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Polygyny and Farm Households' Resilience to Climate Shocks

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Abstract

Climate change and weather shocks pose major challenges for household income security and well-being, especially for smallholder farmers' communities. In such communities, imperfect risk insurance and labor markets may induce households to use traditional institutions such as polygyny to harness their size and composition to their resilience strategies against these shocks. This paper tests this hypothesis by analyzing how polygyny's interaction with droughts affects crop yields. For identification, the paper relies on the spatial variation in polygyny's prevalence across Mali's rural communes and the randomness of drought episodes. The findings show that polygynous communities are more resilient to drought-induced crop failure. Exploration of the mechanisms shows that polygynous communities diversify their income sources more than monogamous ones, including via child marriage—a phenomenon known to undermine women's outcomes. As the literature links polygyny to underdevelopment, interventions to eliminate it should make formal resilience and adaptation strategies available to drought-prone communities. Failure to do so may entrench political opposition to enforcing a ban on polygyny and child marriage.

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Polygyny and Farm Households' Resilience to Climate Shocks *

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1 Introduction

Droughts have long been constant threats to livelihoods in the developing world, increasing both short-term and long-term risks for rural households (Maccini and Yang, 2009; Dinkelman, 2017). The literature documents the dire consequences of droughts in village economies,[1] as well as barriers to households' efficient response to them (Rosenzweig, 1988; Townsend, 1994, 1995; Morduch, 1995; Platteau, 1997; Fafchamps and Lund, 2003; Kazianga and Udry, 2006; Fafchamps and Gubert, 2007; Maccini and Yang, 2009; Dinkelman, 2017). A common feature of this literature is its finding that in village economies, community-based risk-sharing mechanisms break down in the presence of spatially covariant risks such as droughts (Townsend, 1994; Kazianga and Udry, 2006; Fafchamps and Gubert, 2007), causing household resilience to the occurrence of such shocks to be positively correlated with household size (Brock and Coulibaly, 1999; Toulmin and Gueye, 2003; Banda et al., 2016). This finding suggests that fertility may have overarching importance in drought-prone village economies. Yet, despite evidence that polygyny—a marriage practice whereby a man can have multiple wives simultaneously— increases fertility (Tertilt, 2005; Rossi, 2019), and is highly prevalent in drought-prone rural communities, such as those located along the polygyny belt,[2] there has been limited interest in investigating its role as a resilience mechanism for local communities. This study addresses this issue.

We provide the first test of the hypothesis that polygynous communities are more resilient to the adverse impact of drought on crop yields.[3] Theoretically, the link between polygyny and family resilience to drought-induced crop failure can be summarized as follows. First, in village economies, droughts are a well-documented source of localized crop failures (Jayachandran, 2006; Kaur, 2019). Second, diversification of crop production (Asfaw et al., 2019) and sources of income (De Young et al., 2012) are proven resilience

[1]By village economy, we mean an economy in which agriculture is the principal source of livelihood, and whose main characteristic features are the village, a low access to formal risk-management mechanisms, an imperfect agricultural labor market, and little division of labor.

[2]For example, in a study of 56 ethnic groups in rural Tanzania, Lawson et al. (2015) find that polygynous households are mostly clustered in challenging ecological environments, including those with high risks of drought exposure.

[3]By resilience, therefore, we mean a farm household's capacity to recover from the adverse effect of drought shocks on crop yields.

strategies in such environments. Third, leveraging diversification of crop production and income sources as resilience strategies is effective only for rural households with a large family workforce (Brock and Coulibaly, 1999; Toulmin and Gueye, 2003; Lawson et al., 2015; Banda et al., 2016). Fourth, in drought-prone village economies, there may therefore be a vested interest in the preservation of traditional institutions that promote a large family, such as polygyny, to harness household size and composition to the effectiveness of resilience strategies against drought. If this is indeed the case, then communities where polygyny is highly prevalent should be more resilient to drought shocks compared to those where monogamy is highly prevalent. In other words, diversification of crop production and income sources in the aftermath of a drought should be more successful in polygynous than in monogamous communities.

To identify the resilience effect of polygyny, we regress households' crop yields on the interaction of polygyny with current and lag droughts using data on Mali. Several challenges confront our identification of the causal effect of the interaction of drought and polygyny. First, there is the potential presence of spatial correlation in the error term, due to the tendency of both drought and polygyny to be clustered in space. Although droughts can happen randomly over time, they often tend to be clustered across neighboring geographic units (Hsiang et al., 2011). Likewise, polygyny, as a cultural practice, is often clustered in geographic units that share similar cultural values. Second, there is the potential serial correlation of our drought series within each geographic unit. To account for these two sources of correlation, we follow Conley (1999); Hsiang et al. (2011) in adjusting standard errors for both serial and spatial correlation. Third, there is the potential presence of spatial correlation due to omitted weather variables. We account for this problem by constructing a measure of drought during the agricultural season, using the Standardized Precipitation-Evapotranspiration Index (Vicente-Serrano et al., 2010; Miao and Popp, 2014; Harari and Ferrara, 2018). The final issue is the potential presence of unobserved time-constant and time-varying factors that can influence the relationship between our covariates of interest and crop yields. We account for this problem by controlling for enumeration area (EA) fixed effects, and time-variant household-level and community-level observables. Additionally, identification of the resilience effect of polygyny is obtained under the assumption that, upon controlling for EA fixed effects and over a relatively short time (*i.e.*, 3 years), differences across Mali's communes in the prevalence of polygyny are invariant to the agricultural yields reported by households.

Despite the inclusion of all the controls mentioned above, not accounting for internal migration might be seen as another potential threat to the identification of the resilience effect of polygyny. Indeed, it might be argued that internal migration creates a pathway for men who want to have several wives to self-select into communities with a high polygyny prevalence. However, in rural Mali— the setting of our empirical analysis— migration is a rare event. Our data indicate that a mere 0.349% of household heads migrate internally. This evidence has at least two important implications for our identification strategy. First, it assuages concerns about the potential presence of a selection bias, as men are unlikely to self-select into communes with a high polygyny prevalence. Second, even if drought were to determine migration endogenously, this would not affect our estimation results.

We use data from two rounds of Mali's *Enquête Agricole de Conjoncture Intégrée aux Conditions de Vie des Ménages (EAC-I)*, in combination with polygyny data from the *Fourth General Census of Population and Housing* (2009) and meteorological data. Mali is a bride price country (Corno et al., 2020), with the second highest polygyny prevalence in the world at 34% (Kramer, 2020). These facts make Mali a suitable setting for our hypothesis testing.

We find that drought occurring in the current year and the previous year substantially reduces crop yields in all affected communes. This result is evidence that rural households in Mali are highly dependent on rainfed agriculture for their livelihoods. Importantly, we find that polygyny—a marriage practice known to undermine women's health (Bove and Valeggia, 2009; Bove et al., 2014) and increase violence against women (Ebrahim and Atteraya, 2020)— enhances household resilience to this adverse effect a year later following the drought shock. This result is robust to various alternative specifications of the interaction between drought and polygyny.

Exploring the pathways of this resilience effect of polygyny, we find that a year after drought, households living in more polygynous communes are more likely to sell livestock and access credit than those living in less polygynous communes. They are also more likely to hire labor, use improved seeds and chemical inputs, and diversify crop production. These findings suggest that polygyny enhances a family's ability to recover from the adverse effect of drought. More importantly, we also find that two years after drought, more families marry off their underage daughters in highly polygynous communes compared to less polygynous ones. This result provides evidence that in bride price rural communities, the common occurrence of covariate income shocks such as droughts increases the value of having multiple daughters, thus incentivizing men to become polygynous.

The main takeaway of this study thus is that, with climate change showing no sign of a reversal, if no formal resilience and adaptation strategies are made available to drought-prone, bride price communities, the struggle to survive could incentivize the formation of polygynous families, as a resilience mechanism against negative covariate income shocks such as droughts, and fuel political opposition to a ban on the practice of polygyny. Given that this marriage practice is known to increase fertility (Tertilt, 2005; Rossi, 2019), undermine women's health (Bove and Valeggia, 2009; Bove et al., 2014) and increase violence against women (Ebrahim and Atteraya, 2020), any factor that incentivizes its persistence, such as uninsured covariate risks, is likely to push a drought-prone, bride price country into a high-fertility trap, in addition to undermining child human capital (Omariba and Boyle, 2007; Smith-Greenaway and Trinitapoli, 2014; Wagner and Rieger, 2015; Arthi and Fenske, 2018).

This paper contributes to the literature on the effects of polygyny (Tertilt, 2005; Omariba and Boyle, 2007; Smith-Greenaway and Trinitapoli, 2014; Wagner and Rieger, 2015; Lawson et al., 2015; Arthi and Fenske, 2018; Rossi, 2019). With the exception of Lawson et al. (2015), the common denominator of contributions to this literature is that polygyny undermines development. It is harmful to women and children (Omariba and Boyle, 2007; Smith-Greenaway and Trinitapoli, 2014; Wagner and Rieger, 2015; Arthi and Fenske, 2018), and pushes fertility rates upward (Tertilt, 2005; Rossi, 2019). Lawson et al. (2015), in contrast, find that the costs of sharing a husband are offset by greater wealth, with polygynous households holding a significant advantage in terms of land and livestock. However, it is not clear in Lawson et al. (2015) why polygynous households enjoy such an advantage, nor do we know how this advantage plays out in the event of drought. We contribute to this literature by demonstrating that polygyny enhances household resilience in the aftermath of a devastating drought, albeit at the expense of child marriage—a phenomenon known to undermine women's outcomes (Field and Ambrus, 2008).

Additionally, this paper contributes to the literature on risk-management strategies in village economies (Rosenzweig, 1988; Morduch, 1995; Platteau, 1997; Fafchamps and Lund, 2003; Kazianga and Udry, 2006; Fafchamps and Gubert, 2007; Lange and Reimers, 2021). Most contributions to this literature analyze the buffering effects of community-based risk-sharing and self-insurance mechanisms. In particular, Kazianga and Udry (2006), Fafchamps and Gubert (2007) and Lange and Reimers (2021) all focus on the efficiency of community-based risk-sharing and risk-management mechanisms under covariate income shocks such as droughts. The consensus in this literature is that the presumed buffering effect of livestock breaks down in the context of droughts because the risks of crop failure and livestock loss are positively correlated when drought is the risk factor. We contribute to this literature by exploring the resilience effect of polygyny following the occurrence of a covariate negative income shock.

The paper is organized as follows. Section 2 reviews the literature on the causes of the disappearance of polygyny globally, and its confinement to Sub-Saharan Africa. Section 3 presents the context and data. Section 4 turns to testing whether polygyny is a resilience mechanism following a negative covariate income shock. Section 5 reports the findings and investigates the mechanisms, and Section 6 concludes.

