1, Q3)	0.0 (0.0, 0.3)	0.0 (0.0, 0.4)		
Min, Max	0.0, 4.6	0.0, 4.1		
Sole Owner, IHS Acres			0.0561	3.2101 ***
Mean (SD)	0.17 (0.48)	0.23 (0.55)		
Median (Q1, Q3)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
Min, Max	0.0, 3.1	0.0, 4.1		
Included Controller, IHS Acres			-0.2057	-6.9551 ***
Mean (SD)	1.17 (0.86)	0.97 (0.87)		
Median (Q1, Q3)	1.2 (0.5, 1.8)	0.9 (0.0, 1.6)		
Min, Max	0.0, 4.6	0.0, 5.8		
First Controller, IHS Acres			0.0013	0.0604
Mean (SD)	0.34 (0.65)	0.34 (0.65)		
Median (Q1, Q3)	0.0 (0.0, 0.4)	0.0 (0.0, 0.4)		
Min, Max	0.0, 4.6	0.0, 4.1		
Sole Controller, IHS Acres			0.1151	7.2354 ***
Mean (SD)	0.10 (0.38)	0.22 (0.54)		
Median (Q1, Q3)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)		
Min, Max	0.0, 3.1	0.0, 4.1		

p<0.05 *p<0.01

seem to make significant gains in the Sole outcomes, as Included Controllers they seem to lose a huge proportion of the rights. Unfortunately, this does not explain what factors may be influencing these changes, including the policy. The identification strategy should be able to discern if the differences here can be attributed to the policy.

Chapter 4 - Methodology

In the ideal scenario, the data would include a perfect counterfactual for each household exposed to the treatment. The survey would observe and record each household twice—once as a control in the absence of treatment, and again when exposed to treatment. All observed and unobserved characteristics would be exactly comparable, unchanged between periods except those affected by treatment. Comparing these perfect matches would show changes in outcomes, or the exact effect of the treatment on the household without bias or assumptions.

However, the perfect scenario is impossible in this context. With this policy change, the entire population starts receiving treatment the moment the policy is implemented. No household can be both exposed and not exposed to treatment over the same period, as it is impossible to repeat a time period with the exact same external circumstances. The perfect counterfactual does not exist with current restrictions.

In reality, the closest empirical strategy possible is a randomized control trial, where a population or representative sample is randomly assigned to treatment or control groups and observed over the same period. With randomization, the model assumes the groups are comparable across characteristics, and bias is minimized with few assumptions. However, this model is dependent on specific design developed and enacted before implementation even occurs. Since the policy was not implemented as an RCT according to the information available, this approach is not feasible.

Instead, I employ a difference-in-difference identification strategy. Here, the model compares changes in the treated and counterfactual groups across time. The treated group will contain the impact of the treatment within the trend, but the change in outcomes will mask the true impact due to the changes attributed to other factors and the original trend. Since it is not

exposed to the treatment, the counterfactual group is expected to continue the trend the treated group should have experienced in the absence of treatment. Calculating the difference between these two trends results in the estimated impact of the treatment with minimal bias. One of the unique characteristics of the model is it allows comparison groups to display some initial heterogeneity. The difference is removed once differences in trends are calculated. In addition, this model requires the parallel trends assumption. In order to identify any change in trends due to treatment, the outcomes must change consistently, running parallel to each other. If this phenomenon cannot be verified, I assume the trends would retain this characteristic in the absence of treatment. If pre-treatment trends are different, then the model cannot accurately reveal the treatment's impact.

In the ideal setting, a difference-in-difference model would compare treated and control groups before and after the 2015 Implementation Action Plan. However, in this context the treatment and control groups require some assumptions. The Implementation Action Plan occurred in March 2015, the exact same time interviews began for the final survey. As a result, all households have final outcomes measured after the policy was implemented, producing possible exposure to implemented programs in all households. There is no pure control or counterfactual group to compare differences. To resolve this issue, I must assume a few things about the implementation process. Policies take time to implement, and it is unlikely the programs started immediately after the Implementation Action Plan occurred. Therefore, households who received the final survey in March 2015 will stand in as the counterfactual. These 97 households have little to no exposure to the programs and is the closest to a control the dataset presents in this context. Hereafter, this group of households are referred to as the March 2015 households/group or the control group.

Under this approach, I will exploit the variation in the survey timing and estimate impact using a single treatment sample. Comparing the March 2015 group to all other households who received the final survey can reveal if there is any effect on treatment overall. This comparison will yield the average treatment effect but mask changes in treatment overtime.

This model still hinges on the parallel trends assumption outlined above to accurately measure the treatment impact. Referring back to Figure 3.2, comparing the pre-existing trends across the 2013/2014 survey before treatment cannot verify this assumption. Although these trends remain stable and parallel across the survey, they cannot compare the individual points representing the control and treatments across time. This figure does show initial heterogeneity between these groups. In this case, initial differences are minimal across interview timing. There may be a few significant differences the model will identify and remove from the estimate.

In order to accurately identify parallel trends, I employ the previous survey wave from 2011/2012 to look at the trends in outcomes across control and treatment samples prior to treatment. If parallel trends holds, there will be no significant differences in the mean differences of outcomes between 2011/2012 and 2013/2014. Table 4.1 presents the average values of outcomes from these survey waves, along with t-tests assessing differences in trends. A few distinctions create caveats to the results presented here. Due to the structural changes to the survey initiated in the 2013/2014 wave, the Controller category is unavailable, and the Ownership category is not perfectly matched across surveys (see Outcomes section). Since the sample consists of households who complete the survey for three years before being replaced by a new group of households, roughly one third of the households from the panel do not have outcomes from both surveys. Nevertheless, from this table, it is clear there are no significant

differences in trends between the control and treatment samples prior to the treatment period.

Therefore, the result verifies the parallel trends assumption for these outcomes.

