LAND, ASSETS, AND LIVELIHOODS
Gendered Analysis of Evidence from Odisha State in India

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Abstract

Although asset-based approaches for studying poverty have shown that the portfolio of assets households own or can access influences livelihood strategies and a variety of development outcomes, there is little research unpacking gendered dimensions of asset ownership in diverse contexts. Using data collected from the evaluation of two government land titling interventions in the Indian state of Odisha, this paper examines key relationships linking land and livelihood strategies. The investigation is one of the first to explicitly use the Gender, Agriculture, and Assets Project framework to gain additional insights on how gender–asset dynamics relate to household livelihood strategies. Our results point to a gender-segregated wage labor market, where employment opportunities for rural women are limited; education for both men and women can enable the adoption of more food secure livelihood strategies; and a significant link exists between households that adopt more food secure livelihood strategies and the amount of land they can access, whether they own the land, and the share of land owned by the woman. These results suggest that development interventions to enable households to adopt improved livelihood strategies must consider the gendered context in which they operate, including men and women's employment opportunities, their skills and asset holdings, and make explicit efforts to address constraints in order to facilitate improved development outcomes.

Key Words: assets, gender, India , land, livelihoods

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1. Introduction

Recent evidence from the empirical study of structural and chronic poverty argues that rather than income or expenditures, it is assets that play a central role in households' ability to exit poverty (Carter and Barrett 2006). This so-called poverty trap literature suggests that effective poverty reduction efforts are contingent on a household's access to a minimum bundle of assets and access to markets to further accumulate assets (Adato, Carter, and May 2006). We argue that who within the household has secure access and control over those assets matters as well. Two government land titling programs operating in the eastern Indian state of Odisha provide an opportunity to examine these asset–poverty hypotheses, focusing on land as a livelihood asset. Accounting for the nuances of land tenure, local context, and gender dynamics, we exploit this opportunity to examine how ownership of land shapes the set of livelihood activities that households can undertake and, as a result, their food security and well-being.

This paper is developed in partnership with IFPRI and the International Livestock Research Institute's Gender, Agriculture, and Assets Project (GAAP). It represents one of the first empirical applications of the GAAP conceptual framework, an extension of the well-known sustainable livelihoods (SL) framework that explicitly considers gender in every aspect and relationship. We also undertake a nuanced examination of asset ownership that considers multiple dimensions of land tenure. Specifically, we examine whether landownership shapes the set of livelihood strategies available to a household; to what extent its influence varies depending on whether a household simply reports owning land or has formal documents to prove its ownership; and how that land was acquired.

The analysis in this paper was carried out in five steps. First, we created an exhaustive typology of livelihood strategies that describes the combination of economic activities in which households in our sample were engaged. We created this typology using narratives from our qualitative research and employing hierarchical cluster analysis to identify patterns in our household survey data. Second, we determined each household's livelihood strategy. Third, we calculated average food security outcomes for households engaged in each livelihood strategy. Fourth, assuming that households put a premium on food security, we ranked the livelihood strategies based on the food security outcomes they were expected to yield. Although conceptually food security represents only one aspect of well-being, the average rural Indian household spends 52.9 percent of its income on food, making it a significant decision factor in livelihood choices (NSSO 2013). Fifth, we relied on econometric analysis to assess the extent to which having land influenced households' choice of livelihood strategy and, consequently, their food security.

In our analysis, we are able to distinguish among land that households access, land that they own, and land for which they have formally recognized documents. We also distinguish land that was inherited from land that was purchased or received from the government. Finally, because gender dynamics may shape these results, we replicate the analysis using sex-disaggregated measures of asset ownership.

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The paper is organized as follows. Section 2 provides background for the analysis, describing the analytic framework, the context, and the land policies and government programs in Odisha. Section 3 describes the methodology used in this study and the data collected. Section 4 presents our findings. Section 5 concludes with a discussion of policy implications and directions for future research.

2. Background

Sustainable Livelihoods and Gender, Agriculture, and Assets Project Frameworks

Unlike traditional approaches for studying poverty that emphasize income as the basis for poverty and vulnerability, the SL framework considers the entire portfolio of assets that households own or can access; the impact of these assets on household livelihood strategies; and how household assets and livelihood strategies affect a variety of outcomes, such as household food security and vulnerability to shocks and seasonality. The framework was created in response to the recognition that standard definitions of poverty based on income and consumption applied in developed countries were inadequate for lower income economies that were structurally very different (Ellis 2000; Bebbington 1999; Moser 1998; Chambers 1995; Chambers and Conway 1991). The SL framework has been widely adopted by those working in rural poverty research and alleviation because it relies on a mixed-methods contextualized approach, because it considers a wider portfolio of strategies to manage and cope with the risks associated with shocks and seasonality, and because of its recognized potential to better guide the design of effective interventions in developing economies (Ashley and Carney 1999a, 1999b; Scoones 1998).

Under the SL framework, a livelihood activity is defined as any direct income-generating activity in which an individual engages (for example, dairy production or agriculture) or any activity that might not directly bring in income but increases the consumption and/or well-being of an individual (for example, firewood collection or cultivation of medicinal herbs). A household's livelihood strategy, in turn, is the combination of livelihood activities in which its members engage. The livelihood strategies that we observe are the result of households' options and preferences. Their options depend, at least partially, on their asset endowment.

Assets in the SL framework are more than inputs into income creation because they impact agency and status: "Assets are not simply *resources* that people *use* in building livelihoods: they are assets that give them the *capability* to be and to act" (Bebbington 1999, 2022; italics original). The SL literature focuses on the accumulation of five types of assets, often called the asset pentagon: (1) human assets (for example, labor hours, education, and health); (2) social assets (for example, trust, family support, and community membership); (3) physical assets (for example, house and access to nearby

roads); (4) natural assets (for example, land and forest access); and (5) financial assets (for example, cash reserves and credit availability). Other assets, such as political power and psychological assets, are sometimes included as well, although there is lack of agreement on whether and how best to incorporate them into the framework (Scoones 2009; De Haan and Zoomers 2005).

Empirical research in both developed and developing countries has demonstrated that households do not always pool their resources and that who in the household has access to and control over these resources matters (Haddad and Hoddinott 1997). Yet, the SL framework is silent on gender, hampering its ability to explain how individual ownership of or access to assets influences individual livelihood activities and household livelihood strategies. Meinzen-Dick and colleagues (2011) expand the SL construct to consider gender relations and how these relations influence livelihood constraints and opportunities, creating a framework suitable for gendered analysis of asset interventions. In their GAAP framework, individuals' gender and the environment in which they live can affect their access to and control over assets, their livelihood goals, and the livelihood activities they choose. In other words, men and women who have access to and control over the same assets and who live in the same environment can make systematically different consumption, savings, and investment decisions.

Land as a Livelihood Asset

The SL framework describes two important types of relationships between assets: (1) sequencing, or the degree to which the acquisition of one asset enables the acquisition of another, and (2) substitution, or the degree to which particular assets can be substituted for others. Land is a particularly important asset for rural livelihoods because of its primacy in asset sequencing. Those who own land may be more inclined to invest in natural capital through activities like soil conservation (Bekele and Mekonnen 2010; Pender and Kerr 1996) may be able to use it as collateral to access financial capital (Petracco and Pender 2009); they may also be more likely to invest in their children's education, thereby enhancing their households' human capital (Katz and Chamorro 2002). Land is a marker of social status in many agrarian societies, including rural India, and landowners may therefore also benefit from greater social capital (World Bank, Food and Agriculture Organization, and International Fund for Agricultural Development 2009).