2 Polygyny and Drought Risks: A Visual Test

Polygyny —when a man marries multiple women— was a marriage institution in 80% of pre-industrial societies (Lawson et al., 2015). Today, this marriage institution has been outlawed throughout much of the world. In 2000, for example, the United Nations Human Rights Committee moved to ban this marriage institution.[4] Yet, it remains legal or generally accepted in 25 of the 46 countries comprising Sub-Saharan Africa (SSA), where the percentage of people living in polygynous households is highest globally, at 11%

[4] See Human Rights Committee, General Comment 28, Equality of rights between men and women (article 3), U.N. Doc. CCPR/C/21/Rev.1/Add.10 (2000), available online at http://hrlibrary.umn.edu/gencomm/hrcom28.htm.

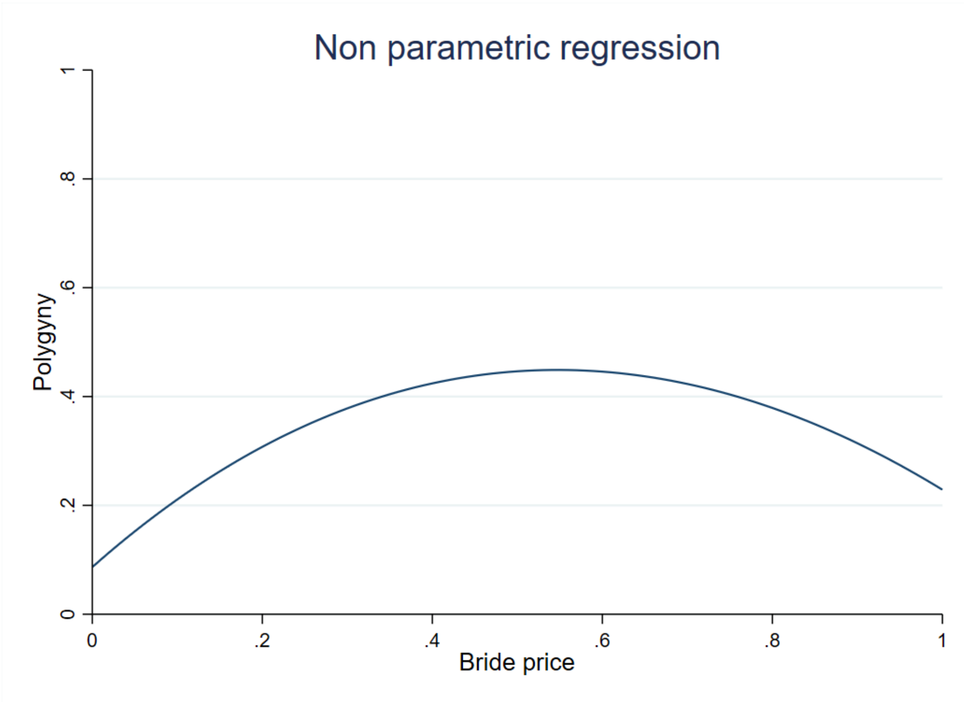
(Kramer, 2020).

2.1 On the Persistence of Polygyny in SSA: A Brief Review of the Literature

Given that the sex ratio in SSA has been near unity for decades (Jacoby, 1995), the reason why so many countries in this region still oppose the abolition of polygyny has been a matter of considerable debate. On the one hand, the literature has advanced our understanding of the forces driving its disappearance in the Western world (Gould et al., 2008), while also contributing evidence of its causal effect on multidimensional poverty in the developing world (Tertilt, 2005; Smith-Greenaway and Trinitapoli, 2014; Wagner and Rieger, 2015; Arthi and Fenske, 2018). On the other hand, there is no consensus in this literature on why this marriage institution persists in Sub-Saharan Africa. For example, Jacoby (1995) argues that polygyny persists in SSA because women's comparative advantage in food production increases their value to men as husbands and household heads (Jacoby, 1995). However, Fenske (2015) provides evidence that this cultural practice is least common in those parts of Sub-Saharan Africa where women have historically been most important in agriculture. This lack of consensus suggests that the socioeconomic forces contributing to the persistence of polygyny in SSA are still not well understood.

Of course, we know from Anderson (2007) that polygyny in SSA correlates with the bride price custom whereby marriage is only sanctioned after the payment of transfer in cash or in-kind from the groom or his family to the bride's family. However, this association is non-linear, as shown in Figure 1 drawn using data from Giuliano and Nunn (2018). Bride price in Figure 1 is measured as the fraction of a population's ancestors who practiced bride price traditionally. Polygyny is measured as the proportion of the population living in polygynous unions.

Figure 1: *Relationship between polygyny and bride price*



Source: Authors' elaboration from data defined in Giuliano and Nunn (2018);
Notes: Bride price is measured as the fraction of a population's ancestors who practiced bride price traditionally. Polygyny is measured as the proportion of the population living in polygynous unions.

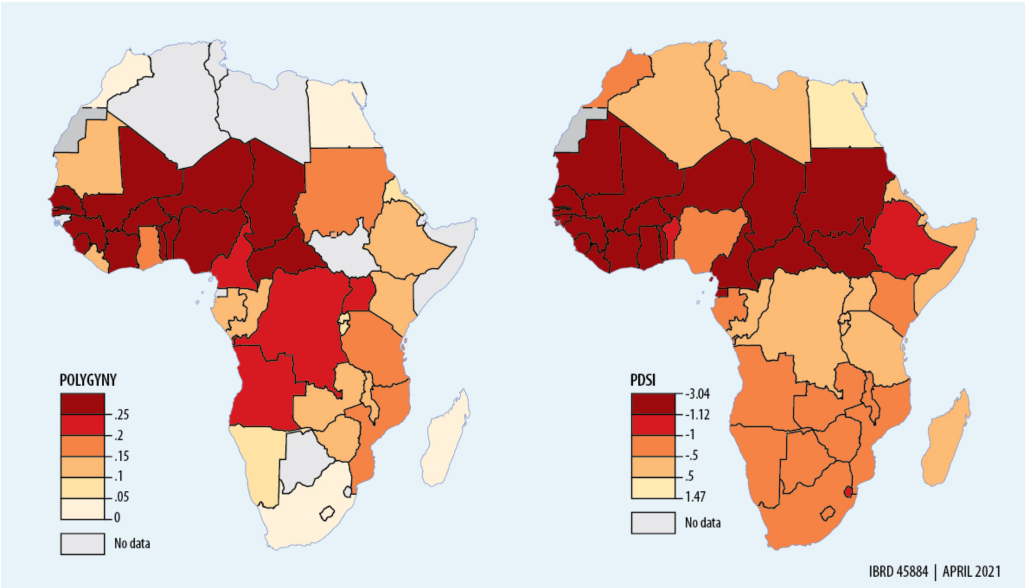
The association is strong up to a certain prevalence threshold. But then it weakens as the prevalence of the bride price custom rises. Indeed, predominantly bride price countries such as Kenya with a bride price prevalence rate of 100%, Lesotho (100%), Rwanda (100%), Eswatini (97%), Ghana (94%) report some of the lowest polygyny rates in the in the world (Kramer, 2020). Exploring a causal link between the bride price custom and polygyny, though interesting, is complicated by lack of reliable data on bride price at the micro-level.

2.2 Are Drought-Prone Countries More Polygynous?

Interestingly, the drought-prone area of Sub-Saharan Africa —which stretches from Senegal on the Atlantic coast, through parts of Mali, Burkina Faso, Niger, Nigeria, Chad and Sudan to Eritrea on the Red Sea coast — almost coincides with the polygyny belt—

stretching from Senegal to Tanzania. This positive correlation between areas prone to agricultural droughts and those where polygyny is prevalent is quite visible in Figure 2.

Figure 2: *Distribution of Polygyny and Drought in Africa*



Source: Authors' elaboration based on DHS data (for polygyny) and Dai (2017) (for drought – defined using the Palmer Drought Severity Index (PDSI), estimated as an average over the period 1968-2018).

The left panel of Figure 2 built using DHS data shows the proportion of married women in polygynous unions. The right panel was built using Dai (2017) and shows the Palmer Drought Severity Index (PDSI) at the country level, calculated over 50 years, from 1968 to 2018. It should be noted that a PDSI lower than -1 identifies drought episodes.

Countries like Burkina Faso, Mali, Senegal, Niger, and Nigeria, all of which are located in the western African part of the drought-prone Sahel region, report the highest proportions of women in polygynous marriages globally. A common characteristic of these countries is that their rural populations are highly dependent on rainfed production systems for their livelihoods and are highly drought-prone, making them vulnerable to agro-climatic conditions that predominantly affect rainfed production systems. What is more, despite the high volatility of rainfed production, which has become intolerable due to climate change, drought-prone sub-Saharan African countries appear to lag others in terms of developing their irrigation sub-sector (Riddell et al., 2006). At the same time, the use of drought-resistant crop varieties among smallholder farmers also remains low (Frenken, 2005).

All these factors heighten the risks of chronic food insecurity in drought-prone countries of Sub-Saharan Africa and raise the need for risk-management mechanisms, as drought shocks become common occurrences due to climate change. Yet, despite the strong correlation between drought risks and the prevalence of polygyny, as shown in Figure 2, there has been limited interest in analyzing this relationship more closely. This paper is the first to examine this issue formally.

3 Context, Data, and Descriptive Statistics

We use Mali's data to test our hypothesis that polygyny enhances households' resilience after drought. Our data come from various sources, including the *Fourth General Census of Population and Housing (2009)*, the *Enquête Agricole de Conjoncture Intégrée aux Conditions de Vie des Ménages (EAC-I)*, and climatological data.

3.1 Context

Mali is a landlocked, West African country located in the Sahel region, and along the polygyny belt that stretches from Senegal to Tanzania (Jacoby, 1995). It is bordered on the north by Algeria, on the east by Niger and Burkina Faso, on the south by Côte d'Ivoire and Guinea, and on the west by Senegal and Mauritania. Mali is among the hottest countries in the world. Its two main geographic areas, North and South, each face different climatic conditions for agricultural production. The northern area is more drought-prone and is in constant threat of desertification and population migration. The southern area, in contrast, is where the vast majority of its population is concentrated, deriving its livelihoods from rainfed subsistence agriculture and pastoralism. [5] About 65% of Mali's land

[5] FAO, 2017.Socio-economic context and role of agriculture. Mali Country Fact Sheet. Available online at http://www.fao.org/3/a-i7617e.pdf.

area is desert or semi-desert, which makes it particularly prone to droughts and increases its vulnerability to food price shocks. For example, in 2010, pastoral communities in northern Mali were affected by a food and nutrition crisis, associated with a shortage of rainfall during the 2009 rainy season (Touré et al., 2012).