Table 4.1: Parallel Trends, 2011/2012 and 2013/2014

	2011/2012	2013/2014	T-Tests: Mean Difference in Trends, Control vs Treatment		
			March 2015 vs All Other Households	March 2015 vs October 2015 Households	March 2015 vs March 2016 Households
	(N = 930)	(N = 930)			
Included Owner, Dummy	748 (80.4%)	709 (76.2%)	-0.0371	-0.0198	0.0659
First Owner, Dummy	283 (30.4%)	268 (28.8%)	0.0578	0.0766	0.1813
Sole Owner, Dummy	162 (17.4%)	140 (15.1%)	0.0454	0.0288	0.3049
Included Decision Maker, Dummy	825 (88.7%)	834 (89.7%)	-0.0714	-0.0767	0.0852
First Decision Maker, Dummy	451 (48.5%)	422 (45.4%)	-0.1096	-0.1441	-0.1346
Sole Decision Maker, Dummy	323 (34.7%)	291 (31.3%)	-0.0858	-0.4872	0.0275
Included Owner, IHS Acres			-0.0418	0.0494	0.6060
Mean (SD)	1.31 (1.02)	1.08 (0.89)			
First Owner, IHS Acres			0.0803	0.1723	0.0718
Mean (SD)	0.43 (0.81)	0.35 (0.67)			
Sole Owner, IHS Acres			0.0930	0.1190	0.2587
Mean (SD)	0.25 (0.67)	0.16 (0.47)			

The difference-in-difference model can be written as follows:

$$(1) \quad Y_i = \alpha + \tau t + \delta T_i t + \rho T_i + \mathbf{x}_i \boldsymbol{\gamma} + \varepsilon_i$$

where Y is the outcome of interest for household i , t is the time binary variable indicating period before ($t=0$) and after ($t=1$) treatment, T_i is the treatment variable indicating control ($T=0$) and treatment ($T=1$), $T_i t$ is the interaction of treatment and time binary variables, and \mathbf{x}_i represents a vector of control variables. Y will change based on the outcome variable of interest.

The coefficient on $T_i t$, δ , is the estimate of the treatment impact, or the difference in outcomes

for the control group before and after the intervention subtracted from the difference in outcomes for the treatment group before and after the intervention.

However, the difference-in-difference model can only explain if any treated household experienced changes when compared to initial outcomes overall. As currently organized, it cannot discern detail beyond the average impact. In addition to every household having some exposure, not every household received the exact same amount of treatment. The final interview timing ranges from 0 to 12 months following the policy's implementation. How does the amount of exposure change outcomes overtime?

To answer this question, one alternate approach would be to employ a regression looking at exposure after the treatment. The programs are unlikely to have been immediately started after the plan passed, and due to the social nature of property rights, it may take time to see results in the population. If this is true, households interviewed later in the survey have greater exposure to the policy programs and are more likely to show changes in outcomes. This variation in the data is important to understanding the differences in immediate and latent effects along with the effectiveness of the programs. Using the previous difference-in-difference framework, I can include treatment exposure as an additional treatment variable containing the number of months from the Implementation Action Plan. In this "exposure difference-in-difference", the variable of interest reveals the impact of the programs as time increases but with greater variation than the estimate of the impact from the interaction term. Since the group has minimal exposure to the subsequent programs, the March 2015 households will act as a baseline at month 0. All other households receive a treatment value corresponding to the number of months after the control they completed their final interview (April 2015 equals 1 month since March 2015, May 2015 equals 2, etc.). The results would be able to indicate if change occurred within the final survey as

the number of months from the shock increased. In addition, this model allows for comparison of outcomes before and after the shock and builds in controls for heterogeneity between groups.

The exposure difference-in-difference model can be written as follows:

$$(2) Y_i = \alpha + \tau t + \delta T_i t + \rho T_i + \varphi M_i t + \omega M_i + \mathbf{x}_i \boldsymbol{\gamma} + \varepsilon_i$$

where Y is the outcome of interest for household i , t is the time binary variable indicating period before ($t=0$) and after ($t=1$) treatment, T_i is the original treatment variable indicating control ($T=0$) and treatment ($T=1$), $T_i t$ is the interaction of treatment and time binary variables, and \mathbf{x}_i represents a vector of control variables. The only difference from the previous model is M_i , the alternate treatment variable showing the number of months since March 2015 the household completed their final interview, and the interaction of this term with the time binary variable, $M_i t$. For this approach, the $M_i t$ term shows how outcomes change as exposure to the policy's programs increases by month.

Together with the basic difference-in-difference model, the exposure difference-in-difference regression can help identify the impact of the Implementation Action Plan on women's property rights. Both models contribute to a clearer picture of the changes land policy has on rights equality and realized land rights in Uganda.

Chapter 5 - Analysis and Results

In the following sections, I report the results of the models explored in the Methodology chapter. The first section presents the basic difference-in-difference models to investigate the impact of the policy change on women's property rights. Then, the exposure difference-in-difference regressions follow to investigate the treatment impact overtime.

Basic Difference-in-Differences

For the first analysis, a difference-in-difference model can explain how women's property rights changed before and after the Implementation Action Plan while accounting for initial differences between control and treatment households. Tables 5.1 through 5.3 present the model in the first equation for the three different samples, denoted by panels within each table. Following the categorization defined in the Context and Data section, Table 5.1 shows ownership outcomes for the model. Table 5.2 shows the results for controller outcomes, while Table 5.3 shows decision maker outcomes.

In each of the following difference-in-difference tables, the outcome of interests span across the top with the regression results below. The dependent variables are listed below, corresponding to the exponentiated coefficient and standard errors. The period variable refers to the survey wave (2013/2014 survey outcomes vs. 2015/2016 survey outcomes), while the treatment variable indicates differences between control and treatment samples. Finally, $\text{Period} \times \text{Treatment}$ is an interaction variable between the period and treatment variables. The coefficient on this variable is the estimate of the treatment impact across time, or the key difference-in-difference indicator.