Ample evidence for gender-differentiated access to and control over land underscores the need to use a gendered lens in an analysis of land and livelihoods (Deere and Doss 2006; Deere and Leon 2003; Agarwal 1994). Beyond the benefits outlined above, secure access to and control over land are particularly important for women when their households or communities lack formal sources of social security or access to other social safety nets (Giovarelli 2009).

In particular, studies have shown that improvements in women's land rights can be linked to a number of socially and economically desirable outcomes. Improved women's land rights have been

associated with (1) lower reported rates of long-term physical and psychological domestic violence (Gupta 2006; Panda 2006); (2) improved family nutrition (Allendorf 2007; Katz and Chamorro 2002); (3) improved children's educational achievements (Katz and Chamorro 2002); (4) decreased fertility (Field 2003); and (5) increases in women's ability to participate in their households' decisionmaking (Santos, Savath, Fletschner and Peterman 2013; Allendorf 2007).

Defining Livelihood Activities and Livelihood Strategies

Research from a range of disciplines shows that, globally, the rural poor employ a vast range of livelihood strategies to meet basic needs and increase their well-being (Nielsen, Rayamajhi, Uberhuaga, Meilby, and Smith-Hall 2012; Ellis 2000). Despite this, many studies use some measure of income-generating activities to classify livelihoods (Babulo et al. 2008; Abdulai and Crole-Rees 2001; Birch-Thomsen, Frederikson, and Sano 2001). Although easy computationally and intuitive, these measures often hide great variation in the livelihood activities of households. They also suppress information on activities that do not bring in direct income but are still important to livelihood and well-being.

Furthermore, these approaches are often unable to distinguish between a household that is diversifying its livelihood strategy—by increasing the number of livelihood activities in which it engages, as it attempts, for example, to cope with a shock or to mitigate risks (Ellis 2000)—and a household that is shifting its livelihood strategies because new strategies are available (for example, as a result of changes in the household's asset portfolio).

Cluster analysis allows us to better differentiate between shifts and diversification, using distance-minimizing methods to sort households' livelihood activity data into similar groups, creating a set of livelihood strategies. By generating data-driven livelihood strategies, this technique allows us to categorize households (each household fits into one livelihood strategy) and, simultaneously, define characteristics of the livelihood strategies themselves (Iiyama, Kariuki, Kristjanson, Kaitibie, and Maitima 2008; Brown, Stevens, Ouma, Murithi, and Barrett 2006; Jansen, Pender, Damon, Wielemaker, and Schipper 2006; Orr and Mwale 2001).

Setting: Odisha Geography and Policy Landscape

Odisha is a coastal state of approximately 155,707 square kilometers in eastern India, with widely varying physiography. The state is typically divided into four physical zones: (1) northern plateau, (2) central river basin, (3) mountainous Eastern Ghats, and (4) coastal plains. The coastal plains zone has the most advanced agriculture due to increased soil fertility and irrigation potential, while other zones of Odisha are often dependent on rainfed agriculture. Our study samples four districts in Odisha from the coastal plains and the Eastern Ghats.

Odisha has historically been one of the poorest states in India, with high rates of poverty and low rates of economic growth and diversification. According to the 2011 census, 83.3 percent of Odisha's population of nearly 42 million people live in rural areas. Nearly 60 percent of the population depend on agriculture to some degree for their livelihoods, most of it rain-fed, leaving much of the population exposed to risk from drought and flood. Odisha has experienced at least one natural disaster in 11 of the past 13 years (State Government of Odisha 2011). In addition, the state has a large proportion of historically disadvantaged groups, including the scheduled tribes and scheduled castes, which comprise 22.1 percent and 16.5 percent of the population, respectively (Census of India 2011). The scheduled tribe and scheduled caste designations form the basis for the distribution of many government entitlement programs at the national and state levels.

The current geography of Odisha comprises four formerly distinct land revenue administration systems originally established during the British colonial period. These administration systems included major differences in revenue assessment and record keeping, leading to administration difficulties that persist today. Beginning with Indian independence in 1947, Odisha passed numerous laws aimed at land reform and unifying land administration in the state. Implementation of many national reform initiatives, such as the land ceiling laws, and early state-level efforts were minimally effective in large part due to the diverse land administration legacy and lack of reliable records (Deo 2011; Mearns and Sinha 1999). The early legislation also typically subsumed women's interests under those of her household, usually represented in public affairs by the adult male "head of household."

In line with India's *land to the tiller* movement, the Odisha Land Reforms Act included provisions for adverse possession. The burden of proof, however, lay on the cultivating party, whose work was highly unlikely to be documented, and these rights were rarely exercised. Under the Odisha Prevention of Land Encroachment Act, revenue inspectors were the only parties able to identify and regularize land to eligible beneficiaries; however, their incentives typically lay in the direction of collecting fees for encroachment on government land rather than on initiating burdensome regularization processes (Mearns and Sinha 1999). Later state-level programs would aim to rectify these shortcomings, with emphasis on joint or women's titling and targeting the particular challenges facing the scheduled tribe and scheduled caste communities.

Vasundhara and Gramakantha Paramboke Land Titling Programs
This study exploits data collected for an evaluation of two Odisha government land titling programs. One program, Vasundhara, grants title to households considered to be encroaching on government land, while the other, Gramakantha Paramboke (GKP), distributes individual title to households residing on previously communally titled land.

The Vasundhara program was launched in 2004 in response to a state-initiated survey finding high numbers (249,334 households) of absolute landlessness in Odisha. This program aims to provide a homestead plot of at least 4 decimals (decimal = 1/100 acre) in size per beneficiary to all homestead-less rural households (later modified to allow 10 decimals per household where feasible). The program leverages already existing, but heretofore largely unused, provisions in the Odisha Government Land Settlement Act and the Odisha Prevention of Land Encroachment Act that allowed homestead distribution and settlement on government land. The program prioritized regularization of government land on which the household is already residing, but where available land is scarce, Vasundhara allows for land purchase. To be eligible for a homestead under the program, a household should not own any other homestead plot, should earn fewer than 15,000 Indian rupees (Rs.) per annum (approximately US$270), and should not possess (via tenancy, borrowing, or other arrangements) more than one standard acre of agricultural land. By granting ownership documents, Vasundhara provides greater security and legal status to households previously considered to be encroaching on government land and subject to government fines. Additionally, households are provided basic agricultural extension services to support cultivation. The program's more recent emphasis on titling land jointly for husband and wife is meant to provide women with an additional layer of legal protection.

GKP is a separate state government program that provides individual titles to households that were previously on collectively owned land, under the 2009 Amendment of the Odisha Government Land Settlement Act. The land was communally titled as a vestige of the colonial Madras presidency, during which a survey on agricultural land opted to count entire village sites as one individual plot, excluding residents of these villages from any record of rights to that land. As with Vasundhara, the Land Revenue Department is now responsible for identifying those eligible households through enumeration and thereafter providing them *patta*, or formal government deed for land, issued jointly in dual-headed households.

The programs are implemented on the basis of the land classification of a particular geography, which is itself partially a vestige of the multiple colonial land administration systems. This means that though both programs regularize households' property by granting them formal documents to the land on which they already reside, the Vasundhara and *GKP* programs generally do not overlap geographically. The enumeration process for both of these programs is labor- and time-intensive. The programs partner with other organizations such as Landesa and the Odisha Tribal Empowerment and Livelihoods Program to speed the identification of eligible families and verification of their land status.