In Mali, agriculture accounts for more than 35% of GDP and 80% of livelihoods. Cotton is the main cash crop, while cereal grains (maize, millet, rice and sorghum) constitute the main food crops. Animal husbandry contributes to 10% of the GDP and is the main resource for 30% of the population. The main constraints to agricultural production are low soil fertility, low and erratic rainfall exacerbated by climate change, and lack of irrigation infrastructure.[6]

In addition to the structural problems mentioned above, Mali also has one of the highest fertility rates in the world, at 5.9, tied for second with the Democratic Republic of Congo, and behind Niger, which has a total fertility rate of 6.9 (World Bank, 2019). Over the years, the country has been experiencing a slow demographic transition, the result of the ongoing preference for large families, early childbearing, the lack of female education and empowerment, poverty, and extremely low contraceptive use.[7] Slowing Mali's population growth by lowering its birth rate will be essential for poverty reduction, improving food security, and developing human capital and the economy. Yet, the country continues to be plagued by social factors known to increase total fertility. First, Mali ranks among the top five countries in the world, in terms of the prevalence of child marriage among married women aged $20-24$, with a prevalence of 54%, behind Niger (76%), the Central African Republic (68%), Chad (67%), and Bangladesh (59%).[8]

Second, in Mali, polygyny is legal and 34% of individuals live in polygynous households, which is the second highest share globally, behind only Burkina Faso (36%). More precisely, according to the 2009 population Census, 20.2% of married people in Mali were in polygynous unions (Diamoutene, 2015). For married women, this proportion rises to 25.7%, while, for married men, it was 14.4%. Tertilt (2005) and Rossi (2019) link polygyny

[6] FAO, 2017. Dual purpose sorghum and cowpea intercropping in Mali. Available online at http://www.fao.org/agroecology/database/detail/en/c/1027957/.

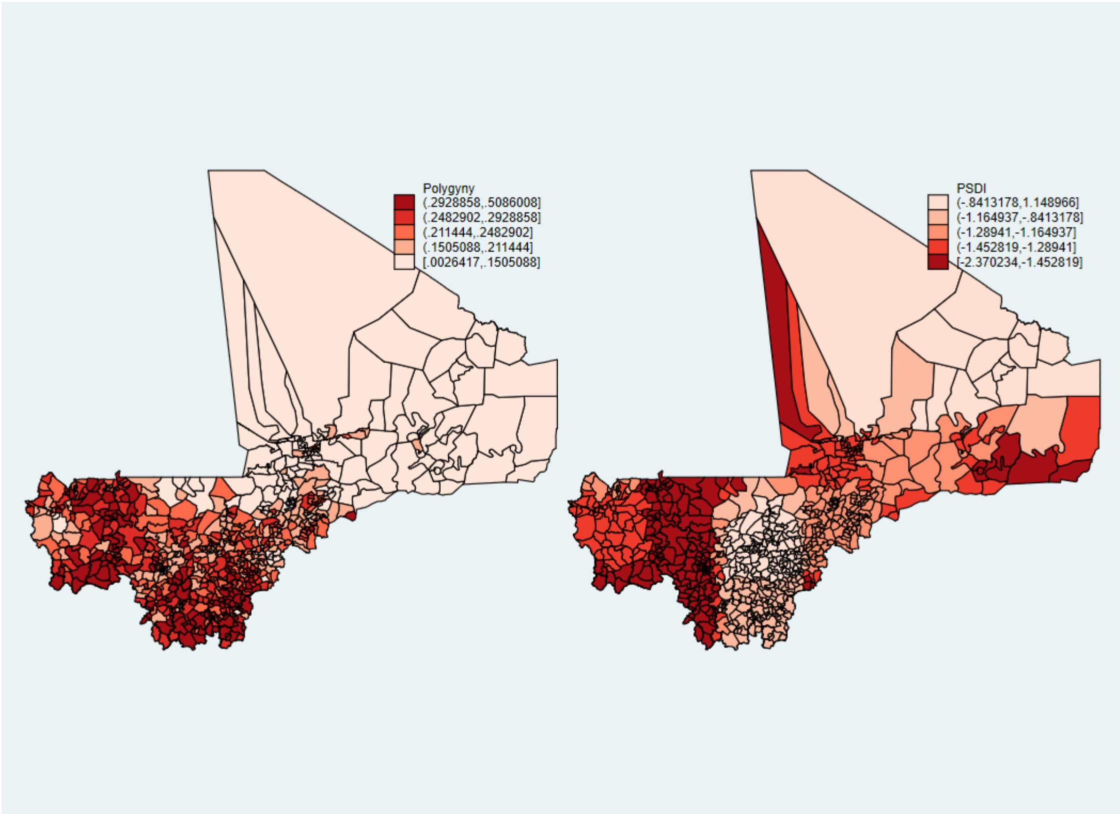
[7] See CIA World Factbook, available online at https://www.cia.gov/the-world-factbook/.

[8] UNICEF global databases 2020, based on Multiple Indicator Cluster Surveys (MICS), Demographic and Health Surveys (DHS), and other national surveys.

to high fertility rates.

Figure 3, built using data from Mali's Fourth General Census of Population and Housing (2009), shows that polygyny is much more widespread in southern Mali, which is also where most of the country's population is concentrated. The population density in the northern regions of Tombouctou, Gao, Kidal, Taoudénit, and Ménaka is low.

Figure 3: *Distribution of Polygyny's Prevalence and PDSI by Commune*

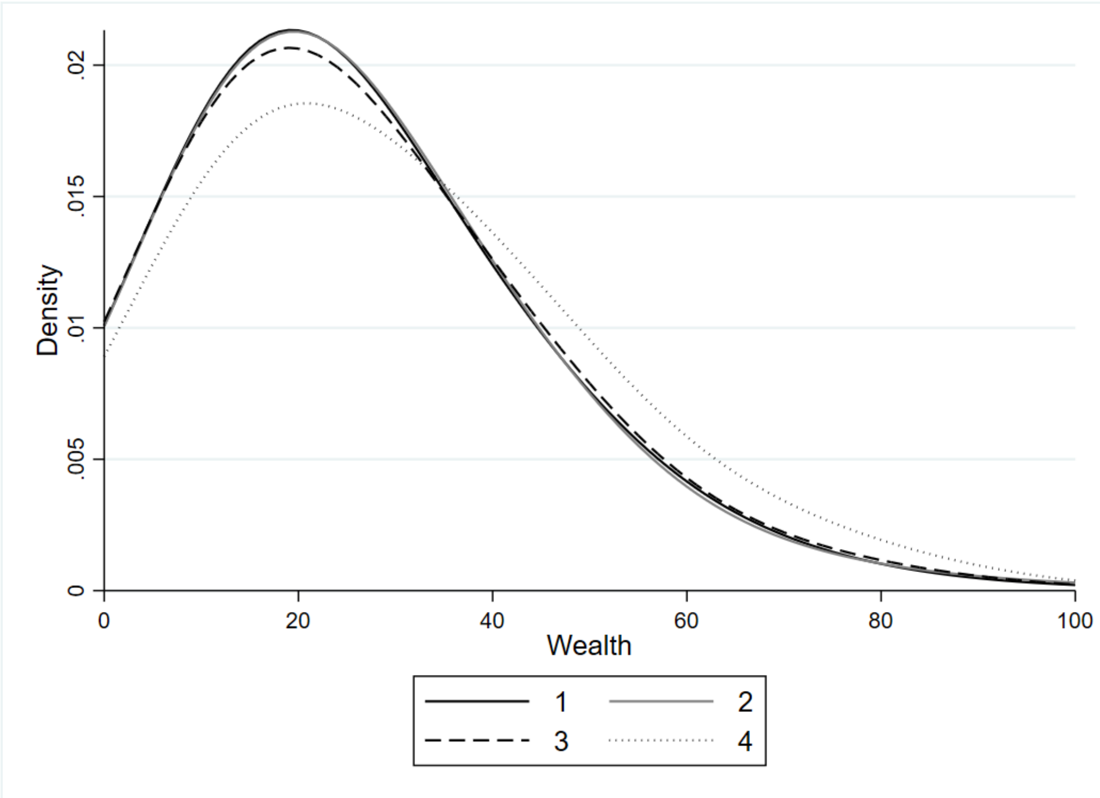


Source: Authors' elaboration based on Mali's Fourth General Census of Population and Housing (2009) (for polygyny's prevalence) and Dai (2017) (for drought – defined using the Palmer Drought Severity Index (PDSI), estimated as an average over the period 1968-2018).

The prevalence of polygyny in southern Mali exceeds 45% in some communes. In the north, polygyny is relatively low compared to other regions. The highest prevalence in the northern communes is relatively low, at 15%. This could be explained by the fact that northern Mali is predominantly populated by ethnic groups (Sonrai 45% and Tuareg 32%) that pursue mainly nomadic pastoral livelihoods, including transhumance (Touré et al., 2012). Polygyny in Mali is also predominantly a rural phenomenon. Among married rural dwellers, 22.4% were in polygynous unions in 2009, while the corresponding figure in urban centers was lower, at 13.5%. The predominance of polygyny in rural areas is interesting because it suggests that there are characteristics of rural life that make this cultural practice more resilient to the test of time.

The literature predicts that wealth inequality among men increases the prevalence of polygyny (Gould et al., 2008). Indeed, Figure 4, built by combining *EAC-I* household data and Census data, shows that wealth is relatively more dispersed in communities located at higher quartiles of polygyny's prevalence across communes. Therefore in testing the hypothesis that polygyny enhances resilience, it will be important to control for wealth.

Figure 4: *Distribution of wealth by quartile of polygyny's prevalence*



Source:Authors' elaboration based on 2009 Census
Notes: The wealth index is constructed with the Principal Component Analysis (PCI) method as proposed in Filmer and Pritchett (2001). The average prevalence of polygyny in each quartile is: 14.4% in the first quartile, 20.9% in the second quartile, 24.9% in the third quartile, and 32.1% in the fourth quartile. The average wealth index (normalised to 100) in each quartile of polygyny is (from the first to the fourth): 26.6, 25.1, 24.4 and 27.6.

All the facts mentioned above make Mali a suitable setting for testing our main hypothesis that polygyny enhances household resilience to drought.

3.2 Polygyny Data and Measurement

Our polygyny data are from the Fourth General Census of Population and Housing (2009). This census contains information on the demographics and socio-cultural characteristics of individuals and the communes in which they live. We use this information to construct our polygyny variable. Polygyny is measured at the commune level and is defined as the prevalence of polygyny in the commune. Measuring polygyny at the commune level is highly relevant given the observed covariance of marriage structure and ecological conditions which often varies across geographic units such as communes. For example, Lawson et al. (2015) find that in northern Tanzania, predominantly polygynous ethnic groups tend to cluster around agro-climatic zones prone to droughts and economic hardships, whereas predominantly monogamous groups tend be clustered in relatively high rainfall, highly fertile agro-climatic zones. This finding suggests that measuring polygyny at the commune level gives a sufficiently high resolution of the within-cluster correlation of marriage structure and its non-correlation across clusters. Our interest in polygyny stems from its hypothesized interaction with drought risk in communities dependent on rainfed agriculture for their livelihoods. To avoid any possible collinearity between drought and its interaction with polygyny, we center our polygyny variable by subtracting from it its mean, and then dividing by its standard deviation (Iacobucci et al., 2016; Dalal and Zickar, 2012). This transformation does not change the interpretation of the coefficient of our interaction term (Allison, 1977).[9] Thus, our results can be interpreted in units of standard deviation. More formally, our standard variable $Poly_j$ is as follows:

$$Poly_j = \frac{Polygyny_j - \overline{Polygyny}}{\sigma_{Polygyny}}, \tag{1}$$

where $Polygyny_j$ is the rate of polygyny in commune j, $\overline{Polygyny}$ its mean and $\sigma_{Polygyny}$ the standard deviation.