Table 5.1: Difference-in-Difference with Controls, Owner Outcomes

	Included Owner, Dummy	First Owner, Dummy	Sole Owner, Dummy	Included Owner, IHS Acres	First Owner, IHS Acres	Sole Owner, IHS Acres
March 2015 vs All Other Households (N=3436)						
Period	-0.046 (0.0652)	-0.06 (0.0689)	-0.058 (0.0586)	-0.051 (0.109)	-0.091 (0.101)	-0.124 (0.0832)
Treatment	-0.096* (0.0497)	0.008 (0.0469)	0.024 (0.0393)	-0.122 (0.0848)	0.015 (0.0662)	0.041 (0.0517)
Period*Treatment	0.070 (0.0596)	0.057 (0.0630)	0.012 (0.0563)	0.097 (0.0965)	0.087 (0.0867)	0.061 (0.0716)

Difference-in-Difference estimating Equation 1 for ownership outcomes (listed across top); Control for Total Household IHS Acres included in model, not reported; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001"

Table 5.2: Difference-in-Difference with Controls, Controller Outcomes

	Included Controller, Dummy	First Controller, Dummy	Sole Controller, Dummy	Included Controller, IHS Acres	First Controller, IHS Acres	Sole Controller, IHS Acres
March 2015 vs All Other Households (N=3436)						
Period	0.070 (0.0546)	-0.038 (0.0677)	-0.036 (0.0518)	0.090 (0.0889)	-0.052 (0.0981)	-0.084 (0.0731)
Treatment	-0.048 (0.0448)	0.025 (0.0463)	0.056 (0.0344)	-0.116 (0.0794)	0.037 (0.0653)	0.078 (0.0453)
Period*Treatment	0.035 (0.0583)	0.039 (0.0646)	-0.064 (0.0548)	0.096 (0.0909)	0.048 (0.0914)	-0.038 (0.0720)

Difference-in-Difference estimating Equation 1 for controller outcomes (listed across top); Control for Total Household IHS Acres included in model, not reported; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001"

Table 5.3: Difference-in-Difference with Controls, Decision Maker Outcomes

	Included Decision Maker, Dummy	First Decision Maker, Dummy	Sole Decision Maker, Dummy
March 2015 vs All Other Households (N=3436)			
Period	0.001 (0.0466)	-0.141 (0.0813)	-0.119 (0.0748)
Treatment	-0.084* (0.0368)	-0.073 (0.0557)	-0.036 (0.0504)
Period*Treatment	0.012 (0.0474)	0.124 (0.0642)	0.072 (0.0638)

Difference-in-Difference estimating Equation 1 for decision making outcomes (listed across top); Control for Total Household IHS Acres included in model, not reported; Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001"

Across outcomes in Tables 5.1 through 5.3, there is no evidence of significant changes to women's property rights on the households' owned land due to the policy implementation. First, when comparing the control to all other households receiving treatment, the estimate of the treatment impact across time is small and insignificant for each possible bundle of rights. In other words, the treatment does not explain any change or variation in the data. The treatment coefficient is significant on its own for outcomes in the incidence of women's inclusion as decision makers and the magnitude in IHS acres of women's inclusion as owners and controllers. This phenomenon indicates there is an initial difference between the control and treatment groups for these outcomes. However, once the treatment variable interacts with the period variable, the change is no longer significant. As expected, the model cancels out this initial heterogeneity between groups, but no other impacts can be detected.

For this particular model and context, there does not seem to be a strong need for additional controls for omitted variable bias. The model captures many of the differences that may bias the results. By accounting for potential initial heterogeneity between treatment and control groups, any significant differences attributed to other factors are already contained within the specifications of the model. Although they may correlate with the treatment, these potential controls do not change across survey years and are therefore captured in the initial difference. Only a handful of relevant variables change overtime, and few of these are correlated with the treatment. Although the concern for omitted variable bias is low, I add a few controls to the difference-in-difference models above in order to increase precision. The results without controls are included in Appendix B.

In the difference-in-difference model, there is no impact from the policy implementation across the board, but it does not tell the whole story. This identification strategy may be too conservative to capture all of the variation related to the treatment. These models also have r-squared values close to zero, meaning they explain little to no variation in the data. As an alternative approach, I can utilize more of the intertemporal timing to understand how other variation might relate to the policy changes. To better understand detail in the relationship, I turn to the exposure difference-in-difference framework.

Exposure Difference-in-Difference

At this point, the exposure difference-in-difference framework may be able to identify the impact of the treatment on outcomes overtime. As explained earlier in the methodology, the exposure difference-in-difference regressions from the second equation are similar to the previous model but include an additional treatment variable indicating the number of months since the Implementation Action Plan and an interaction term between the treatment exposure

and the survey period (2013/2014 survey outcomes vs. 2015/2016 survey outcomes). This modification allows the model to reveal any changes to outcomes due to differences in program exposure. Instead of coming from the interaction of the original treatment and period in the previous models, the interaction term between period and treatment exposure shows the estimate of the impact but with greater detail on changes overtime. The results with controls are broken into categories of rights: ownership, control, and management/decision making outcomes, corresponding with Tables 5.4, 5.5, and 5.6, respectively.

While the coefficients are slightly different, the results from these exposure difference-in-difference models lead to similar finding to the previous framework. Again, as seen in the models above, there is little evidence to suggest any impact occurred for women's property rights as a result of the policy implementation. Focusing on the interaction term between treatment exposure and time period, both the change in incidence and magnitude of various bundles of rights are small and not significant across outcomes. As before, there are a few significant treatment coefficients for several outcomes, but they simply indicate initial differences in the control and treatment groups. The significance falls out in both the treatment exposure and interaction variables. Adding IHS-transformed total acres to the model as an additional control accounts for potential bias from differences in total household land over the course of the surveys (see Appendix B for additional results without this control).

Similar to the previous model, the exposure difference-in-difference regressions also explain little to no variation in the data. While the additional controls help boost the r-squared results across outcomes, the treatment itself does not seem to have influence over these outcomes. Overall, the results provide no evidence of impact from the NLP Implementation Action Plan on women's land rights in Uganda one year from its release.