3. Methods

Qualitative Data Collection

Qualitative data collection took place in the post-monsoon season, September and October 2012, one to two years after land program beneficiaries in pilot sites received *patta.* We conducted 15 key informant interviews with implementers of the land allocation and regularization programs, 14 life history interviews with eligible beneficiaries, and seven focus group discussions to gain a view of community-level norms surrounding landownership and use, as well as a survey of available livelihoods.

We chose to do the qualitative work in Ganjam District, the site of Landesa's first pilot activity, to allow the longest possible time period to detect treatment effects. Key informant interviews were sampled to include perspectives from all levels of implementation, from the village to the district administration. Those interviewed through life history interviews and focus group discussions were purposefully selected to include diverse demographic categories, such as single women and scheduled tribes.

Quantitative Data Collection

This study leverages data collected for an evaluation of the Vasundhara/GKP programs in the areas where Landesa has partnered with the government. We surveyed 1,730 households across three pilot intervention districts and one control district of Odisha in October and November 2012.

The sample was determined before actual beneficiaries entered the program, and therefore our sample design includes households that we deemed likely to become beneficiaries—because they were in blocks where Landesa assisted with the program—as well as households that we thought were less likely to be selected, either because they were in other blocks or because they were occupying land that was harder to regularize. The survey firm worked with local land administration officials to identify program-eligible households to include in the sample.

We interviewed the adult woman in each household using questions to capture the household's demographics, housing condition, physical infrastructure, access to water and sanitation, adult men and women's participation in household decisionmaking, engagement in self-help groups, income-generating activities, expenditures and debt, membership and participation in local social institutions, food security, cultivation of home gardens, and livestock assets.

Analysis

We hypothesize that households' livelihood options and consequently their chosen livelihood strategy are influenced by access to and rights over land. That is, the livelihood strategy they choose depends on the size of the plots they can access, how long they have had access to that land, whether they own those

plots, whether they have documents to prove their ownership, and how they acquired the land—through inheritance, purchase, or government programs. To test these hypotheses we took the following steps. First, we drew upon qualitative and quantitative information to elicit a comprehensive list of livelihood activities observed in the study region, to determine their prevalence and to probe their relation to contextual factors. The qualitative data were coded and analyzed deductively using Nvivo and following GAAP's conceptual framework.

Second, as proposed by the SL framework, a study of household behavior must consider that households can and often do engage in more than one livelihood activity—the combination of their activities is their livelihood strategy. Thus, we leveraged our quantitative data and relied on a clustering technique described below to determine data-driven livelihood strategies observed among households in our sample.

Third, because one can uniquely match each household in our sample to a livelihood strategy, we used the food security data we had collected to calculate average food security outcomes per livelihood strategy. Assuming that households value food security, we can predict which livelihood strategies are superior.

Fourth, based on this food security ranking of livelihood strategies, we relied on a multinomial logit analysis to identify whether and to what extent households' choices of livelihood strategies are influenced by the amount of land households can access and the rights they have to that land.[1] This econometric approach allows us to identify which factors are statistically associated with households choosing one livelihood strategy over another and enables us to determine whether the land-related factors play a role. Moreover, because we can control for other asset-based factors that may also influence households' choices, this approach permits us to assess the magnitude of the land-related effects.

Clustering Technique Used to Identify Livelihood Strategies

Following researchers such as Alinovi, D'Errico, Erdgin, and Romano (2010) and Jansen, Pender, Damon, Wielemaker, and Schipper (2006), we use cluster analysis to create a taxonomy of the livelihood strategies observed in the sample. Cluster analysis is a highly flexible and intuitive method for assigning a large number of observations to a smaller number of distinct groups, or clusters. In hierarchical cluster

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[1] The multinomial logit model relies on the assumption of independence of irrelevant alternatives, which in our case means it assumes that the probability that a household would choose a livelihood strategy *x* over the base livelihood strategy is independent of what other livelihood strategies are available to the household. Although this can be a fairly restrictive assumption, we relied on two robustness checks to determine that the relative probabilities of participating in the livelihood strategies as defined are adequately independent to use the multinomial logit model. First, we used the Small-Hsiao method to test the independence of irrelevant alternatives assumption statistically and failed to reject it. Second, we repeated the analysis using two alternative estimation strategies that do not impose independence of irrelevant alternatives, namely individual logit models and a multivariate probit model. The results from these alternative specifications largely confirm our findings. (See Tables A.3 and A.4 in the appendix.)

analysis, each of the cases begins as a cluster unto itself. Clusters are then successively merged together based on their similarity using Ward's algorithm, which seeks to minimize the merging cost.[2]

In our case, the analysis started by looking at each household's data to derive their livelihood strategy (the set of activities they chose). That is, we started with 1,730 livelihood strategies or clusters by themselves. Comparing each cluster to all the others, the algorithm determined which of them looked sufficiently *similar* and merged them. The algorithm then compared each cluster to all the other clusters and combined those that were similar into bigger clusters, minimizing the merging cost each time. The resulting clusters are the livelihood strategies observed in the sample. Note that by definition, each household belongs to one and only one cluster, or equivalently, has one and only one livelihood strategy.

To determine which strategies/clusters were similar, we used the Jaccard index.[3] This index is widely used for generating taxa in ecological fields and is especially fitting for matching on asymmetric binary variables, such as our household livelihood activity data. Asymmetric variables are those for which the researcher is interested in matching those who *do* participate in particular activities (positive matches), but cannot draw any conclusions about similarities between those who do *not* participate in that activity (negative matches).

Hierarchical clustering requires determining the desired number of clusters in advance. We used the Caliński-Harabasz index to determine the optimal number of clusters (Caliński and Harabasz 1974). This measure suggested that we should aim for four clusters. In other words, our analysis includes 11 livelihood activities and four livelihood strategies.

Econometric Estimation of the Relationship between Assets and Livelihood Strategies

A household's livelihood strategy is understood to be a polychotomous choice, and we followed the existing literature (Nielsen, Rayamajhi, Uberhuaga, Meilby, and Smith-Hall 2012; Jansen, Pender, Damon, Wielemaker, and Schipper 2006) in estimating a multinomial logit model to identify whether and to what extent households' choices of livelihood strategies are influenced by the amount of land households can access and the rights they have to that land. This econometric approach uses a set of parallel equations to allow us to identify which explanatory factors are statistically associated with

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[2] The *merging cost* is calculated as the increase in the sum of squared distances after merging clusters A and B, $\Delta(A, B)$. The following equation describes the merging cost, where A and B are the potential resulting clusters after a merge, *i* indexes the current clusters, and *n* is the number of observations in the resulting clusters.

$$\Delta(A, B) = \sum \|x_i - x\|^2 - \sum_{i \in A} \|x_i - \bar{a}\|^2 - \sum_{i \in B} \|x_i - \bar{b}\|^2 = \frac{n_a n_b}{n_a + n_b} \|\bar{a} - \bar{b}\|^2$$

[3] The Jaccard distance is calculated with the following formula, where m_{ab} is a count of livelihood activities that match a particular combination between strategies A and B. For example, m_{01} is the number of activities that strategy A *does not* do (0), but strategy B *does* do (1).