[9]Multicollinearity is known to undermine the statistical significance of an independent variable. When this problem is present, small sampling fluctuations in the estimates of the covariance can result in great variability in the values and signs of least squares estimates of the coefficient (Kromrey and Foster-Johnson, 1998).

3.3 Main Outcome Data and Measurement

Our main data source is the *Enquête Agricole de Conjoncture Intégrée aux Conditions de Vie des Ménages* (EAC-I). We use the 2014 and 2017 editions of the EAC-I (EAC-I 2014 and EAC-I 2017). EAC-I 2014 and EAC-I 2017 are nationally representative[10] multi-topic household surveys with a focus on agriculture. These surveys were implemented by Mali's Ministry of Agriculture under the Living Standards Measurement Study – Integrated Household Surveys on Agriculture (LSMS-ISA) program.[11] It contains detailed information on the socioeconomic characteristics of farm households, as well as about the crop production activities (type and quantity of fertilizers, pesticides, seeds, credit, etc.). Information is collected at the level of the cultivated plots (area, soil quality, etc.), as well as on the seasonal crops produced (quantity harvested, area on which the crop was harvested, etc.). The EAC-I also contains crucial GPS information that allows us to identify enumeration areas that are exposed to local rainfall shocks.

For each edition of the survey, households were visited twice: the same households interviewed in the first visit are re-interviewed in the second visit and the visits were planned to match the timing of the post-planting and post-harvest periods of the 2014/15 and 2017/18 agricultural rainy seasons. Households interviewed in the EAC-I 2014 differ from those interviewed in the EAC-I 2017. However, the same Enumeration Areas (EA) were visited during these two surveys. Combining the two editions of the EAC-I and excluding the urban areas to focus on rural production, we obtain a final sample of 7,400 households (1,740 in 2014 and 5,660 in 2017).[12]

Our main variable of interest is crop yields, which is measured in kilograms per hectare. We define yield as the ratio of crop output reported by the household over the area occupied by the crop on the plot.

[10]The sample covers all regions and areas (urban and rural) with the exception of the region of Kidal, excluded for security reasons from the sample.

[11]The Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS-ISA) provides financial and technical support to governments in Sub-Saharan Africa in the design and implementation of multi-topic, national, panel household surveys with a strong focus on agriculture. The EAC-I data and documentation are publicly available on https://www.worldbank.org/en/programs/lsms.

[12]Few observations have been omitted due to lack of information on production and/or outliers on production, yields, acreage, etc.

One of the main advantages of the data from the EAC-I is that plot size is measured by GPS. This avoids measurement errors that lead to biased results. We aggregate crop yields at the household level. We convert production to kilograms (kg) using World Bank conversion factors. Interestingly, our data indicate that crop yields vary according to the extent to which polygyny is practiced in the commune. Indeed, as shown in Table 1 crop yields is respectively 1263.1 kg/ha, 925.9 kg/ha, 892.7 kg/ha and 1027.4 kg/ha for the EA located in the first, second, third and the fourth quartiles of polygyny's prevalence. This distribution of crop yields by quartile of polygyny suggests a negative association between polygyny and crop yields. The economic literature documents an inverse relationship between farm size and productivity in developing countries (Bevis and Barrett, 2020; Barrett, 1996; Henderson, 2015). The difference in crop yields between highly polygynous and less polygynous communes could thus be explained by the variation in farm size. We define farm size as the sum of the land area (in hectares) that is currently cultivated by a household.

3.3.1 Data and Measurement for Mechanisms' Outcomes

This sub-section presents the variables we use as the mechanism of our results. Descriptive results of these variables are reported in Table 2, and are shown by monogamous and polygynous households. For this table, the marriage type is constructed at the household level based on the EAC-I data.

(i) Livestock Sales

We use the detailed information on livestock ownership and production, included in the EAC-I, to construct a binary livestock sale variable equal to 1 if the household has sold one or more of its livestock and 0 otherwise. Table 2 shows that nearly a quarter of households (24.1%) in Mali have traded livestock. In terms of comparison, polygynous households are slightly more likely to sell livestock (24.8%) than monogamous households (23.8%). Livestock sales contribute to family food security by providing financial resources that can be used directly to obtain food or to develop and improve the family's production system (Schiere and Katere, 2001).

(ii) Access to Credit

Access to formal financial services such as credit is cited as an essential factor in agricultural production systems (Dong et al., 2012). The availability of credit enables households' purchase of farm inputs (improved seed, pesticides, etc.), which positively influences crop yields. Credit information is measured at the individual level in our database. We use this information to construct a binary credit access variable at the household level, which equals 1 if at least one member of the household obtained loans in the last 12 months of the survey and 0 otherwise. Table 2 reveals that a mere 17.4% of households have access to credit in Mali. There does not appear to be a large difference in access to credit between polygynous and monogamous households (17.9% vs. 17.4%).

(iii) Agricultural Inputs

Agricultural inputs such as fertilizer, herbicides and pesticides, and improved seeds contribute significantly to increased crop yields. Therefore, in investigating mechanisms likely to drive the effect of polygyny on households' resilience to drought, we explore the effect of polygyny on households' use of chemical inputs, improved seeds, hired labor, farm size, number of plot and number of crops cultivated.

We measure our chemical inputs use variable as a binary variable equal to 1 if the household used chemical inputs during the agricultural season and 0 otherwise. Table 2 shows that polygynous households use more chemical inputs (58.1%) than monogamous households (53.2%).

Our measure of improved seeds is also a binary variable equal to 1 if the household used improved seeds on one of the farm plots during agricultural season and 0 otherwise. Among the households in our sample, 26.4% use improved seeds (Table 2). However, the use of improved seeds is more prevalent among polygynous households (29%) than monogamous households (25.2%).

Polygyny can also influence crop yields through the use of the labor force. In fact, polygyny increases fertility (Rossi, 2019), which tends to increase the size of the household's labor force. The average size of households in our sample is $11,947$. The corresponding figure in highly polygynous communes is 13,595, compared to 9,892 in less polygynous communes (Table 1).

Labor is defined in our analysis as the sum of total days worked (for soil preparation, seeding, weeding, crop treatment and protection, harvesting, and threshing) by family members on the farm plus days worked by hired labor. We divide the labor by the area of the farm to obtain its per hectare value. Table 2 shows that, in Mali, the average number of days of labor per hectare is 39.95 days. The number of labor days per hectare is slightly lower in polygynous households (36.69 days vs. 39.95 days). Polygynous households spend fewer household labor days per hectare (32.29 days) and use fewer hired labor days per hectare (3.51) than monogamous households (34.28 days and 5.44 days, respectively).

Finally, we define the number of cultivated plots as the total number of plots that a household farmed during the agricultural season. Likewise, we define the number of crops cultivated as the total number of crops cultivated by a household during the agricultural season. The average farm size in Mali is 17.90 ha (Table 2). Polygynous households have larger farms (20.98 ha) and plots (5.15 ha) than monogamous households (16.76 and 4.09 ha for farms and plots, respectively).

(iv) Off-Farm Employment and Livestock

As part of our exploration of mechanisms, we also test the combined effect of weather shock and polygyny on off-farm work and animal husbandry. Off-farm activities and animal husbandry are sources of income for the household. For example, polygynous households (who usually have many children) may decide to send one or more of their children (daughters) to the city to do domestic work. The income earned from these children's labor could be used to buy fertilizer or to modernize the family's agricultural production system. We construct two off-farm labor variables to test this mechanism. The first variable is a binary variable equal to 1 if the household member is engaged in non-farm activities and 0 otherwise. The second variable is the total number of off-farm work-days in the month. We also construct a binary variable equal to 1 if an individual is involved in animal husbandry and 0 otherwise.

(v) Child Marriage

In Mali, it is customary for husbands to pay a bride price to the parents of the new wife. The bride price is a transfer of money and/or livestock from the groom and/or his parents to the bride's family at the time of marriage (Giuliano and Nunn, 2018). This practice could have negative effects on girls and women, as it could encourage child marriage (Corno et al., 2020), and thus exacerbate gender inequalities. The bride price provides the bride's family with a source of income that can be used to smooth family consumption or modernize the agricultural production system to improve crop yields. We test this mechanism using DHS (Mali) data of 1995 – 96, 2001, 2006 and 2012 – 13. We follow Corno et al. (2020), by constructing our marriage variable as a binary variable equal to 1 if the female had her first marriage at age t and 0 otherwise. We limit our sample to women between 12 and 17 years of age.

3.4 Drought Data

Following Harari and Ferrara (2018); Miao and Popp (2014) and Vicente-Serrano et al. (2010), we use the Standardized Precipitation-Evapotranspiration Index (SPEI), to construct a measure of droughts. Our SPEI data are from the SPEI Global Drought Monitor. The SPEI Global Drought Monitor provides information on drought on a global scale. The SPEI time scales provided range from 1 to 48 months and the SPEI calibration period for our data is from January 1950 to December 2019.

Our SPEI value is observed during the 2014 and 2017 rainy seasons in Mali (June-October). We use GPS information from EAC-I data to match each EA to the SPEI grid cell and calculate rainfall shocks at the EA level. Drought occurred if and only the SPEI value is below -1, which captures moderate to extreme droughts (Vicente-Serrano et al., 2010). Interestingly, the SPEI index accounts for the joint effects of precipitation, potential evaporation, and temperature. This measure then allows to control for weather variables strongly correlated with rainfall. This index is, therefore, less susceptible to omitted (weather) variables threats.

In Mali, rains are brought seasonally by monsoon winds that feed the lower layers of the atmosphere with water vapor (Jean, 1985). In recent years, climatic droughts seem almost endemic in Mali. Figure 5 reports the spatial and temporal frequency of drought occurrences in Mali EA based on the SPEI. With the exception of the year 2016, at least 15% of the EA have experienced drought episodes between 2013 and 2017. In 2017, nearly half of the EA experienced drought episodes. In 2016, cumulative rainfall was normal or above normal throughout Mali. However, some localized areas in northeastern Mali experienced erratic rainfall.