Table 5.4: Exposure Difference-in-Difference with Controls, Owner Outcomes

	Included Owner, Dummy	First Owner, Dummy	Sole Owner, Dummy	Included Owner, IHS Acres	First Owner, IHS Acres	Sole Owner, IHS Acres
March 2015 vs All Other Households (N=3432)						
Period	0.0447 (0.0623)	0.0584 (0.0649)	0.0568 (0.0554)	0.0497 (0.104)	0.0868 (0.0922)	0.117 (0.0741)
Treatment	0.0813 (0.0500)	-0.0126 (0.0521)	-0.0119 (0.0444)	0.0755 (0.0833)	-0.0224 (0.0740)	-0.0280 (0.0594)
Period*Treatment	-0.0318 (0.0706)	-0.0445 (0.0736)	-0.0147 (0.0627)	-0.0266 (0.118)	-0.0566 (0.104)	-0.0512 (0.0839)
Period*Treatment Exposure	-0.00654 (0.00476)	-0.00225 (0.00496)	0.000467 (0.00423)	-0.0122 (0.00794)	-0.00560 (0.00705)	-0.00182 (0.00566)
Treatment Exposure	0.00167 (0.00337)	0.000679 (0.00351)	-0.00192 (0.00300)	0.00626 (0.00562)	0.00115 (0.00499)	-0.00214 (0.00401)

Exposure Difference-in-Difference estimating Equation 2 for ownership outcomes (listed across top), with additional treatment exposure and time period interaction estimating treatment impacts overtime; Control for Treatment Exposure included in model; Control for Total Household IHS Acres included in model, not reported; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001"

Table 5.5: Exposure Difference-in-Difference with Controls, Controller Outcomes

	Included Controller, Dummy	First Controller, Dummy	Sole Controller, Dummy	Included Controller, IHS Acres	First Controller, IHS Acres	Sole Controller, IHS Acres
March 2015 vs All Other Households (N=3432)						
Period	-0.0721 (0.0587)	0.0370 (0.0653)	0.0351 (0.0501)	-0.0946 (0.0978)	0.0508 (0.0932)	0.0812 (0.0675)
Treatment	0.0516 (0.0471)	-0.0288 (0.0523)	-0.0374 (0.0402)	0.118 (0.0784)	-0.0487 (0.0747)	-0.0590 (0.0541)
Period*Treatment	-0.0335 (0.0666)	-0.0422 (0.0739)	0.0404 (0.0567)	-0.104 (0.111)	-0.0163 (0.106)	0.0307 (0.0764)
Period*Treatment Exposure	-0.000292 (0.00449)	0.000453 (0.00498)	0.00350 (0.00382)	0.000447 (0.00747)	-0.00536 (0.00712)	0.00106 (0.00515)
Treatment Exposure	-0.000763 (0.00318)	0.000488 (0.00353)	-0.00322 (0.00271)	-0.00139 (0.00529)	0.00166 (0.00504)	-0.00353 (0.00365)

Exposure Difference-in-Difference estimating Equation 2 for controller outcomes (listed across top), with additional treatment exposure and time period interaction estimating treatment impacts overtime; Control for Treatment Exposure included in model; Control for Total Household IHS Acres included in model, not reported; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001"

Table 5.6: Exposure Difference-in-Difference with Controls, Decision Maker Outcomes

	Included Decision Maker, Dummy	First Decision Maker, Dummy	Sole Decision Maker, Dummy
March 2015 vs All Other Households (N=3432)			
Period	-0.00107 (0.0467)	0.132 (0.0712)	0.112 (0.0668)
Treatment	0.0877* (0.0374)	0.0540 (0.0571)	0.0253 (0.0536)
Period*Treatment	-0.00211 (0.0529)	-0.120 (0.0807)	-0.0616 (0.0757)
Period*Treatment Exposure	-0.00160 (0.00357)	-0.00207 (0.00544)	-0.00218 (0.00510)
Treatment Exposure	-0.00119 (0.00252)	0.00261 (0.00385)	0.00157 (0.00361)

Exposure Difference-in-Difference estimating Equation 2 for decision making outcomes (listed across top), with additional treatment exposure and time period interaction estimating treatment impacts overtime; Control for Treatment Exposure included in model; Control for Total Household IHS Acres included in model, not reported; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001 "

Chapter 6 - Discussion and Conclusion

In conclusion, the results of the analysis revealed the National Land Policy's Implementation Action Plan did not impact women's land rights in Uganda one year after the plan passed. Neither difference-in-difference model discovered a relationship between the treatment and property rights. Throughout the 2013/2014 and 2015/2016 surveys, women's rights remain stable and reveal no change despite the new enforcement measures of rights equality at the statutory level.

These results imply either the policy did not make progress towards realized gender equality, or the data did not capture the impact in a long enough time period or the right outcomes. First, due to the lack of clear information on how the Implementation Plan was carried out, a scenario where the programs were not implemented well is possible. A variety of government and international organizations manage and implement these programs, not just the Ministry of Lands. With the lack of publicly available documentation, it is difficult to track down who is running these programs, verify the programs' existence, and identify if the programs were implemented as outlined. Second, the theory of change could be potentially flawed. While the policy and plan set forth land reforms to create specific changes, these programs may not exactly impact the population as expected, especially if not implemented correctly. Again, property rights exist within a complex network, and producing these desired changes may be inhibited if the programs do not influence the other legitimizing frameworks correctly. Third, these programs may be in place and working as expected, but the impacts may take time. Although a statutory change to rights can happen overnight, impacts on social systems take years due to the complexity of human networks and behaviors. As a result, realized property rights may not change immediately with a policy. In addition, as previously stated, the programs might not have

started immediately after the plan but lagged a few months before being released. This would increase the amount of time before any effects might appear. The window of data currently available limits the amount of time following the shock to identify impacts; expanding the data to follow these households another year or two after may yield more information about the changes. Finally, property rights are inherently difficult to capture quantitatively, and the current outcomes may not be the best way to evaluate changes in women's rights. There could be other nuances to the bundles of rights these outcomes are not set up to capture.