$$J(A, B) = \frac{m_{01} + m_{10}}{m_{01} + m_{10} + m_{11}}, \text{ m} = 1, \ldots, 11$$

households choosing livelihood strategy j_i over a base livelihood strategy j_1. Moreover, because we can control for other asset-based factors that may also influence households' choices, this approach allows us to isolate the magnitude of the land-related effects. Specifically, the probability p_{ij} of household i choosing livelihood strategy j is a function of a vector of case-specific regressor variables $\mathbf{x_i'}$ subject to the constraints that $0 < p_{ij} < 1$ and $\sum_{j=1}^{4} p_{ij} = 1$ where:

$$p_{ij} = \frac{\exp(\mathbf{x_i'}\beta_j)}{\sum_{l=1}^{4}\exp(\mathbf{x_i'}\beta_l)} j = 1, 2, 3, 4.$$

when we set $\beta_{j=1}$ to zero, we can interpret the coefficients for the alternate, $j \neq 1$, livelihood strategies relative to the base strategy. For ease of interpretation, the results we report in this paper refer to the change in probability that households will choose livelihood strategy j rather than the base strategy, where:

$$\frac{\Pr(y_i = j)}{\Pr(y_i = base\ strategy)} = \exp(\mathbf{x_i'}\beta_j), j = 1, 2, 3, 4.$$

We estimate these probabilities using two models: a *Basic Model* and a *Gendered Model*. The Basic Model estimates $\mathbf{x_i'}\beta_j$ as a function of (1) land-related variables (LAND) that include land tenure status, land size, and number of years over which the household has had access to these plots; (2) variables related to nonland assets (NLASSETS) that serve as proxies for the household asset endowment; and (3) other household (HH) and community (CC) characteristics, where:

$$\mathbf{x_i'}\beta_j = \beta_{j0} + \beta_{j1} * LAND + \beta_{j2} * NLASSETS + \beta_{j3}HH + \beta_{j4}CC + \varepsilon_{ij}, j = 1, 2, 3, 4.$$

The Gendered Model works with the same variables but further considers the share of land over which the male and female heads of household claim ownership and for some of the nonland assets (such as labor force and education) uses sex-disaggregated variables. We chose to use the share of land owned, rather than the amount, to capture the man/woman's standing relative to other members of his/her household. Shares were counted toward both the man and the woman if a particular asset was reported to be jointly owned, and counted toward neither if someone other than the male and female heads of household was reported as the owner. Thus,

$$\mathbf{x_i'}\beta_j = \beta_{j0} + \beta_{j1} * LAND + \beta_{j2}LAND * LANDSHR_f + \beta_{j3}LAND * LANDSHR_m$$

$$+\beta_{j4}NLASSETS + \beta_{j5}NLASSETS_f + \beta_{j6}NLASSETS_m + \beta_{j7}HH + \beta_{j8}CC + \varepsilon_{ij}, j = 1, 2, 3, 4.$$

Descriptive statistics for all the explanatory variables are presented in Tables A.3 and A.4 in the appendix. The Gendered Model was estimated using a sample limited to households that had both a male and a female head of household.[4]

Food Security Variables

We examined three household-level food security outcomes to rank livelihood strategies. To capture households' dietary diversity we used the Household Dietary Diversity Score, an indicator that summarizes the total number of food groups (out of a possible 12) consumed by the household members in the past 24 hours (Swindale and Bilinsky 2006). As a proxy for a household's vulnerability to hunger we used a binary indicator for whether the household reported experiencing times when it did not have food or money to buy food in the past three months. Finally, we used total household expenditure on food.

4. Results

Land Tenure

Our household survey revealed that all of the households interviewed had some access to land. However, the data we gathered also show that tenure security varies considerably: more than one-third of the households do not own land (38 percent) and another third of them (31 percent) reported owning land but not having formal documents to prove their ownership. The remaining 31 percent of households have documents to prove that they own at least one of the plots they are currently accessing. Among households that own land, the vast majority acquired it through inheritance, typically from the male side.[5]

[Insert Table 4.1]

A quick initial probe into the relationship between landownership and food security, based on a simple comparison of means, shows that even though all households have access to some land, those that own land are more food secure: they spend more on food, they are less vulnerable to hunger, and they have a more diverse diet. A further check on how these results vary depending on whether the household has land documents or how their land was acquired shows that although the results remain generally positive, the patterns become less obvious and uncovering them requires a more sophisticated analysis. We devote the remainder of the paper to a robust examination of these relationships between land and livelihoods.

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[4] Because the Gendered Model was likely to be affected by multicollinearity, we tested the independent variables' variance inflation factors (VIF). The resulting mean VIF for all of these models was below 3, signaling a generally acceptable level of multicollinearity (a common, though arbitrary, cut-off is 4).

[5] For households that own more than one plot of land and whose plots were acquired through multiple sources—8.73 percent of the sample—we classified them as acquiring land from the source from which they had obtained their largest plot.

Livelihood Activities

Data from the quantitative survey allowed us to determine the most common livelihood activities in the study region. They include cultivation of (1) rice, (2) fruits, and (3) vegetables; rearing of (4) draft animals, (5) cows, (6) small animals, and (7) poultry; working (8) in agriculture, (9) as a nonagricultural wage laborer, or (10) as self-employed; and (11) receiving food or other public transfers. Information about activities 1 through 7 came from households' reported engagement in agriculture and animal husbandry. We classified them into these seven categories recognizing that these activities differ considerably in the investments they tend to require, the length of time they take to produce results, and the level of revenues they typically yield. Information about activities 8 through 10 was captured when we inquired about the main occupation (whether or not it was compensated) of each household member over the age of seven during the past three months. Unfortunately, because our questionnaire asked only about their main activity, it is possible that we missed activities that, while important, were not a household member's main activity.

Lastly, we identified households that participated in government entitlement and support programs. These mainly consisted of the Public Distribution System (PDS), a national program for distributing price-controlled foods through ration shops. The PDS is notoriously rife with inclusion and exclusion errors, and Landesa's experience over the years indicates that accessing these programs is often incumbent on the recipient and represents a strategic choice much like any other livelihood activity.

Table 4.2 provides a distribution of households by livelihood activity. As shown, nearly half of the households surveyed reported engaging in agricultural wage labor. This might be partially due to the surveyed reference period of the past three months, which happened to coincide with the planting season (October 2012).

 [Insert Table 4.2]

Rice is the most common crop, cultivated by more than a third of the households. Approximately 20 percent of the households engaged in large livestock rearing, both draft animals (most commonly buffalo) and cows. Small livestock and poultry rearing were less common, though the qualitative data suggest that livestock ownership is a common aspiration.

Close to one-third of the households engage in nonagricultural wage labor, which consists mainly of earthwork, factory work, and construction. Self-employment, practiced in 17 percent of households, consists of skilled trades such as carpentry and masonry, and small enterprises such as vending.

Finally, 64 percent of the sampled households are receiving public transfers. Most of these households receive subsidized food staples purchased at specific distribution centers of the PDS. In the life history interviews, respondents frequently brought up access to this program as a reason for improvements in their lives.

Livelihood Strategies

The four livelihood strategies we identified by aggregating the 11 livelihood activities described above using the hierarchical cluster analysis are:

1. Agricultural wage laborer: Households that earn their living through agricultural work on others' land. They do not engage in their own cultivation or livestock rearing.

2. Off-farm wage laborer: Households whose only source of income is wage labor that is not directly related to agriculture, typically factory or construction work. They do not engage in their own cultivation or livestock rearing.