4 Drought, Polygyny, and Crop Yields

In this section, we discuss our empirical model. To provide evidence that polygyny enhances resilience to the adverse effects of agricultural droughts, we use a linear regression model. The unit of observation for crop yields is the household. We define the following model:

$$\begin{aligned} Q_{hijt} =& \beta_1 Drougth_{it} + \beta_2 Drougth_{it} \times Poly_j + \beta_3 Drougth_{it-1} \\ &+ \beta_4 Drougth_{it-1} \times Poly_j + \beta_5 X_{hijt} + \eta_t + \lambda_i + \epsilon_{hijt}, \end{aligned} \tag{2}$$

The dependent variable Q_{hijt} is the natural logarithm of crop yields for household h living in EA i (located in commune j) at time t. X_{hijt} is a vector of household head and farm characteristics, including household wealth; $Drougth_{it}$ or $Drougth_{it-1}$ are time-varying variables measuring the occurrence of drought at EA i in year t or $t-1$; $Poly_j$ measures polygyny in commune j. We include EA fixed effects λ_j, to account for the potential correlation between unobserved time invariant at the EA level and polygyny, and year η_t fixed effects to account for year effect. ϵ_{hijt} is a zero-mean error, which captures the effect of unobserved factors that influence crop yields. Robust standard errors are clustered at the EA level to account for potential serial correlation between drought episodes.

The effect of drought on crop yields is captured by the parameter β_1 (current drought) and β_3 (past drought). We expect both parameters to be negative. $\beta_2 \times Poly_j$ and $\beta_4 \times Poly_j$ represent the effect of past and present droughts, respectively, on crop yields in polygynous communes. The overall effect of drought on crop yields in polygynous communes depends on the prevalence of polygyny. Conditional on household wealth and EA and year fixed effects, this overall effect is equal to $\beta_1 + \beta_2 \times Poly_j$ for present drought and $\beta_3 + \beta_4 \times Poly_j$ for past drought. Therefore, when:

$$\beta_2 < 0 \quad (\text{or} \quad \beta_4 < 0); \text{ polygyny enhances resilience,} \tag{3}$$

$$\beta_2 = 0 \quad (\text{or} \quad \beta_4 = 0); \text{ polygyny has no effect,} \tag{4}$$

$$\beta_2 > 0 \quad (\text{or} \quad \beta_4 > 0); \text{ polygyny undermines resilience.} \tag{5}$$

The sign of β_2 or β_4 cannot be determined theoretically. For example, in the face of a challenging drought, polygynous women can increase their cooperation and lead to the scenario in equation 3 (Akresh et al., 2012). Alternatively, the scarcity of financial resources (following a drought) could increase stress and conflict within polygynous households and lead to the scenario in equation 5. Finally, these two effects could work in opposite directions and lead to a zero effect of polygyny (scenario equation 4).

Following Heath et al. (2020), we also specify an alternative empirical model similar to the baseline model, except for the addition of the interaction of polygyny with each control variable, to account for the fact that the effect of polygyny may differ with respect to basic household characteristics. The underlying regression equation is written as follows:

$$\begin{aligned} Q_{hijt} =& \beta_1 Drougth_{it} + \beta_2 Drougth_{it} \times Poly_j + \beta_3 Drougth_{it-1} \\ &+ \beta_4 Drougth_{it-1} \times Poly_j + \beta_5 X_{hijt} \times Poly_j + \eta_t + \lambda_i + \epsilon_{hijt} \end{aligned} \tag{6}$$

Identification Assumption

The key identifying assumption of the analysis is that, within a given EA and year, our drought variables are orthogonal to potential confounders. Each EA has equal chance of experiencing a drought episode. We account for potential serial correlation of droughts within an EA by clustering standard errors at the EA level.

The main concern regarding our identification strategy is that polygyny may be endogenous. Communes with a high proportion of polygynous households may have different characteristics (geographic, cultural, etc.) than less polygynous communes. This could affect crop yields. For example, if the majority of polygynous communes are located in fertile areas, households living in these areas will tend to have higher crop yields than households living in less polygynous communes. We could (wrongly) attribute the yield differential as the impact of polygyny. We address this potential threat to identification using EA fixed effects. These EA-level fixed effects, capture average differences in geographic, economic, and cultural factors that do not vary over time. Over a short period of time like that denoted by our data set (2014 and 2017), we can reasonably assume that the prevalence of polygyny in a commune is not affected by omitted time-variant variables.

Spatial Correlation

A serious problem confronting our identification is the potential presence of spatial correlation in the error term, due to the tendency of both droughts and polygyny to be clustered in space. Although droughts can happen randomly over time, they often tend to be clustered across neighboring geographic units (Hsiang et al., 2011). Likewise, polygyny, as a cultural practice, is often clustered in geographic units that share similar livelihoods and cultural values (Lawson et al., 2015). To account for this problem, we adjust the standard errors using the method developped by Conley (1999) and Hsiang et al. (2011). In particular, we correct standard errors by allowing for both spatial correlation across the EAs within a radius of 52 km (the median distance across EAs) and infinite serial correlation.

Furthermore, there is the potential presence of spatial correlation due to omitted weather variables (Auffhammer et al., 2013). To account for this problem, we construct a measure of drought during the agricultural season, using the Standardized Precipitation-Evapotranspiration Index (Vicente-Serrano et al., 2010; Miao and Popp, 2014; Harari and Ferrara, 2018).

5 Results

In this section, we present and discuss the results of the estimation of our various regression specifications. We also discuss the results of our robustness tests and mechanisms.

5.1 Baseline Estimation Results

The results of our basic model are reported in Table 3. Column 1 of Table 3 reports the results of our first specification (equation 2) and column 2 reports the results of the second specification (equation 6). Drought negatively affects crop yields in rural Mali. This is consistent with the fact agriculture is predominantly rainfed in rural Mali. The coefficients of interests are negative and statistically significant for both specifications. Column 1 indicates that drought occurring in the current agricultural season (t) reduces yields by 34.42%, while drought that occurred during the previous agricultural season ($t-1$) reduces current season crop yields by 27.88%. These results are robust to the second specification, as shown in column 2, where current and previous droughts reduce crop yields by 29.02% and 17.29%, respectively. In both cases, the relatively large magnitude of the effect of lagged drought indicates that affected communities are unable to fully recover from the adverse effects of past droughts, due to a breakdown of community-based risk-sharing mechanisms (Kazianga and Udry, 2006; Fafchamps and Gubert, 2007).

Table 3 also shows that the interaction variable between current drought and polygyny has no effect on crop yields, implying that polygyny has no buffering effect on current drought. On the other hand, the coefficient of the interaction with past drought is positive and statistically significant. In other words, in communes that experienced drought episodes during the previous year (year $t-1$), when polygyny increases by one standard deviation, crop yields in the current year (year t) increase by 33.20% and 26.38%, respectively for our first and second specifications. The overall effect of drought in $t-1$ is thus reduced and even compensated for in highly polygynous communities. These results indicate that polygyny enhances resilience to the adverse effects of past droughts. They are consistent with the literature (Akresh et al., 2012; Damon and McCarthy, 2019), suggesting that polygyny increases crop yields.

That drought in $t-1$ indirectly affects crop yields in the current year stems from the fact that, after drought episodes, dry soils are no longer able to absorb rainfall properly, as a result of moisture loss. In addition, dry soils prevent the transport of nutrients to the roots and their diffusion into the plants (Munroe et al., 2006). In contrast, drought in t directly affects crop yields through the availability of water essential for crop growth. Our analysis indicates that polygyny cannot buffer this direct effect of current drought on crop yields. It only enhances resilience to the devastating effects of past droughts.

Finally, our results are unaffected when we account for spatial correlation across the EAs (see column 3).

5.2 Heterogeneous Effect by Crop Type

We have just shown that polygyny enhances crop yields' resilience in the aftermath of drought, thereby enhancing polygynous communities' ability to recover from its devastating effects. This resilience-enhancing effect of polygyny could be driven by endogenous planting decisions. First, since polygynous communes have a larger workforce, they may decide to diversify into more labor-intensive crops, if these crops are more resilient to droughts. To verify this, we divide our sample by crop type: care-intensive crops and care-saving crops. In contrast to care-saving crops, care-intensive crops are labor-intensive crops that require significant care during the cycle. We use the classification of care-intensive crops and care-saving crops from Guirkinger et al. (2015). In other words, we consider rice, cotton, maize, and vegetables to be in the category of care-intensive crops. In contrast, we consider sorghum, millet, fonio, and niebe to be in the category of care-saving crops.

Crops such as sorghum, millet, fonio, and niebe are traditional crops localized in the Sahel region including Mali, whereas cotton, rice and maize are cultivated in many other geographic areas throughout the world, including in developed countries where drought-resistant varieties have been developed (Tirado and Cotter, 2010). Availability of drought-resistant seeds for cotton, rice and maize in the international market can enhance the adaptation of rural households in the Sahel region where droughts are a recurrent phenomenon. What is more, there is also evidence in Sub-Saharan Africa, that inter-cropping maize with a legume tree— small tree, shrub or undershrub — helps soil hold water longer than in maize monocultures (Makumba et al., 2006). Such inter-cropping also yields a double dividend, particularly for agricultural households engaged in animal husbandry, as legume trees are an important component of the fodder resources for livestock. According to the Food and Agriculture Organization (FAO), the fodder value of their leaves and fruits is very high. For example, in arid and semi-arid zones, such as the Sahel, they provide the largest part of the protein supply during the driest months (Devendra, 1992). The above-mentioned facts suggest that for Mali's farmers, switching to care-intensive crops such as cotton, maize and rice may be an effective adaptation strategy to recurrent droughts in the country.

Table 4 reports the results of our estimations. Column 1 reports the estimation results for care-intensive crops and column 2 those of care-saving crops. It can be seen from Table 4 that the resilience-enhancing effect of polygyny is entirely driven by the care-intensive crops. The coefficient of drought interaction in $t-1$ is positive and statistically significant for care-intensive crops and is not significant for care-saving crops.

5.3 Robustness Test

In this subsection, we demonstrate that our findings are robust to various alternative specifications of our outcome variable and covariates of interest.

(i) Yield is measured at the EA level

Recall that in our baseline specification, the unit of observation is the household. Here, we change the unit of observation of our crop yields variable to be aggregated at the EA level. Using the model specified in equation (2) and controlling for year and EA fixed effects, we obtain the results reported in Table 5. These results are nearly identical to those reported in Table 3, but the effects are slightly larger. Further, the negative effect of drought in t and the positive effect of the interaction between drought in $t-1$ and polygyny are statistically significant at the 10% level. As in Table 3 (columns 2 and 3), the effect of the interaction between drought in $t-1$ and polygyny is positive, indicating a resilience of polygynous communities to the adverse effects of past droughts.

(ii) Alternative Measure of Polygyny

Here, we use an alternative definition of polygyny based on geographical considerations. In Mali, polygyny is more prevalent in the Kayes and Sikasso regions, where 37.2% and 37.5% of men are polygynous respectively (Census, 2009). We use these regional differences to construct our polygyny variable. The variable takes the value 1 if the household resides in the Kayes or Sikasso region and 0 otherwise. The region is not entirely exogenous; for example, an individual might decide to migrate to a particular region because that region is more open to polygyny. Our data indicate that internal migration seems to be a rare event in rural Mali. Indeed, only 0.349% of heads of households migrate within the country. Therefore, the choice of region can be considered as determined at the time of birth. We specify the model in equation (2), always controlling for the year and EA fixed effects.