There are several limitations to this analysis. As mentioned earlier, the current timeline of the data might not be able to capture the full effects of the policy. Changes to property rights and the network of systems they reside within take time, and from the information available, there is little verification of when the programs were implemented, if at all. Unfortunately, at the time of publication, the 2017/2018 survey wave is not publicly available and prevents further investigation with this dataset. The dataset itself may have issues as well. In addition to potential household head response bias, the outcomes available may not be able to fully capture all the changes to rights before and after treatment. The household's owned parcels are not connected across surveys nor consistently measured, preventing more detailed outcomes at the parcel level. Some of the changes in rights may therefore be masked with the household level outcomes. This might also explain the difficulty of explaining variation with the models used. With the r-squared close to zero across all variations of the models, there may be other things going on the data and outcomes cannot capture. The models must also rely on a few assumptions to analyze the data, some of which are more difficult to validate than others.

Why do these results matter? Countries across East Africa have been passing and implementing land reforms similar to Uganda in an attempt to secure individuals' rights to land

and facilitate greater development. A major factor of agricultural production, land also is culturally important for many of the groups in this region. These types of policies can have major impacts on households' economic prospects and the social systems they participate in. In Uganda, about 25 million people depend on agriculture for their livelihoods, and of these over 75 percent are women (Walker et al. 2018, Hill et al. 2017). Changing statutory law to secure land rights to female farmers can dramatically change how she invests in her production, accesses and controls credit, and makes decisions about economic opportunities. But if the policy does not make an impact due to interactions with invisible infrastructures and other social systems, then positive changes and development will be inhibited. Finding ways to improve and implement these policies with legal pluralism in mind can help achieve gender equality in land rights.

For future research, there is more to investigate with the National Land Policy and its effects on property rights, in addition to how legal pluralism can be harnessed to drive agricultural development. This study focuses on implementation and impact through the Implementation Action Plan, but a broader policy analysis might be able to identify more information on what additional progress has been made and what obstacles are preventing changes in rights for women in this particular context. Again, extending the timeline to encompass more data past the first year may help identify latent changes to rights. For this particular dataset, there is more information to include in future study. Tenure security is a major issue for households across the developing world, and securing use rights to rented land can help facilitate agricultural investment (Jacoby et al. 2002, Banerjee et al. 2002). This analysis only looks at the households' owned land. Applying a similar analysis to rented land would increase the sample size to include agriculture households without ownership rights to land, potentially expanding the bundles of rights. It could also shed light on use rights relationships between

landowners and tenants in Uganda. In addition, the data includes responses about access, use, and fructus right, the rest of a complete bundle of rights. The complex structure and seasonality of these responses makes it difficult to include them with the current outcomes but not impossible. Finally, the next step in this analysis is to understand how this policy or a similar one impacts agricultural investment and output through property rights. Many studies have investigated this economic relationship without proving the direct mechanics from policy to property rights to investment. If a change in property rights occurs due to the policy, researchers may be able to employ a similar analysis to follow the effects all the way to agricultural development.

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Appendix A - Additional Decision Maker Outcomes

Table A.1: List of Outcomes, Decision Maker Outcomes, Entire Parcel

Outcome Categories	Outcome Sub-Categories	Question	Final Outcome
Management/ Decision Making	First Decision Maker, All	Is a female member listed as the first decision maker for an entire parcel of HH land?	Dummy IHS Acres
	Sole Decision Maker, All	Is a female member listed as the sole decision maker for an entire parcel of HH land?	Dummy IHS Acres

Table A.2: Outcomes, 2013/2014 and 2015/2016

	2013/2014	2015/2016	Difference in Means	T-Tests	
				T-Stat	Significance
First Decision Maker, Entire Parcel, Dummy	678 (39.5%)	664 (38.6%)	-0.0081	-0.4894	
Sole Decision Maker, Entire Parcel, Dummy	491 (28.6%)	535 (31.1%)	0.0561	0.9495	
First Decision Maker, Entire Parcel, IHS Acres			-0.0188	-0.7761	
Mean (SD)	0.45 (0.73)	0.43 (0.69)			
Median (Q1, Q3)	0.0 (0.0, 0.8)	0.0 (0.0, 0.8)			
Min, Max	0.0, 4.6	0.0, 4.1			
Sole Decision Maker, Entire Parcel, IHS Acres			0.0303	1.4124	
Mean (SD)	0.31 (0.62)	0.34 (0.64)			
Median (Q1, Q3)	0.0 (0.0, 0.3)	0.0 (0.0, 0.5)			
Min, Max	0.0, 4.6	0.0, 4.1			

Table A.3: Difference-in-Difference with Controls, Decision Maker Outcomes, Entire Parcel

	First Decision Maker, Entire Parcel, Dummy	Only Decision Maker, Entire Parcel, Dummy	First Decision Maker, Entire Parcel, IHS Acres	Only Decision Maker, Entire Parcel, IHS Acres
March 2015 vs All Other Households (N=3436)				
Period	-0.085 (0.0755)	-0.157 (0.117)	-0.096 (0.0713)	-0.106 (0.100)
Treatment	-0.070 (0.0542)	-0.085 (0.0798)	-0.042 (0.0493)	-0.013 (0.0669)
Period*Treatment	0.093 (0.0649)	0.156 (0.0877)	0.071 (0.0622)	0.070 (0.0868)

Difference-in-Difference estimating Equation 1 for additional decision making outcomes (listed across top); Control for Total Household IHS Acres included in model, not reported; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001"

Table A.4: Difference-in-Difference, Decision Maker Outcomes, Entire Parcel

	First Decision Maker, Entire Parcel, Dummy	Sole Decision Maker, Entire Parcel, Dummy	First Decision Maker, Entire Parcel, IHS Acres	Sole Decision Maker, Entire Parcel, IHS Acres
March 2015 vs All Other Households (N=3436)				
Period	-0.076 (0.0762)	-0.088 (0.0722)	-0.170 (0.121)	-0.113 (0.102)
Treatment	-0.051 (0.0542)	-0.024 (0.0495)	-0.114 (0.0834)	-0.028 (0.0683)
Period*Treatment	0.083 (0.0668)	0.06 (0.0642)	0.17 (0.0879)	0.078 (0.0866)