3. Wage laborer with a farm: Households whose livelihoods tend to combine agricultural and livestock work on their farm with work that they do for others.

4. Farm and self-employment: Households that, in addition to working on their own farm and for others, are likely to have their own income-generating activities.

Table 4.3 presents a profile of the average household for each of the livelihood strategies.

[Insert Table 4.3]

Fourteen percent of the households we surveyed fall into the agricultural wage laborer livelihood strategy. Their sole source of livelihood is agricultural wage work, which yielded a three-month average income of Rs. 4,651 (US$77) for men and Rs. 2,895 (US$48) for women. As a group, households following this livelihood strategy exhibit the worst food security indicators: lowest expenditures on food, highest vulnerability to hunger, and a less diversified diet. As such we assume that, given the option, households would prefer any of the other livelihood strategies; we have therefore chosen to use the agricultural wage laborer category as the base livelihood strategy for the econometric analysis that follows.

Off-farm wage laborer households account for approximately 10 percent of the sample. Compared to households following the base livelihood strategy, these households tend to spend more on food and are less vulnerable to hunger, but their diet is not more diversified.

Wage laborer with a farm households make up 58 percent of the sample. Only 3 percent of these households experienced hunger in the previous three months, and their diet is significantly more diverse than those following either of the first two livelihood strategies. We are unable to distinguish to what extent the superior food security outcomes are a result of their productive activities or their ability to join the PDS and receive public transfers—70 percent of the households in this group have received food or cash transfers.

Finally, 18 percent of the households we interviewed follow the fourth livelihood strategy: farm and self-employment. Approximately 73 percent of these households have a member who is self-

employed. These households experience relatively low vulnerability to hunger. They are among the ones who spend the most on food and, as a group, they exhibit the most diverse diet.

Results from the Basic Model: Assets and Livelihood Strategies

The results presented in Table 4.4 enable us to distinguish which factors, and particularly which assets, may affect households' ability to embrace a given livelihood strategy rather than choosing to be an agricultural wage laborer household. As discussed earlier, in analyzing households' livelihood strategy choices we considered four types of factors: land-related characteristics, households' nonland asset endowments, other household characteristics, and community-level conditions. Because of our focus on land, we tried three versions of this model. We started by only considering households' access to land, how long they had had access to those plots, and whether they owned at least one plot. We then further disaggregated the analysis by paying attention to whether the households had documents to prove their ownership rights. Lastly, we looked at whether the way they had obtained the plot mattered

[Insert Table 4.4]

To interpret these results we start at the first row of Table 4.4, where we can see how likely households are to choose any of the preferred livelihood strategies. More specifically, our models predict that the average household in our sample is 10 times more likely to choose to be an off-farm wage laborer household than to be an agricultural wage laborer household. However, according to our results, the average household in our sample is just as likely to choose to be an agricultural wage laborer household as it is to be a wage laborer with a farm or a household with a farm and self-employment.

These relative probabilities can change as soon as we depart from the average household. The remaining numbers in the table tell us the multiplicative impact of each of the factors to this baseline relative probability. Because they are multiplicative factors, numbers higher (lower) than one mean that the factor increases (decreases) the likelihood that the household would choose the more food secure livelihood strategy by the column heading.

We start by examining which factors may enable or constrain a household from becoming an off-farm wage laborer household (rather than a more food insecure agricultural wage laborer household). Although the average household is 10 times more likely to choose to be an off-farm wage laborer household, our results suggest that households are less likely to adopt this livelihood strategy if they are located in Jagatsinghpur District or if they are classified as other backward caste. Neither access to nor ownership of land appears to affect the choice of livelihood strategy. However, households that have been settled for longer are less likely to be off-farm wage laborer households and so have more productive capital. On the other hand, increases in education appear to enable households to become off-farm wage laborer households.

A similar analysis allows us to distill factors that might explain which households are more likely to opt for being wage laborers with a farm rather than following the more food insecure livelihood strategy of agricultural wage laborer. Compared to households in Ganjam or Jagatsinghpur, households in Gajapati and Khurda are less likely to become wage laborers with a farm. This strategy is more likely to be chosen by ST households and those with a higher value of productive assets. Land matters. Households that have access to more land and households that own land are more likely to become wage laborers with a farm. More specifically, households that have formally documented land and those that have inherited land are more likely to adopt this livelihood strategy.

Finally, those with access to more land and with higher levels of education are more likely to be a farm and self-employment household than to be an agricultural wage laborer household.

To summarize, being in disadvantaged castes may prevent households from adopting higher food secure livelihood strategies, while education, access to land, and ownership of land may act as enabling factors. Furthermore, the district in which a household resides plays a role in determining livelihood strategies.

These results, while interesting, mainly confirm what conventional wisdom and existing research would have suggested about the relationship between land and livelihood. In light of the need to design gender-sensitive projects and programming, the Basic Model is limited in what it can contribute. We now turn to the Gendered Model, aligned with the GAAP framework, to look for additional insights.

Results from the Gendered Model: Assets and Livelihood Strategies

Table 4.5 shows the results of the Gendered Model, which disaggregates several of the asset-related variables by sex and allows us to see how sex-specific asset ownership influences households' choice of livelihood strategy.

[Insert Table 4.5]

As can be observed, all the patterns associated with factors other than assets mirror those in the Basic Model. The relative probabilities that households would choose any given strategy are similar to the ones already discussed, as is the influence of factors such as district and caste on households' choice of livelihood strategy.

Households' access to land and the amount of time that has passed since they acquired the plot are household-level variables and have not been disaggregated by sex. The extent to which they influence households' decisions and in which direction is thus similar to what the Basic Model uncovered.

For the rest of the variables, the Gendered Model can contribute to a more nuanced identification of patterns. We find: An average household in our sample is between eight and nine times more likely to be an off-farm wage laborer household than an agricultural wage laborer household. However, this

changes dramatically, reducing the probability that the household will be an off-farm wage laborer household, if the household has inherited land or purchased land, especially if most of the land owned by the household is owned by the male head. Similarly, while the household's education matters, with higher levels of education enabling households to become off-farm wage laborer households, what really matters is the education of the men in the household, not that of the women. This is likely to signal that wage employment opportunities (or demand) may be biased toward men and that the men who are more educated and who have not inherited or purchased land are the most likely to avail themselves of these opportunities.

Building on this discussion, the center panel of Table 4.5 sheds lights on characteristics associated with households that are more likely to choose to be wage laborers with a farm rather than agricultural wage laborer households. in line with the idea that wage opportunities may favor males, households that follow a wage laborer with a farm strategy have a significantly larger male labor force—a greater number of adult male members between the ages of 15 and 59.

Interestingly, the land and nonland productive assets owned by the households do not seem to matter, but as posited by the GAAP framework, *who owns these assets does matter*. When listing their households' assets, women were asked to indicate which ones they owned, either jointly with their husbands or by themselves. We find that households that are more likely to follow a wage laborer with a farm strategy are households in which women own or co-own a larger share of their households' assets. More specifically, this is the case when the woman owns a larger share of her household's productive assets and, among households that have inherited land, the woman owns a larger share of her household's land.

Finally, looking at the right panel of Table 4.5, we can see that while the Basic Model revealed that education was the key factor leading households to adopt a farm and self-employment strategy, the Gendered Model indicates that the education of the men *and* the female heads of household matter. The more educated either or both of them are, the more likely their household is to follow a farm and self-employment strategy. The model also indicates that the households that are more likely to pursue this strategy are those in which women own a larger share of land, particularly among households who have documents to prove their ownership and have inherited land.