Table 6 reports the results of our estimations. These results are nearly identical to those reported in Table 3. The negative effect of drought in t is less important and is significant at a level of 10%. Finally, the effect of drought in $t-1$ and its interaction with polygyny is greater. These differences could be explained by the fact that the region is not a perfect indicator of polygyny, as other social factors such as the evolution of certain norms in the region could influence crop yields.

5.4 Mechanisms

Our results suggest that polygyny can reduce (or even reverse) the adverse effects of drought on crop yields a year after its occurrence. We find that the interaction between polygyny and drought in $t-1$ is positive and statistically significant. A logical question therefore arises: what mechanism underlies the resilience effect of polygyny?

The literature outlines a number of resilience strategies for farmers living in drought-prone agricultural communities. This includes the use of modern agricultural inputs (like drought-resistant seeds), diversification of crop production and of sources of income (including off-farm work and animal husbandry), and the use of hired labor (Schiere and Katere, 2001; Gitz et al., 2012). However, to leverage these resilience strategies requires that farming households have access to economic resources (e.g., access to credit, remittances, bride price, livestock sales, family labor). In this subsection we explore how polygyny can enable communities to use the above-mentioned resilience strategies.

We start by exploring theoretically the link between polygyny and the resilience strategies mentioned above. In a context of an imperfect rural labor market, family labor can become a major determinant of a household's capacity to recover from the adverse effect of drought. First, diversification of crop production or of income sources also may require a large family size to be an effective resilience strategy. Second, in a bride price community, households can time their daughters' marriages to cash by using the bride price as a source of investment (Corno et al., 2020). Therefore, households with many daughters are effective at using these resilience strategies. This is where polygyny can make a difference. As this marriage practice has been known to increase fertility (Tertilt, 2005; Rossi, 2019), it can become a household strategy for increasing its endowment of family labor as well as the number of daughters. Indeed, as shown in Table 2, polygynous households have roughly twice as many children as monogamous households. They also have nearly twice as many daughters aged $12-17$ as monogamous households. Additionally, they cultivate more crops than their monogamous counterparts, and also tend to use more improved seeds.

In this section, we test these different mechanisms, highlighting the interacting effect with polygyny.

5.4.1 Empirical Strategy

To test our hypotheses that polygyny induces an increase in livestock sales, access to credit, labor use, diversification of crop production, off-farm employment, animal husbandry, and child marriage during or after drought episodes, we specify the model in equation (2) by controlling for year and EA fixed effects for each outcome mentioned.

Our data on days worked by hired labor, off-farm work, and animal husbandry employment are left-censored as they have many zero values (around 35% for hired labor and 90% for off-farm and husbandry). If we ignore the censoring, the effect of our explanatory variables would be underestimated. Therefore, we use the semiparametric method for censored estimation developed by (Honoré, 1992), which, unlike typical maximum likelihood estimators for censored variables, accounts for fixed effects in a consistent way. We estimate the following censored model:

$$\begin{aligned} Q^*_{hijt} =& \beta_1 Drougth_{it} + \beta_2 Drougth_{it} \times Poly_j + \beta_3 Drougth_{it-1} \\ &+ \beta_4 Drougth_{it-1} \times Poly_j + \beta_5 X_{hijt} + \eta_t + \lambda_i + \epsilon_{hijt}, \end{aligned} \tag{7}$$

with $Q_{hijt} = max\{0, Q^*_{hijt}\}$, and where Q_{hijt} represents days worked by hired labor for household h, as well as days worked by household members in off-farm work, or in animal husbandry, Q^*_{hijt} represents their unobserved latent variables, and the explanatory variables are the same as in Equation 2.

Finally, to test the hypothesis that polygyny increases child marriage during or after the drought, we specify the following model:

$$\begin{aligned} M_{ghijt} =& 1[\beta_1 Drougth_{it} + \beta_2 Drougth_{it} \times Poly_j + \beta_3 Drougth_{it-1} + \beta_4 Drougth_{it-1} \times Poly_j \\ &+ \beta_5 Drougth_{it-2} + \beta_6 Drougth_{it-2} \times Poly_j + \lambda_g + \alpha_h + \eta_t + \epsilon_{ghijt} > 0], \end{aligned}$$

where M_{ghit} is a binary variable coded as 1 if a girl g born in cohort h living in EA i (located in commune j) entered her first marriage at age t and 0 otherwise. 1[.] is an indicator function equal to 1 if the inequality in brackets holds. $Drougth_{it}$, $Drougth_{it-1}$ and $Drougth_{it-2}$ are time-varying variables measuring the occurrence of drought at EA i in year t, $t-1$ and $t-2$; $Poly_j$ measures the prevalence of polygyny in commune j. λ_g, α_h and η_t are individual fixed effects, cohort fixed effects and year fixed effects respectively; ϵ_{ghijt} is a zero-mean error.

5.4.2 Estimation Results

The results of our different estimations are reported in Tables 7, 8, 9, and 10. We separate the estimation results of polygyny's effects on households' resilience strategies in three groups: (i) Crop resilience and diversification; (ii) Diversification of income sources; (iii) Child marriage.

(i) Drought-Resistant Crops and Diversification of Crop Production

Here we present the test results that polygynous communities are more able to leverage improved crop variety and diversification of crop production as a resilience strategy. By crop diversification, we mean adding new crops or cropping systems to agricultural production on a farm. In drought-prone regions, crop diversification is known to serve as an important climate risk management strategy. By diversifying, smallholder farmers increase the range of potential food and income sources available to them (Asfaw et al., 2019). We find that drought in the current year increases the probability of household access to credit by 6.86 percentage points when the prevalence of polygyny in the communes in which they live increases by one standard deviation (Table 7, columns (2)). We also find that drought that occurred the previous year increases the probability of livestock sales, access to credit, and use of improved seeds in the current year by 8.24, 13.07, 11.70 percentage points, respectively, when the prevalence of polygyny in the communes in which they live increases by one standard deviation. Furthermore, drought in the previous year also increases the number of crops grown and days worked per hectare by hired workers in the current year by 6.38% and 54.13%, respectively, when the prevalence of polygyny in the communes increases by one standard deviation. For days worked per hectare by hired workers, this effect rises to 58.60% when we use the censored regressor method.

All the above results are consistent with the resilience strategy based on the adoption of drought-resistant crop varieties and the diversification of crop production. Polygyny enhances the adoption of these resilience strategies through its long-term effect on the household workforce, allowing each family worker to specialize in a specific task.

(ii) Diversification of Income Sources

Diversification of income sources is also a well-documented resilience strategy in drought-prone rural regions Wan et al. (2016). By diversification of income sources, we mean the addition to household income from sources other than farm work. This includes not only households' simultaneous involvement in crop production, animal husbandry, and non-agricultural employment, but also remittances or other transfers linked to adjustment of household size over time.

We explore whether polygyny influences household ability to use these potential income diversification sources to build resilience to drought. The results of this empirical exercise are reported in Table 7. We find that drought in the current year increases days worked by family labor and the family's hired workers by 18.67 and 23.33 percentage points, respectively when the prevalence of polygyny in the communes in which they live increases by one standard deviation (Table 7, columns (5) and (6) respectively). Given the relatively high number of zero values for days worked by hired workers, we replicate the estimation presented in column (6) – which uses a linear probability model – by estimating Honoré (1992)'s method for censored data with fixed effects (column (7)). Unfortunately, we find that polygyny has no statistically significant effect on days worked by hired workers with this alternative method. In general, since drought induces crop failure during the year in which it occurs, the rise in family labor use in that year is likely an indicator of household participation in off-farm activities, including livestock herding.

Furthermore, when participation in off-farm work and animal husbandry are measured at the intensive margin, we find that droughts in the current and in the past year increase work in animal husbandry by 74.14 and 52.03 days, respectively among individuals aged $12-18$ (Table 9). If we consider that, for those households that reported a positive outcome, the average number of days in husbandry activities equals about 40 days a month at the household level, the above changes correspond to relative increases of 185% and 130%, respectively. However, we do not find any statistically significant polygyny effect on off-farm and husbandry employment when measured at the extensive margin (see Table 8).

To understand why the above effects are linked to polygyny, we highlight the importance of the relationship between risk management in rainfed-dependent rural communities and household size and composition, as documented in the literature. In risk-prone rural environments, the literature shows that there are considerable advantages to living in large domestic units. For example, Toulmin and Gueye (2003) find that, in the village of Kala in central Mali, larger households (averaging 24 people in size) were associated with higher levels of livestock wealth (cattle per person) and access to farm equipment (plow teams per person), as well as greater food security (harvest per person). In contrast, smaller families (averaging eight people) were much more vulnerable to risk and could not benefit from economies of scale in production, investment, and diversification of income source (Toulmin et al., 1992; Brock and Coulibaly, 1999). Indeed, in the context of imperfect rural labor markets, successful diversification of crop production and income sources hinges on household size, not just in terms of the number of people in the household workforce, but also in terms of its composition by age and gender (Toulmin and Gueye, 2003). A household whose relatively young labor force is well-balanced between the genders is considered much more sustainable than a few children or mainly girls or boys.

The above facts are consistent with descriptive statistics in the Mali sample, showing that polygynous households have nearly twice as many people as monogamous households, twice as many males aged $0-17$, and females aged $0-17$ (Table 2). They are also consistent with evidence showing that polygyny increases fertility (Tertilt, 2005; Rossi, 2019), which, over time, enables households to increase the size of the family workforce, and diversify their incomes and assets portfolio as a resilience strategy (Brock and Coulibaly, 1999).

(iii) Child Marriage

Finally, our estimation results show that developing mixed crop-livestock production systems and pursuing off-farm work are not the only income diversification strategies used by polygynous communities to respond to drought shocks. We find that polygynous households have more daughters, who they can marry off in exchange for bride price, as a resilience strategy to drought shocks. Our estimations show that two years after a drought shock, marriage among girls (aged $12-17$) increases by 0.51 percentage point when polygyny in the communes in which they live rises by one standard deviation (Table 10). This result is consistent with Corno et al. (2020) who find that drought increases child marriage in bride-price countries. As Mali is a bride-price country Corno et al. (2020), polygyny can enable households to have many daughters, whose marriage can become a source of income during hard times. Indeed, our sample's descriptive statistics show that polygynous households in Mali have nearly twice as many daughters aged $12 - 17$ as monogamous households (Table 2), putting girls in polygynous households at further risk of lower human capital and individual agency.

6 Conclusion

This paper extends the literature on risk coping in village economies by analyzing polygyny's resilience effect in the aftermath of a drought shock. We study the interacting effect of polygyny—a marriage practice known to undermine development outcomes—and drought episodes, both current and lagged, in the context of rural Mali—a drought-prone country located on the polygyny belt in the West African Sahel region. For identification, we rely on the plausibly exogenous spatial and temporal variation in drought occurrences across rural Mali communes, accounting for potential serial correlation in our drought indicator and many commune-level as well as time-variant household-level confounders. We use the Standardized Precipitation-Evapotranspiration Index (SPEI) to construct our drought indicator for the rainy season, enabling us to control for a potential spatial correlation of drought episodes due to possible omitted weather variables.