Difference-in-Difference estimating modified Equation 1 for additional decision making outcomes (listed across top); Control for Total Household IHS Acres not included; Standard errors in parentheses

* p<0.05, ** p<0.01

Table A.5: Exposure Difference-in-Difference with Controls, Decision Maker Outcomes, Entire Parcel

	First Decision Maker, Entire Parcel, Dummy	Sole Decision Maker, Entire Parcel, Dummy	First Decision Maker, Entire Parcel, IHS Acres	Sole Decision Maker, Entire Parcel, IHS Acres
March 2015 vs All Other Households (N=3432)				
Period	0.0813 (0.0696)	0.146 (0.101)	0.0919 (0.0650)	0.101 (0.0906)
Treatment	0.0526 (0.0558)	0.0664 (0.0810)	0.0255 (0.0521)	-0.0227 (0.0726)
Period*Treatment	-0.0780 (0.0788)	-0.147 (0.114)	-0.0582 (0.0736)	-0.0281 (0.103)
Period*Treatment Exposure	-0.00316 (0.00531)	-0.00383 (0.00771)	-0.00250 (0.00497)	-0.00728 (0.00692)
Treatment Exposure	0.00227 (0.00376)	0.00234 (0.00546)	0.00255 (0.00352)	0.00571 (0.00490)

Exposure Difference-in-Difference estimating Equation 2 for additional decision maker outcomes (listed across top), with additional treatment exposure and time period interaction estimating treatment impacts overtime; Control for Treatment Exposure included in model; Control for Total Household IHS Acres included in model, not reported; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001"

Table A.6: Exposure Difference-in-Difference, Decision Maker Outcomes, Entire Parcel

	First Decision Maker, Entire Parcel, Dummy	Only Decision Maker, Entire Parcel, Dummy	First Decision Maker, Entire Parcel, IHS Acres	Only Decision Maker, Entire Parcel, IHS Acres
March 2015 vs All Other Households (N=3432)				
Period	0.0813 (0.0696)	0.146 (0.101)	0.0919 (0.0650)	0.101 (0.0906)
Treatment	0.0624 (0.0533)	0.0783 (0.0773)	0.0332 (0.0498)	-0.0000932 (0.0694)
Period*Treatment	-0.0976 (0.0716)	-0.170 (0.104)	-0.0737 (0.0669)	-0.0732 (0.0932)
Treatment Exposure	0.000692 (0.00266)	0.000424 (0.00387)	0.00130 (0.00249)	0.00207 (0.00347)
Total Household IHS Acres	-0.117*** (0.0105)	0.177*** (0.0152)	-0.118*** (0.00982)	0.0975*** (0.0137)

Exposure Difference-in-Difference estimating modified Equation 2 for additional decision making outcomes (listed across top), with additional treatment exposure and time period interaction estimating treatment impacts overtime; Control for Treatment Exposure included in model; Control for Total Household IHS Acres not included; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001"

Appendix B - Identification Strategies without Controls

Table B.1: Difference-in-Difference, Owner Outcomes

	Included Owner, Dummy	First Owner, Dummy	Sole Owner, Dummy	Included Owner, IHS Acres	First Owner, IHS Acres	Sole Owner, IHS Acres
March 2015 vs All Other Households (N=3436)						
Period	-0.043 (0.0652)	-0.054 (0.0693)	-0.054 (0.0588)	-0.095 (0.138)	-0.099 (0.103)	-0.128 (0.0839)
Treatment	-0.09 (0.0495)	0.021 (0.0468)	0.033 (0.0393)	-0.231* (0.113)	-0.003 (0.0681)	0.032 (0.0524)
Period*Treatment	0.066 (0.0600)	0.049 (0.0643)	0.006 (0.0571)	0.148 (0.110)	0.097 (0.0867)	0.066 (0.0715)

Difference-in-Difference estimating modified Equation 1 for ownership outcomes (listed across top); Control for Total Household IHS Acres not included; Standard errors in parentheses

* p<0.05, ** p<0.01

Table B.2: Difference-in-Difference, Controller Outcomes

	Included Controller, Dummy	First Controller, Dummy	Sole Controller, Dummy	Included Controller, IHS Acres	First Controller, IHS Acres	Sole Controller, IHS Acres
March 2015 vs All Other Households (N=3436)						
Period	0.071 (0.0546)	-0.032 (0.0681)	-0.032 (0.0520)	0.048 (0.120)	-0.061 (0.100)	-0.088 (0.0736)
Treatment	-0.044 (0.0447)	0.037 (0.0462)	0.063 (0.0343)	-0.238* (0.113)	0.018 (0.0675)	0.071 (0.0457)
Period*Treatment	0.032 (0.0585)	0.031 (0.0657)	-0.069 (0.0555)	0.153 (0.110)	0.06 (0.0914)	-0.033 (0.0719)

Difference-in-Difference estimating modified Equation 1 for controller outcomes (listed across top); Control for Total Household IHS Acres not included; Standard errors in parentheses

* p<0.05, ** p<0.01

Table B.3: Difference-in-Difference, Decision Maker Outcomes

	Included Decision Maker, Dummy	First Decision Maker, Dummy	Sole Decision Maker, Dummy
March 2015 vs All Other Households (N=3436)			
Period	0.000 (0.0467)	-0.135 (0.0817)	-0.111 (0.0754)
Treatment	-0.086* (0.0369)	-0.059 (0.0555)	-0.020 (0.0504)
Period*Treatment	0.013 (0.0474)	0.116 (0.0654)	0.063 (0.0655)

Difference-in-Difference estimating modified Equation 1 for decision making outcomes (listed across top); Control for Total Household IHS Acres not included; Standard errors in parentheses