To summarize, the Gendered Model suggests that among the people we interviewed: (1) the level of education matters when households want to engage in either wage labor or self-employment, (2) wage employment appears to be heavily biased toward men, and (3) households whose livelihood strategy includes a farm are those in which women tend to own a larger share of the productive assets, particularly land.

5. Discussion

As the analysis in this paper demonstrates, a gendered framework and analysis allows for a more nuanced understanding of the factors—particularly assets—that enable or constrain households' ability to adopt livelihood strategies expected to yield higher food security. By exploring the relationship between households' sex-disaggregated asset portfolios and the livelihood strategies they adopt, we provide evidence-based support for a three-pronged gender-sensitive strategy to improve rural households' food security that addresses wage employment, access to education, and land rights.

First, wage labor markets in this region appear to be highly gendered. Households were significantly more likely to engage in wage work and become more food secure if they had a larger male labor force—more adult men in the household—or if the men were more educated. Despite their households' poverty and women's eligibility for the National Rural Employment Guaranty Scheme, the majority of the women in our sample described themselves as housewives. Our qualitative research suggests that in this relatively remote and hilly region of India, social norms defining what constitutes appropriate behavior for women greatly constrain their wage-earning opportunities. The wage labor available through National Rural Employment Guaranty Scheme in this area is mostly limited to earth moving for road construction, requiring hard physical labor in the company of men, an unappealing option for all but the most destitute women.

A gender-sensitive and more inclusive version of an employment guarantee scheme would effectively expand the job opportunities to encompass activities in which women can engage, provide childcare assistance, and offer safe and affordable transportation if needed. More broadly, our findings point to the need for interventions by government agencies and civil society organizations to equip women and men with the necessary skills to be employable and to work with communities to address discriminatory perceptions of what constitutes acceptable jobs for women.

Second, higher levels of education enable households to adopt livelihood strategies associated with better food security. Households with higher levels of education were significantly more likely to engage in wage labor or to be self-employed. We note that the education of both men and women influences households' adoption of these more food secure livelihood strategies. This finding emphasizes the importance of investing in both boys' and girls' education, despite the common argument that girls will become *just housewives*. Moreover, given that the most food secure households have adopted livelihood strategies that include self-employment, an effective strategy to improve food security should include interventions to strengthen rural men and women's negotiation, marketing, and management skills, forms of education that extend beyond what is taught in the formal public schools and that can be integrated into youth programs and skill-development efforts.

Finally, land plays a key role. Households that are most food secure are those whose livelihood strategies include agricultural and livestock work on their farms. Households that adopt these strategies have access to more land and are more likely to own their land. They are more likely to have documents to prove their ownership and more likely to have inherited land. Importantly, results from the Gendered Model show that households that adopt these strategies tend to be those in which women own or co-own a larger proportion of their households' land. The nature of our data prevents us from rigorously determining to what extent these land-related factors enable households to adopt the more food secure livelihood strategies that include a farm or whether they are an outcome of these strategies. Yet the strong and significant associations we find are enough to prompt policy action and to support government allocation programs of the type proposed under the Homestead Act currently being discussed by the government of India.

More specifically, our results suggest that (1) the size of the plot matters, and therefore land allocation programs should resist the political and economic temptation to settle for plots that are too small; (2) having documents to prove ownership is important, and therefore land regularization programs may constitute effective tools to enhance food security; and (3) who owns the land makes a difference, making a strong case for designing land allocation and regularization programs that are gender-sensitive, whereby staff are equipped to address gender biases in customs and processes, work in an inclusive and gender-sensitive way at all stages, and ensure that women's names are included on the land documents.

In addition, our results suggest that development interventions that seek to enable the adoption of better household livelihood strategies in this region must consider the gendered context in which they operate—men and women's employment opportunities, their skills, and the land they have—and must incorporate explicit efforts to address constraints on these three fronts.

To conclude, we should note that this analysis would have not been possible without sex-disaggregated data. This highlights the need to develop, fund, and implement systematic efforts to gather sex-disaggregated asset data at the national and state levels.

Tables in text

Table 4.1 Preliminary association between households' landownership and their food security

Food security indicator	Households that do not own land	Households that own land	
Percentage of sample (N = 1,730)	37.5	62.5	
Household dietary diversity score (mean)	5.51	5.66	***
Households vulnerable to hunger (%)	7.4	4.0	***
Food expenditure (Rupees/month)	1,375	1,610	***

Source: Authors' calculations based on household survey data.

Note: *** indicates that the mean outcomes are significantly different at the 1% level.

Table 4.2 Distribution of households by livelihood activity

Livelihood activity	Percentage of households that engaged in each livelihood activity (N = 1,730)
Cultivation	
Rice	34.5
Fruits (for example, mango, banana, coconut, papaya)	26.0
Vegetables (for example, green leafy vegetables, pumpkin, beans)	8.2
Livestock Rearing	
Draft animals (horses, oxen)	18.2
Cows	20.9
Small animals (pigs, goats, sheep)	12.7
Poultry (ducks, pigeons, chickens)	9.9
Employment	
Agriculture labor	49.7
Nonagriculture wage labor	32.0
Self-employed	17.2
Government Transfers	
Ration card and other public transfers	64.1

Source: Authors' calculations based on household survey data.

Table 4.3 Profile of households by livelihood strategy

Livelihood activities and food security outcomes	Livelihood Strategies			
	Agricultural wage laborer households	Off-farm wage laborer households	Wage laborer with a farm households	Farm and self-employment households
Number of households	245	176	995	312
Livelihood activities in which they engage (%)				
Cultivation				
Rice			55.1	15.0
Fruits			37.8	23.6
Vegetables			13.5	2.6
Livestock rearing				
Draft animals (horses, oxen)			30.2	4.5
Cows			34.3	6.4
Small animals (goats, pigs, sheep)			21.6	1.6
Poultry (ducks, chickens)			17.1	0.3
Employment				
Agricultural labor	100.0		55.4	19.8
Other wage labor		100.0	33.3	14.4
Self-employed			7.0	72.8
Government transfers				
Ration card and other public transfers	50.6	52.3	69.9	62.9
Food security outcomes				
Household dietary diversity score (mean)	5.4	5.6	5.6	5.9 ***
Percentage of households vulnerable to hunger	15.5	4.6 ***	3.3***	4.2 ***
Food expenditure (Rupees/month)	1,377.3	1,784.0 **	1,439.9	1,749.8 **

Source: Authors' calculations based on household survey data.