We link the identified resilience effect of polygyny to its positive impact on household fertility documented in the literature. Because polygyny raises fertility, it enables households in drought-prone rural communities to harness the size and composition of the family workforce to their resilience strategies in the context of imperfect rural labor markets. In that context, having a large family workforce, well-balanced in age and gender, enables households to leverage diversification of crop production and income sources as resilience strategies to the occurrence of drought shocks. Furthermore, in bride-price countries like Mali, polygyny also enables a household to have many daughters, whose marriage can be a source of income during hard times. In that sense, our study is the first to directly link polygyny to child marriage —a phenomenon known to curtail women's schooling (Field and Ambrus, 2008), undermine their reproductive health (Dupre and Meadows, 2007; de Groot et al., 2018), and increase child mortality (de Groot et al., 2018).

As its main takeaway, this study suggests that the high prevalence of polygyny along the Sahel belt in Sub-Saharan Africa may be a response to the scarcity of formal risk-management mechanisms and the breakdown of informal risk-sharing mechanisms in rural communities. These problems induce rural households to harness their size and composition to their resilience strategies against the common occurrence of droughts. Given that the literature links polygyny to the presence of underdevelopment factors, including high fertility rates and multidimensional poverty, public interventions aimed at eliminating it should promote the adoption of alternative risk-management mechanisms in these drought-prone communities along the polygyny belt in Sub-Saharan Africa. Failure to do so may entrench political opposition to enforcing a ban on polygyny and child marriage.

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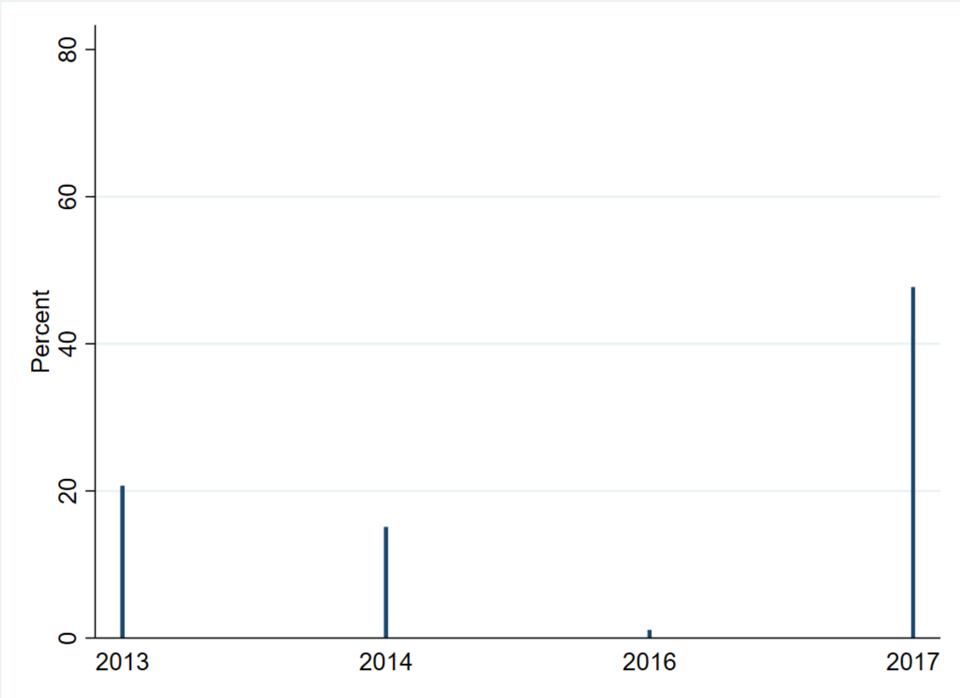
Figure 5: *Percentage of EA with drought experiences by year*



Source: Authors' elaboration from the SPEI Global Drought Monitor data (https://www.spei.csic.es)

Table 1: *Descriptive statistics*

	Full sample	Quartile of polygyny's prevalence			
		First quartile	Second quartile	Third quartile	Fourth quartile
	(1)	(2)	(3)	(4)	(5)
Yield (kg/ha)	1026.5138	1263.1724	925.9755	892.7635	1027.4660
	(28.9484)	(74.8853)	(52.4973)	(40.7850)	(55.5380)
Head's sex (=1 if is male)	0.9778	0.9655	0.9843	0.9826	0.9788
	(0.0031)	(0.0081)	(0.0039)	(0.0046)	(0.0073)
Head's education	0.0581	0.0416	0.0707	0.0567	0.0633
	(0.0054)	(0.0105)	(0.0105)	(0.0113)	(0.0101)
Household size	11.9860	9.7318	11.6352	13.0788	13.4769
	(0.2112)	(0.6624)	(0.3257)	(0.3760)	(0.3626)
Number of household	7,400	1,876	1,832	1,857	1,835

Source: Authors' elaboration based on EAC-I 2014/EAC-I 2017, rural areas. Standard errors in parentheses.
Notes: Yields are reported in thousands of kg per hectare.
Chemical inputs =1 if farm use fertilizer, herbicides and pesticides.
Head's education =1 if has at least 1 year of education

Table 2: *Descriptive statistics on mechanism's outcomes*

	Full	Monogamous	polygynous	T-test
	Mean (Std.dev.)	Mean (Std.dev.)	Mean (Std.dev.)	Difference (Std.dev.)
Farm size (hectares)	17.9048	16.7626	20.9807	4.2181***
	(42.1142)	(41.0640)	(45.1654)	(1.0681)
Plot size (hectares)	4.8847	4.7871	5.0523	0.2652
	(13.9986)	(13.9113)	(13.7255)	(0.3483)
Improved seed (0/1)	0.2637	0.2520	0.2900	0.0380***
	(0.4406)	(0.4342)	(0.4539)	(0.0111)
Access to credit (0/1)	0.1737	0.1741	0.1786	0.0045
	(0.3789)	(0.3792)	(0.3831)	(0.0096)
Sale of animals (0/1)	0.2409	0.2382	0.2478	0.0096
	(0.4277)	(0.4260)	(0.4318)	(0.0108)
Farm labor (days per ha per month)	39.1637	39.9525	36.6915	-3.2610***
	(45.9528)	(46.0013)	(44.6757)	(1.1524)
Household farm labor (days per ha per month)	33.6918	34.2769	32.2872	-1.9897*
	(41.0550)	(40.4447)	(41.5936)	(1.0269)
Hired farm labor (days per ha per month)	5.0132	5.4440	3.5088	-1.9352***
	(13.4650)	(14.1646)	(9.9746)	(0.3251)
Chemical inputs (0/1)	0.5357	0.5222	0.5814	0.0591***
	(0.4988)	(0.4996)	(0.4934)	(0.0125)
Number of plot	4.3980	4.0890	5.1457	1.0568***
	(3.0587)	(2.8620)	(3.3354)	(0.0761)
Number of crop	1.8666	1.7750	2.0654	0.2905***
	(1.0858)	(1.0203)	(1.1932)	(0.0272)
Livestock	4.8708	4.3695	6.1227	1.7531***
	(10.0604)	(10.6675)	(9.1177)	(0.2681)
Livestock donated	0.0131	0.0108	0.0187	0.0079**
	(0.1455)	(0.1527)	(0.1389)	(0.0039)
Livestock received	0.0078	0.0054	0.0127	0.0073*
	(0.1592)	(0.1558)	(0.1717)	(0.0043)
Number of children (age $\in [0, 17]$)	6.5849	5.4680	9.1043	3.6364***
	(5.0754)	(4.2429)	(5.7351)	(0.1163)
Number of males (age $\in [0, 17]$)	3.4883	2.9016	4.8242	1.9226***
	(2.9841)	(2.4880)	(3.4625)	(0.0691)
Number of females (age $\in [0, 17]$)	3.0965	2.5663	4.2801	1.7138***
	(2.7523)	(2.3752)	(3.1247)	(0.0643)
Number of males (age $\in [12, 17]$)	0.9046	0.7785	1.1925	0.4140***
	(1.1522)	(1.0682)	(1.2837)	(0.0278)
Number of females (age $\in [12, 17]$)	0.7376	0.5914	1.0564	0.4650***
	(1.0221)	(0.9000)	(1.1920)	(0.0244)
Moved (household head) (0/1)	0.0032	0.0030	0.0035	0.0005
	(0.0590)	(0.0548)	(0.0594)	(0.0020)
Remittances (Money or goods) (0/1)	0.1642	0.1635	0.1656	0.0021
	(0.3705)	(0.3699)	(0.3719)	(0.0133)
Number of hh members in off-farm employment	0.2154	0.1931	0.2662	0.0731***
	(1.0150)	(0.7144)	(1.4659)	(0.0249)
Number of hh members in husbandry activities	0.2080	0.1690	0.2898	0.1208***
	(1.0648)	(0.7729)	(1.5124)	(0.0261)
Number of days per month of work in off-farm activities	3.4657	2.9808	4.5327	1.5518**
	(24.7760)	(14.0804)	(38.8447)	(0.6097)
Number of days per month of work in husbandry	3.8958	2.8767	5.9545	3.0778***
	(24.8252)	(16.0093)	(37.1007)	(0.6075)
Number of household	7400	4621	2510	

Source: Authors' elaboration based on EAC-I 2014/EAC-I 2017, rural areas.
Notes: The livestock is expressed in livestock unit (Upton, 2011). Livestock units are used to aggregate the numbers of different categories of livestock. Conversion ratios are based on metabolizable energy requirements, with one unit being considered as the needs for maintenance and production of a typical dairy cow and calf .

Table 3: *The effect of drought on crop yields*

Log Yield	(1)	(2)	(3)
$Drought_t$	-0.3442***	-0.2902***	-0.3442***
	(0.0869)	(0.0847)	(0.1121)
$Drought_t \times Polygyny$	0.0534	0.1175	0.0534
	(0.0774)	(0.0772)	(0.0937)
$Drought_{t-1}$	-0.2788***	-0.1729*	-0.2788**
	(0.1009)	(0.0980)	(0.1227)
$Drought_{t-1} \times Polygyny$	0.3320***	0.2638**	0.3320**
	(0.1279)	(0.1066)	(0.1522)
$Test:$			
$Drought_{t-1} + Drought_{t-1} \times Polygyny = 0$	0.0531	0.0908	0.0531
	(0.1485)	(0.1334)	(0.1610)
Additional controls	Y	Y	Y
Additional controls ×*polygyny*	N	Y	N
Year FE	Y	Y	Y
EA FE	Y	Y	Y
Accounted for spatial correlation	N	N	Y
Number of household	7,324	7,324	7,324
R-squared	0.6095	0.6194	0.6095

Source: Authors' elaboration based on EAC-I 2014/EAC-I 2017, rural areas.