* p<0.05, ** p<0.01

Table B.4: Exposure Difference-in-Difference, Owner Outcomes

	Included Owner, Dummy	First Owner, Dummy	Sole Owner, Dummy	Included Owner, IHS Acres	First Owner, IHS Acres	Sole Owner, IHS Acres
March 2015 vs All Other Households (N=3432)						
Period	0.0421 (0.0625)	0.0526 (0.0657)	0.0526 (0.0558)	0.0905 (0.126)	0.0948 (0.0932)	0.121 (0.0744)
Treatment	0.0710 (0.0501)	-0.0352 (0.0526)	-0.0302 (0.0427)	0.235* (0.101)	0.00870 (0.0747)	-0.0126 (0.0596)
Period*Treatment	-0.0285 (0.0708)	-0.0373 (0.0744)	-0.00575 (0.0575)	-0.0779 (0.142)	-0.0666 (0.106)	-0.0562 (0.0843)
Period*Treatment Exposure	-0.00647 (0.00477)	-0.00208 (0.00502)	N/A (N/A)	-0.0134 (0.00960)	-0.00583 (0.00712)	-0.00193 (0.00568)
Treatment Exposure	0.00236 (0.00338)	0.00221 (0.00355)	-0.000515 (0.00213)	-0.00456 (0.00679)	-0.000951 (0.00504)	-0.00318 (0.00402)

Exposure Difference-in-Difference estimating modified Equation 2 for ownership outcomes (listed across top), with additional treatment exposure and time period interaction estimating treatment impacts overtime; Control for Treatment Exposure included in model; Control for Total Household IHS Acres not included; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001"

Table B.7: Exposure Difference-in-Difference, Controller Outcomes

	Included Controller, Dummy	First Controller, Dummy	Sole Controller, Dummy	Included Controller, IHS Acres	First Controller, IHS Acres	Sole Controller, IHS Acres
March 2015 vs All Other Households (N=3432)						
Period	-0.0737 (0.0588)	0.0316 (0.0659)	0.0316 (0.0504)	-0.0491 (0.126)	0.0595 (0.0944)	0.0842 (0.0677)
Treatment	0.0454 (0.0471)	-0.0502 (0.0528)	-0.0511 (0.0404)	0.297** (0.101)	-0.0143 (0.0756)	-0.0469 (0.0542)
Period*Treatment	-0.0315 (0.0666)	-0.0354 (0.0747)	0.0448 (0.0571)	-0.161 (0.142)	-0.0273 (0.107)	0.0268 (0.0767)
Period*Treatment Exposure	-0.000245 (0.00449)	0.000614 (0.00504)	0.00360 (0.00385)	-0.000893 (0.00960)	-0.00562 (0.00721)	0.000971 (0.00517)
Treatment Exposure	-0.000344 (0.00318)	0.00193 (0.00356)	-0.00229 (0.00272)	-0.0135* (0.00679)	-0.000663 (0.00510)	-0.00435 (0.00366)

Exposure Difference-in-Difference estimating modified Equation 2 for controller outcomes (listed across top), with additional treatment exposure and time period interaction estimating treatment impacts overtime; Control for Treatment Exposure included in model; Control for Total Household IHS Acres not included; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001"

Table B.6: Exposure Difference-in-Difference, Decision Maker Outcomes

	Included Decision Maker, Dummy	First Decision Maker, Dummy	Sole Decision Maker, Dummy
March 2015 vs All Other Households (N=3432)			
Period	0.0000 (0.0467)	0.126 (0.0720)	0.105 (0.0679)
Treatment	0.0919* (0.0374)	0.0306 (0.0577)	-0.00181 (0.0544)
Period*Treatment	-0.00346 (0.0529)	-0.112 (0.0815)	-0.0529 (0.0769)
Period*Treatment Exposure	-0.00163 (0.00357)	-0.00189 (0.00550)	-0.00197 (0.00519)
Treatment Exposure	-0.00147 (0.00252)	0.00418 (0.00389)	0.00341 (0.00367)

Exposure Difference-in-Difference estimating modified Equation 2 for controller outcomes (listed across top), with additional treatment exposure and time period interaction estimating treatment impacts overtime; Control for Treatment Exposure included in model; Control for Total Household IHS Acres not included; Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001"