Table 4.4 Basic Model: Multinomial logit model to determine households' livelihood strategies (N = 1,695)

Covariates	Probability that households choose the *off-farm wage laborer* strategy over being an *agricultural wage laborer* household			Probability that households choose the *wage laborer with a farm* strategy over being an *agricultural wage laborer* household			Probability that households choose the *farm and self-employment* strategy over being an *agricultural wage laborer* household		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Baseline probability that households would choose livelihood strategy *[...]* over being an *agricultural wage laborer* household	10.449**	10.499**	10.480**	0.837	0.834	1.007	0.914	0.922	0.867
LAND									
Log (land household can access)	1.116	1.110	1.116	2.161***	2.150***	2.146***	1.408***	1.400***	1.412***
Log (average number of months since land was acquired)	0.694***	0.699***	0.697***	0.912	0.923	0.896	0.926	0.930	0.935
Owns land	0.746			1.420**			1.357		
Owns land, undocumented		0.656			1.161			1.233	
Owns formally documented land		0.882			1.797***			1.549	
Owns inherited land			0.744			1.593**			1.344
Owns purchased land			0.758			1.261			1.338
Owns Vasundhara/Gramakantha Paramboke land			0.690			0.883			1.405
NLASSETS (nonland assets)									
Maximum years of education in household	1.075**	1.074**	1.075**	1.001	1.000	1.000	1.101***	1.100***	1.101***
Number of adults (15–59)	1.008	1.004	1.008	1.127	1.120	1.136	0.942	0.939	0.94
Log (total value of household productive assets)	0.942**	0.941**	0.942**	1.041**	1.039**	1.039**	1.042	1.041	1.042
Household level									
Scheduled caste	0.668	0.681	0.664	1.005	1.024	0.980	0.596	0.605	0.596
Scheduled tribe	0.812	0.819	0.805	2.611**	2.608**	2.511**	1.276	1.284	1.263
Other backward caste	0.401**	0.406**	0.401**	0.873	0.885	0.857	0.669	0.675	0.673
Community Level									
Gajapati District	0.584	0.575	0.575	0.495***	0.486***	0.451***	0.403	0.396	0.405
Jagatsinghpur District	0.290***	0.279***	0.286***	0.673	0.633	0.618	0.590	0.575	0.586
Khurda District	0.609	0.579	0.596	0.207***	0.190***	0.188***	0.716	0.686	0.715
Baseline	10.449**	10.499**	10.480**	0.837	0.834	1.007	0.914	0.922	0.867

Source: Authors' calculations based on household survey data.

Notes: Omitted categories are Does Not Own Land, General Caste, and Ganjam District; ** and *** indicate significance at the 5%, and 1% levels, respectively. Standard errors were clustered by revenue circle (the next land administration level above the village level) and bootstrapped with 500 repetitions.

Table 4.5 Gendered Model: Multinomial logit model to determine households' livelihood strategies (N = 1,578)

Covariates	Probability that households choose the *off-farm wage laborer* strategy over being an *agricultural wage laborer* household			Probability that households choose the *wage laborer with a farm* strategy over being an *agricultural wage laborer* household			Probability that households choose the *farm and self-employment* strategy over being an *agricultural wage laborer* household		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Baseline probability that households would choose livelihood strategy *[...]* over being an *agricultural wage laborer* household	9.041*	7.902*	8.125*	0.601	0.602	0.745	0.604	0.601	0.611
LAND									
Log (land household can access)	1.105	1.109	1.119	2.181***	2.169***	2.159***	1.425***	1.420***	1.429***
Log (average number of months since land was acquired)	0.749**	0.783	0.766	0.998	1.017	0.969	0.978	0.991	0.969
Owns land * female share	1.109			1.308			2.055**		
Owns land * male share	0.880			1.273			0.935		
Owns undocumented land		0.237			0.655			0.763	
Owns undocumented land * female share		1.156			1.141			1.462	
Owns undocumented land * male share		2.539			1.646			1.387	
Owns documented land		0.148			0.981			0.808	
Owns documented land * female share		1.884			1.749			3.649**	
Owns documented land * male share		6.017			1.502			0.931	
Owns inherited land			0.247**			0.734			0.646
Owns inherited land * female share			1.738			2.165**			3.326**
Owns inherited land * male share			2.554			1.545			1.155
Owns purchased land			0.000***			0.851			0.498
Owns purchased land * female share			1.133			0.829			1.382
Owns purchased land * male share			0.000***			1.755			2.117
Owns Vasundhara/*GKP* land			0.476			2.513			5.377
Owns Vasundhara/*GKP* land * female share			0.908			0.319			0.571
Owns Vasundhara/*GKP* land * male share			1.662			0.669			0.395

Table 4.5 Continued

Covariates	Probability that households choose the *off-farm wage laborer* strategy over being an *agricultural wage laborer* household			Probability that households choose the *wage laborer with a farm* strategy over being an *agricultural wage laborer* household			Probability that households choose the *farm and self-employment* strategy over being an *agricultural wage laborer* household		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
NLASSETS (nonland assets)									
Maximum years of education among females in hh	1.001	0.996	0.997	1.027	1.024	1.027	1.042**	1.039**	1.042**
Maximum years of education among males in hh	1.095**	1.097**	1.103**	0.998	0.998	0.999	1.106***	1.106**	1.113***
Number of adult females (15–59)	0.857	0.893	0.894	0.949	0.958	0.965	0.837	0.848	0.844
Number of adult males (15–59)	1.026	1.012	1.024	1.206**	1.192	1.223**	1.068	1.056	1.052
Log (total value of household productive capital)	0.846***	0.865**	0.870**	1.047	1.047	1.051	1.076	1.079	1.083
Share of productive assets owned by female head of hh	1.714	1.752	1.652	1.660**	1.736**	1.635**	1.491	1.533	1.454
Share of productive assets owned by male head of hh	1.521	1.199	1.273	0.631	0.596	0.629	0.532	0.503**	0.538
Household level									
Scheduled caste	0.639	0.657	0.631	1.020	1.027	1.005	0.618	0.617	0.625
Scheduled tribe	0.759	0.769	0.751	2.812**	2.747**	2.759**	1.303	1.274	1.273
Other backward caste	0.351**	0.355**	0.347**	0.849	0.841	0.823	0.634	0.619	0.627
Community Level									
Gajapati District	0.596	0.574	0.580	0.488***	0.472***	0.437***	0.457	0.445	0.452
Jagatsinghpur District	0.262***	0.268***	0.282***	0.589	0.551	0.543	0.482	0.476	0.476
Khurda District	0.640	0.636	0.712	0.184***	0.165***	0.173***	0.657	0.631	0.699

Source: Authors' calculations based on household survey data.

Notes: hh = household; GKP = Gramakantha Paramboke. Omitted categories are Does Not Own Land, General Caste, and Ganjam District; ** and *** indicate significance at the 5%, and 1% levels, respectively. Standard errors were clustered by revenue circle (the next land administration level above the village level) and bootstrapped with 500 repetitions. Share of productive assets owned by female and male heads of household includes value of assets jointly owned by female and male heads.

Appendix: Supplementary Tables

Table A.1 Sample composition (N = 1,730)

Districts	Blocks	Villages
Ganjam (751 households)	*Khallikote (156 households)	Chillipoi, Gunduripur, Marei Nuagon, Chakasingh, Badapalli, P. Balarampur
	Beguniapada (206 households)	Belapada, Burujhari Nuagon, Maridipalli, Baidipada, Chhunchipada, Jokalundi, Borabara, Nuamaridipalli, Saranianuasahi, Kalimeghi, Chakundajhola, Manipur
	Seragada (130 households)	Padampur, Khairbethi, Gothagaon, Kaspa, Baklikana
	^Digapahandi (119 households)	Bharamarapurpalli, Siripur, Badadumula, Ankarada, Bomkei
	^Sanakhemundi (140 households)	Konkorada, Matiaburei, Pattapur, Ambagaon, Maulabhanja
Gajapati (354 households)	*Mohana (177 households)	Endrima, Dhepapadar, Kirma, Narangi, Bhaliapada, Hikirikupa, Sanakhani
	Gumma (177 households)	Pattimul colony, Buruding, Tarava
Jagatsinghpur (374 households)	*Erasama (196 households)	Nauratanpur, Padmapur, Harishpurgarh, Dhobei, Asia, Garia, Kanaguli
	Biridi (178 households)	Chandapur, Hajipur, Kulakoijanga
Khurda (251 households)	Banapur (251 households)	Narandihi, Aranga, Dhuanali, Padanpur, Bandhamundei, Nandapur, Antarakiari, Dolamundei, Bhesari, Raipada, Kiagorada, Pari Nuagaon, Mangarajpur, Gopikartapur, Saranai, Alaidiha Patna, Kaunrapali Patana, Manitiri

Source: Authors' calculations based on household survey data.
Notes: * denotes Landesa Vasundhara pilot area. ^ denotes *GKP*-eligible area.