Notes: FE = fixed effects. Standard errors are clustered at the EA level. Y=yes; *** p<0.01, ** p<0.05, * p<0.1. Additional controls are : farm size; chemical inputs (=1 if farm use fertilizer, herbicides and pesticides); labor applied per ha (person- day of labor); head's education (=1 if has at least 1 year of education); head's sex; household size and quintile of household's wealth index. In column (3) we account for spatial correlation across the EAs within a radius of 52 km (the median distance across the EAs) by following Conley (1999).

Table 4: *The effect of drought on crop yields – care-saving crops vs. care-intensive crops*

Log Yield	care-saving crops (1)	care-intensive crops (2)
$Drought_t$	-0.1854*	-0.4402***
	(0.1025)	(0.1122)
$Drought_t \times Polygyny$	-0.0996	0.1460
	(0.1124)	(0.0970)
$Drought_{t-1}$	-0.2163**	-0.2593**
	(0.1095)	(0.1301)
$Drought_{t-1} \times Polygyny$	0.1846	0.3482**
	(0.1420)	(0.1583)
Additional controls	Y	Y
Year FE	Y	Y
EA FE	Y	Y
Observations	5,306	5,874
R-squared	0.5895	0.6292

Source: Authors' elaboration based on EAC-I 2014/EAC-I 2017, rural areas.

Notes: FE = fixed effects. Standard errors are clustered at the EA level. Y=yes; *** p<0.01, ** p<0.05, * p<0.1. Additional controls are : farm size; chemical inputs (=1 if farm use fertilizer, herbicides and pesticides); labor applied per ha (person-day of labor); head's education (=1 if has at least 1 year of education); head's sex; household size and quintile of household's wealth index.

Table 5: *Robustness test: effect of drought on crop yields (EA estimate)*

Dependent Variable	Log Yield
$Drought_t$	-0.4464***
	(0.1651)
$Drought_t \times Polygyny$	0.1083
	(0.1607)
$Drought_{t-1}$	-0.3382*
	(0.1878)
$Drought_{t-1} \times Polygyny$	0.3927*
	(0.2354)
Additional controls	Y
Year FE	Y
EA FE	Y
Number of EA	1,411
R-squared	0.7154

Source: Authors' elaboration based on EAC-I 2014/EAC-I 2017, rural areas.

Notes: FE = fixed effects. Standard errors are clustered at the EA level. Y=yes; *** p<0.01, ** p<0.05, * p<0.1. the schooling rate in EA; number of farm in EA and the logarithm of the average farm size in EA.

Table 6: *Robustness test: effect of drought on crop yields – region is a binary variable (0/1)*

Dependent Variable	Log Yield
$Drought_t$	-0.1716*
	(0.1035)
$Drought_t \times region$	-0.2079
	(0.1381)
$Drought_{t-1}$	-0.3968***
	(0.1248)
$Drought_{t-1} \times region$	0.4299**
	(0.1971)
Additional controls	Y
Year FE	Y
EA FE	Y
Number of household	7,324
R-squared	0.6106

Source: Authors' elaboration based on EAC-I 2014/EAC-I 2017, rural areas.

Notes: FE = fixed effects. Standard errors are clustered at the EA level. Y=yes; *** p<0.01, ** p<0.05, * p<0.1. Additional controls are : farm size; chemical inputs (=1 if farm use fertilizer, herbicides and pesticides); labor applied per ha (person- day of labor); head's education (=1 if has at least 1 year of education); head's sex; household size and quintile of household's wealth index.

Table 7: *Mechanism : effect of drought on farm inputs*

				farm labor (inverse hyperbolic sine transformation)							
	sale of animals (0/1)	access to credit (0/1)	improved seeds (0/1)	full	household	hired		chemical inputs (0/1)	farm size (ha)	log number of plot	log number of crops
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Drought$_t$	-0.1062**	-0.1446***	0.0790**	-0.4283***	-0.3900***	-0.3706***	-0.2169	-0.0126	0.1171	0.0146	-0.1238***
	(0.0423)	(0.0327)	(0.0392)	(0.1004)	(0.1141)	(0.1157)	(0.1770)	(0.0391)	(0.0766)	(0.0485)	(0.0366)
Drought$_t$ × *Polygyny*	0.0002	0.0686**	-0.0184	0.2750***	0.1867**	0.2333**	0.2025	-0.0321	-0.0425	0.0040	0.0480
	(0.0389)	(0.0296)	(0.0368)	(0.0844)	(0.0900)	(0.1025)	(0.1599)	(0.0379)	(0.0697)	(0.0404)	(0.0292)
Drought$_{t-1}$	0.1394***	0.1264***	0.0459	-0.0605	0.1117	-0.4072***	-0.4247**	0.0482	0.3335***	0.0084	0.0209
	(0.0434)	(0.0377)	(0.0448)	(0.1151)	(0.1269)	(0.1213)	(0.1724)	(0.0431)	(0.0861)	(0.0530)	(0.0393)
Drought$_{t-1}$ × *Polygyny*	0.0824*	0.1307**	0.1170**	0.3211**	0.1915	0.5413***	0.5860***	0.0127	-0.1476	-0.0209	0.0638*
	(0.0474)	(0.0628)	(0.0524)	(0.1268)	(0.1384)	(0.1303)	(0.1793)	(0.0412)	(0.0981)	(0.0496)	(0.0357)
Additional controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
EA FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Outcome mean	0.4070	0.0933	0.2554	3.8497	3.6792	1.2382	1.2382	0.4948	1.5645	1.2131	0.4784
Observations	7,324	7,324	7,324	7,324	7,355	7,355	7,324	7,324	7,324	7,324	7,324
R-squared	0.3392	0.3246	0.5919	0.6307	0.5691	0.5912		0.6444	0.8054	0.6357	0.4520

Source: Authors' elaboration based on EAC-I 2014/EAC-I 2017, rural areas.
Notes: FE = fixed effects. Standard errors are clustered at the EA level. Y=yes; *** p<0.01, ** p<0.05, * p<0.1. chemical inputs = 1 if household use chemical fertilizer, herbicides or pesticides. Labor is defined as the total number of days per month worked in the farm at the household level. 'Full" does not distinguish between household and hired labor. In all columns except (7) the linear probability model described by Eq. 2 is used; column (7) is estimated through the censored model presented in Eq. 7.

Table 8: *Mechanism: effect of drought on off-farm employment and animal husbandry*

	if at least one hh member works in off-farm (0/1)			if at least one hh member works in husbandry (0/1)		
	Full sample	age $\in [12, 18]$	age $\in]18, 60]$	Full sample	age $\in [12, 18]$	age $\in]18, 60]$
	(1)	(2)	(3)	(4)	(5)	(6)
$Drought_t$	-0.0100	-0.0078	-0.0101	0.0628***	0.0547***	0.0445**
	(0.0248)	(0.0193)	(0.0233)	(0.0234)	(0.0189)	(0.0209)
$Drought_t \times Polygyny$	0.0172	0.0174	0.0176	-0.0007	-0.0023	-0.0072
	(0.0247)	(0.0264)	(0.0186)	(0.0179)	(0.0150)	(0.0134)
$Drought_{t-1}$	-0.0035	-0.0208	-0.0011	0.0498*	0.0569**	0.0424*
	(0.0257)	(0.0178)	(0.0237)	(0.0281)	(0.0243)	(0.0253)
$Drought_{t-1} \times Polygyny$	0.0076	0.0098	0.0172	-0.0102	-0.0059	-0.0200
	(0.0295)	(0.0222)	(0.0254)	(0.0305)	(0.0285)	(0.0271)
Additional controls	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
EA FE	Y	Y	Y	Y	Y	Y
Outcome mean	0.0817	0.0269	0.0769	0.0677	0.0431	0.0492
Observations	7,304	5,610	7,295	7,304	5,610	7,295
R-squared	0.3637	0.2930	0.3590	0.2843	0.2868	0.2804

Source: Authors' elaboration based on EAC-I 2014/EAC-I 2017, rural areas.
Notes: FE = fixed effects. Standard errors are clustered at the EA level. Y=yes; *** p<0.01, ** p<0.05, * p<0.1. chemical inputs = 1 if household use fertilizer, herbicides and pesticides. Seed type = 1 if household use improved seed. Manual farming = 1 if household does not use mechanical tools in production.

Table 9: *Mechanism : effect of drought on days per month of work in off-farm activities and in animal husbandry*

	days of work in off-farm activities			days of work in animal husbandry		
	Full sample	age $\in [12, 18]$	age $\in]18, 60]$	Full sample	age $\in [12, 18]$	age $\in]18, 60]$
	(1)	(2)	(3)	(4)	(5)	(6)
$Drought_t$	-3.7784	-5.9264	-0.6584	70.6228**	66.8908*	51.5365
	(29.3644)	(31.9551)	(26.3486)	(33.7259)	(38.3430)	(39.1422)
$Drought_t \times Polygyny$	8.0971	-10.5634	15.6205	24.4658	74.1406**	-4.3832
	(17.0035)	(37.9962)	(13.5867)	(33.0896)	(33.6705)	(62.5348)
$Drought_{t-1}$	-38.2997	35.2977	-32.3902	-9.4131	12.9152	-27.1071
	(37.2807)	(55.9488)	(25.8511)	(43.0268)	(22.9363)	(46.0475)
$Drought_{t-1} \times Polygyny$	27.7050	46.4349	30.9725	40.5464	52.0398*	26.8343
	(65.2053)	(65.0194)	(32.5607)	(39.3252)	(26.8066)	(48.0734)
Additional controls	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
EA FE	Y	Y	Y	Y	Y	Y
Outcome mean (if outcome>0)	45.2865	32.2222	39.0796	60.4223	40.6428	52.0896
Observations	7,304	5,610	5,610	7,304	5,610	7,295

Source: Authors' elaboration based on EAC-I 2014/EAC-I 2017, rural areas.
Notes: FE = fixed effects. Y=yes; *** p<0.01, ** p<0.05, * p<0.1. chemical inputs = 1 if household use fertilizer, herbicides and pesticides. Seed type = 1 if household use improved seed. Manual farming = 1 if household does not use mechanical tools in production. All specifications are estimated with Honoré (1992)'s method.

Table 10: *The effect of drought on women's marriage (12-17 years)*

Dependent Variable	Marriage (0/1)
$Drought_t$	-0.0025
	(0.0029)
$Drought_t \times Polygyny$	0.0031
	(0.0038)
$Drought_{t-1}$	0.0018
	(0.0029)
$Drought_{t-1} \times Polygyny$	0.0035
	(0.0025)
$Drought_{t-2}$	0.0119***
	(0.0026)
$Drought_{t-2} \times Polygyny$	0.0051*
	(0.0028)
$Polygyny$	-0.0267
	(0.0231)
Birth year FE	Y
Age FE	Y
Individual FE	Y
Number of Individuals	130,677
R-squared	0.3530

Source: Authors' elaboration based on DHS 1995-96/2001/2006/2012-13, rural areas.

Notes: FE = fixed effects. Standard errors are clustered at the EA level. Y=yes; *** p<0.01, ** p<0.05, * p<0.1.