Appendix C - Difference-in-Difference Results, Coefficient Plots

Figure C.1: Difference-in-Difference, Ownership Outcomes

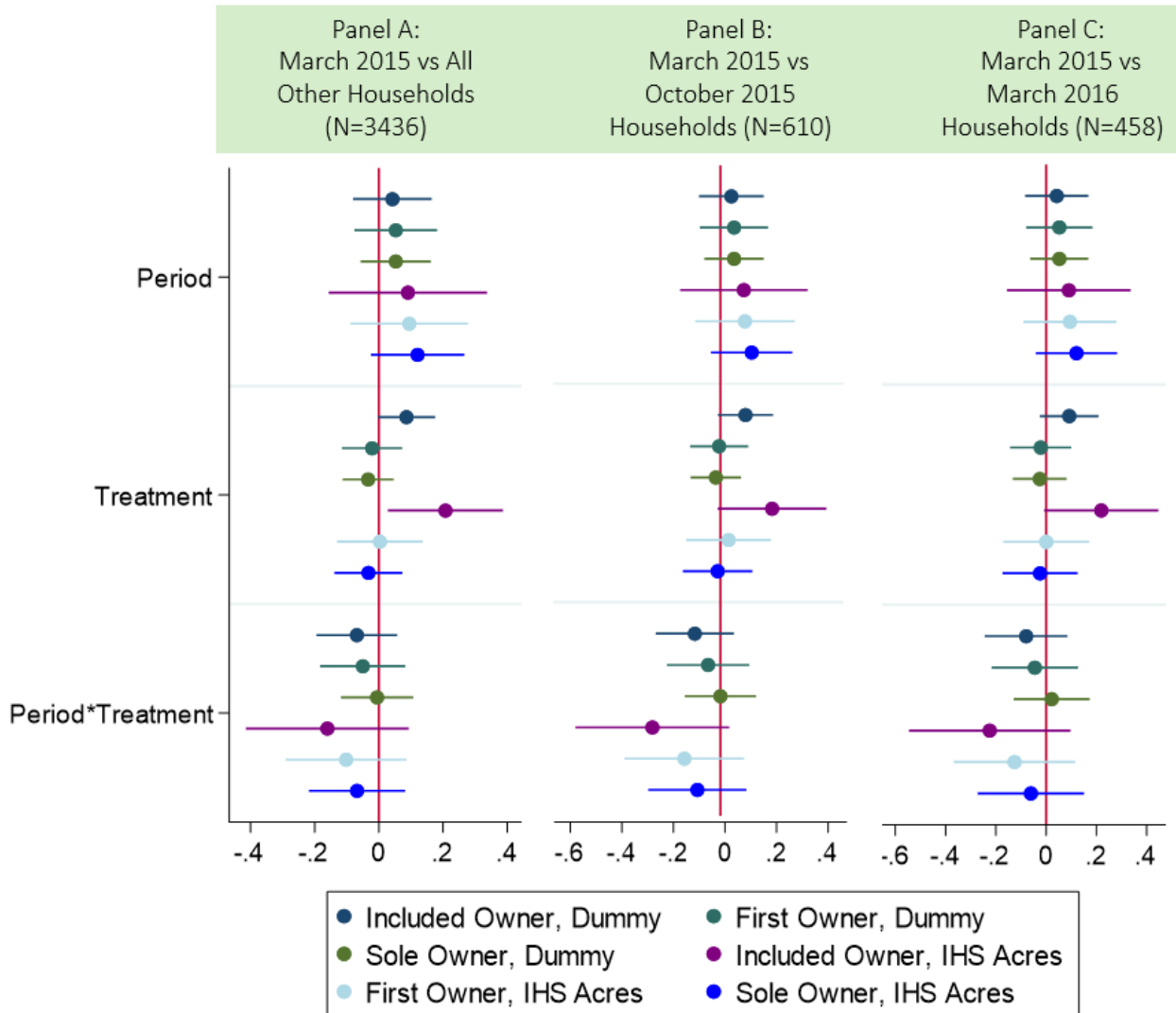


Figure C.2: Difference-in-Difference, Controller Outcomes

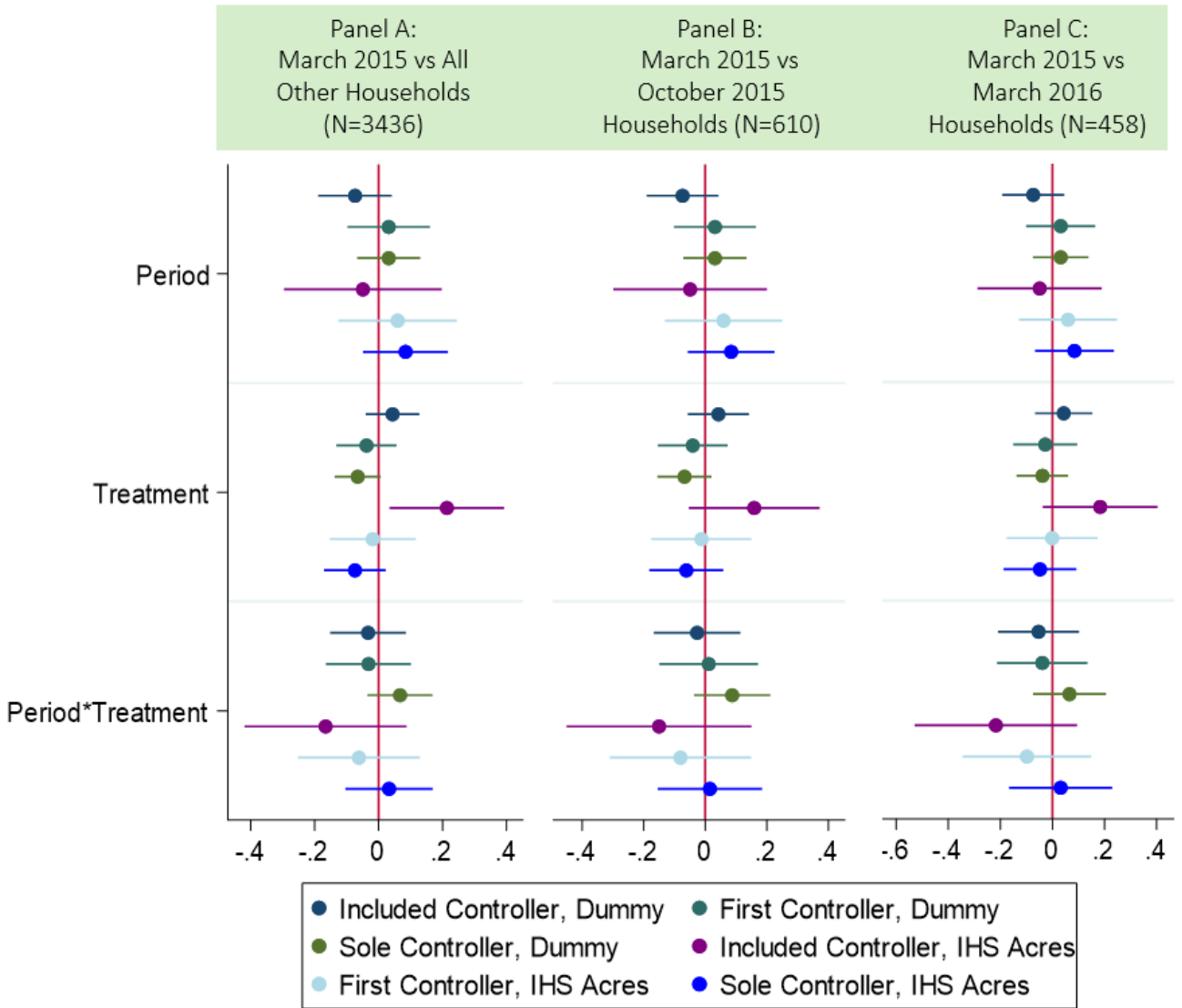


Figure C.3: Difference-in-Difference, Decision Maker Outcomes