Table A.2 Descriptive summary of variables used in the Basic Model (N = 1,695)

Variable Description	Mean	Standard Deviation	Minimum	Maximum
LAND				
Log (land household can access)	2.608	1.844	0	9.328
Log (average number of months since land was acquired)	5.294	0.794	1.386	7.343
Does not own land	0.371	0.483	0	1
Owns land	0.629	0.483	0	1
Owns land, undocumented	0.314	0.464	0	1
Owns formally documented land	0.316	0.465	0	1
Owns inherited land	0.455	0.498	0	1
Owns purchased land	0.091	0.287	0	1
Owns Vasundhara/GKP land	0.083	0.276	0	1
NLASSETS (nonland assets)				
Maximum years of education in household	6.044	3.908	0	15
Number of adults (15–59)	2.532	1.287	0	10
Total value of household productive assets (Rupees)	3016	4618	0	70000
Household Level				
Scheduled caste	0.318	0.466	0	1
Scheduled tribe	0.299	0.458	0	1
Other backward caste	0.286	0.452	0	1
General caste	0.097	0.297	0	1
Community Level				
Ganjam District	0.438	0.496	0	1
Gajapati District	0.203	0.402	0	1
Jagatsinghpur District	0.219	0.414	0	1
Khurda District	0.139	0.346	0	1

Source: Authors' calculations based on household survey data.
Note: GKP = Gramakantha Paramboke.

Table A.3 Descriptive summary of variables in the Gendered Model (N = 1,578)

Variable Description	Mean	Standard. Deviation	Minimum	Maximum
LAND				
Log (land household can access)	2.668	1.853	0	9.328
Log (average number of months since land was acquired)	5.288	0.787	1.386	7.343
Does not own land	0.364	0.481	0	1
Owns land	0.636	0.481	0	1
Owns land, undocumented	0.314	0.464	0	1
Owns formally documented land	0.321	0.467	0	1
Owns inherited land	0.463	0.499	0	1
Owns purchased land	0.089	0.285	0	1
Owns Vasundhara/GKP land	0.084	0.277	0	1
Share of land owned by female head of household	0.380	0.463	0	1
Share of land owned by male head of household	0.526	0.472	0	1
NLASSETS (nonland assets)				
Maximum years of education among females in household	3.939	3.917	0	15
Maximum years of education among males in household	5.313	4.000	0	15
Number of adult females (15–59)	1.343	0.755	0	5
Number of adult males (15–59)	1.290	0.810	0	6
Total value of household productive assets (Rupees)	3118	4654	0	70000
Share of productive assets owned by female head of hh	0.479	0.462	0	1
Share of productive assets owned by male head of hh	0.601	0.471	0	1
Household Level				
Scheduled caste	0.321	0.467	0	1
Scheduled tribe	0.295	0.456	0	1
Other backward caste	0.285	0.451	0	1
General caste	0.100	0.299	0	1
Community Level				
Ganjam District	0.431	0.495	0	1
Gajapati District	0.202	0.401	0	1
Jagatsinghpur District	0.224	0.417	0	1
Khurda District	0.143	0.350	0	1

Source: Authors' calculations based on household survey data.
Notes: GKP = Gramakantha Paramboke; hh = household. Share of productive assets owned by female and male heads of household includes value of assets jointly owned by female and male heads.

Table A.4 Summary of significant results using alternative estimations of basic land documentation model

Covariates	Probability that households choose the *off-farm wage laborer* strategy over being an *agricultural wage laborer* household			Probability that households choose the *wage laborer with a farm* strategy over being an *agricultural wage laborer* household			Probability that households choose the *farm and self-employment* strategy over being an *agricultural wage laborer* household		
	(a) MNL	(b) MNP	(c) LOGIT	(a) MNL	(b) MNP	(c) LOGIT	(a) MNL	(b) MNP	(c) LOGIT
LAND									
Log (land household can access)				+	+	+	+	+	+
Log (average number of months since land was acquired)	-	-	-						
Owns undocumented land		-	-						
Owns documented land				+	+	+			+
NLASSETS (nonland assets)									
Maximum years of education in household	+	+	+				+	+	+
Number of adults (15–59)						+			
Log (total value of household productive assets)	-	-	-	+	+				+
Household Level									
Scheduled caste									
Scheduled tribe				+	+				
Other backward caste	-	-	-						
Community Level									
Gajapati District				-	-	-			-
Jagatsinghpur District	-	-	-			-	-		-
Khurda District	-	-	-	-	-				-

Source: Authors' calculations based on household survey data.

Note: MNL = Multinomial logit model; LOGIT = individual logit model; MNP = Multivariate probit model. + denotes a positive, significant effect; - denotes a negative, significant effect; blank cells indicate no significant effect detected; significance determined at p<0.1.

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Table A.5 Summary of significant results using alternative estimations of gendered land documentation model

Covariates	Probability that households choose the *off-farm wage laborer* strategy over being an *agricultural wage laborer* household			Probability that households choose the *wage laborer with a farm* strategy over being an *agricultural wage laborer* household			Probability that households choose the *farm and self-employment* strategy over being an *agricultural wage laborer* household		
	(a) MNL	(b) MNP	(c) LOGIT	(a) MNL	(b) MNP	(c) LOGIT	(a) MNL	(b) MNP	(c) LOGIT
LAND									
Log (land household can access)				+	+	+	+	+	+
Log (average number of months since land was acquired)		-							
Owns undocumented land		-							
Owns undocumented land * female share									
Owns undocumented land * male share									
Owns documented land									
Owns documented land * female share							+	+	+
Owns documented land * male share									
NLASSETS (nonland assets)									
Maximum. years of education among females in household							+	+	
Maximum. years of education among males in household	+	+	+				+	+	+
Number of adult females (15–59)									
Number of adult males (15–59)				+	+				
Log (total value of household productive capital)	-	-							
Share of productive assets owned by female head of hh			+	+	+	+			
Share of productive assets owned by male head of hh							-		
Household Level									
Scheduled caste									
Scheduled tribe				+	+				
Other backward caste	-	-							
Community Level									
Gajapati District				-	-	-			
Jagatsinghpur District	-	-	-				-		
Khurda District				-	-	-			

Source: Authors' calculations based on household survey data.

Note: hh = household; MNL = Multinomial logit model; LOGIT = individual logit model; MNP = Multivariate probit model. + denotes a positive, significant effect; - denotes a negative, significant effect; blank cells indicate no significant effect detected; significance determined at $p < 0.1$. Standard errors were clustered by Revenue Circle (the next land administration level above the village level) and bootstrapped with 500 repetitions. Share of productive assets owned by female and male heads of household includes value of assets jointly owned by female and male heads

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