On the Origins of Gender Roles: Women and the Plough*

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Abstract: This paper seeks to better understand the historical origins of current differences in norms and beliefs about the appropriate role of women in society. We test the hypothesis that traditional agricultural practices influenced the historical gender division of labor and the evolution and persistence of gender norms. We find that, consistent with existing hypotheses, the descendants of societies that traditionally practiced plough agriculture, today have lower rates of female participation in the workplace, in politics, and in entrepreneurial activities, as well as a greater prevalence of attitudes favoring gender inequality. We identify the causal impact of traditional plough use by exploiting variation in the historical geo-climatic suitability of the environment for growing crops that differentially benefited from the adoption of the plough. Our IV estimates, based on this variation, support the findings from OLS. To isolate the importance of cultural transmission as a mechanism, we examine female labor force participation of second-generation immigrants living within the US.

Keywords: Culture, beliefs, values, gender roles.

JEL Classification: D03, J16, N30.

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1. Introduction

The gender division of labor varies significantly across societies. In some cultures women actively participate in employment outside of the home, while in others there is a clear specialization of tasks along gender lines: women tend to remain within the home and do not participate in activities outside of the domestic sphere. These differences are most clearly illustrated by the vast differences in female labor force participation (FLFP), which in 2000 ranged from 16.1% (Pakistan) to 90.5% (Burundi).[1]

Many determinants of these differences have been well-studied, including per capita income and the specialization of the economy in female-friendly industries (e.g., Goldin, 1995, Ross, 2008, Iversen and Rosenbluth, 2010). However, even controlling for these determinants there remain important time-invariant differences in gender roles.[2] A number of studies have provided evidence that these persistent differences may be explained by differences in cultural beliefs about the appropriate role of women in society (Fortin, 2005, Fernandez, 2007, Fernandez and Fogli, 2009, Borck, 2011). However, this then raises the natural question of the origins of these differences in norms and beliefs.

This study tests the hypothesis, originally put forth by Ester Boserup (1970), that gender role differences have their origins in different forms of agriculture practiced traditionally. In particular, Boserup identifies important differences between shifting cultivation and plough cultivation. Shifting cultivation, which uses hand-held tools like the hoe and the digging stick, is labor intensive and women actively participate in farm-work. Plough cultivation, by contrast, is much more capital intensive, using the plough to prepare the soil. Unlike the hoe or digging stick, the plough requires significant upper body strength, grip strength, and burst of power, which are needed to either pull the plough or control the animal that pulls it. Because of these requirements, when plough agriculture is practiced, men have an advantage in farming relative to women (Murdock and Provost, 1973).[3] Also reinforcing this gender-bias in ability is the fact that when the plough is used, there is less need for weeding, a task typically undertaken by women and children (Foster and Rosenzweig, 1996). In addition, child care, a task almost universally performed by women, is most compatible with activities that can be stopped and resumed easily and do not

[1] Data are from the World Bank's *World Development Indicators*.

[2] In Section 4, we provide evidence that these difference have persisted for centuries.

[3] See Pitt, Rosenzweig and Hassan (2010) for evidence from Bangladesh and the USA on the very different distributions of grip strength for men and women.

put children in danger. These are characteristics that are satisfied for hoe agriculture, but not for plough agriculture, particularly since large animals are typically used to pull the plough.

The result, according to Boserup, is that societies that traditionally practiced plough agriculture – rather than shifting cultivation – developed a specialization of production along gender lines. Men tended to work outside of the home in the fields, while women specialized in activities within the home.[4] This division of labor then generated norms about the appropriate role of women in society. Societies characterized by plough agriculture, and a resulting gender-based division of labor, developed the belief that the natural place for women is within the home. These cultural beliefs tend to persist even if the economy moves out of agriculture, affecting the participation of women on activities performed outside of the home, such as market employment, entrepreneurship, or participation in politics.[5]

To test Boserup's hypothesis, we combine pre-industrial ethnographic data, reporting whether societies traditionally used plough agriculture, with contemporary measures of individuals' views about gender roles, as well as measures of female participation in activities outside of the home. Our analysis examines variation across countries, ethnic groups, and individuals. Consistent with Boserup's hypothesis, we find a strong and robust negative relationship between historical plough-use and unequal gender roles today. Traditional plough-use is positively correlated with attitudes reflecting gender inequality and negatively correlated with female labor force participation, female firm ownership, and female participation in politics.

Although these findings support Boserup's hypothesis, they are also consistent with other interpretations. For example, we would observe the same relationships if societies with attitudes favoring gender inequality were more likely to adopt the plough historically and if these attitudes continue to persist today. To better understand whether past plough use did have a causal impact on subsequent cultural norms, we instrument historical plough-use using specific geo-climatic

[4]Prior to Boserup, anthropologists and ethnographers had recognized a relationship between traditional gender roles and the use of the hoe (e.g., Baumann, 1928). However, we focus our discussion here on Boserup's analysis since she was the first to argue for the importance of agricultural technology on the subsequent evolution of norms and values, and their importance for the development process.

[5]Boserup (1970), in her analysis, most strongly argues for a relationship between traditional plough use and gender norms when she hypothesizes that the use of the veil may be associated with the use of the plough in agriculture. She writes that plough cultivation "shows a predominantly male labor force. The land is prepared for sowing by men using draught animals, and this... leaves little need for weeding the crop, which is usually the women's task... Because village women work less in agriculture, a considerable fraction of them are completely freed from farm work. Sometimes such women perform purely domestic duties, living in seclusion within their own homes only appearing in the street wearing a veil, a phenomenon associated with plough culture and seemingly unknown in regions of shifting cultivation where women do most of the agricultural toil." (pp. 13–14)

conditions of a society's historical location which affected the relative benefits of adopting the plough. As Pryor (1985) shows, the benefit of the plough depends on the crop being cultivated. The plough is more beneficial for crops that require large tracts of land to be prepared in a short period of time (e.g., due to multiple-cropping), and can only be grown in soils that are not shallow, sloped, or rocky.[6] These crops, which Pryor refers to as 'plough-positive', include teff, wheat, barley, rye and wet rice. These can be contrasted to 'plough-negative' crops, such as maize, sorghum, millet and various types of root and tree crops, which require less land to be prepared over a longer period of time, and/or can be cultivated on thin, sloped or rocky soils, where using the plough is difficult. Unlike plough-positive crops, plough-negative crops benefit much less from the adoption of the plough.

Using data from the FAO, we identify the geo-climatic suitability of finely defined locations for growing plough-positive cereals (wheat, barley and rye) and plough-negative cereals (sorghum and millet). We then use the relative differences in ethnic groups' geo-climatic conditions for growing plough-positive and plough-negative cereals as instruments for historical plough use. We find that the IV estimates provide results consistent with the OLS estimates. Traditional plough use is associated with attitudes of gender inequality, as well as less female labor force participation, female firm-ownership, and female participation in politics.

Our analysis then considers potential underlying mechanisms. It is possible that the long-term effect of the plough reflects persistent cultural beliefs. However, it is also possible that part of the long-term impact arises because historical plough-use promoted the development of institutions, policies and markets that are less conducive to the participation of women in activities outside of the home.[7] To distinguish these two channels we exploit the fact that cultural norms and beliefs – unlike institutions, policies and markets – are internal to the individual. Therefore, when individuals move, their beliefs and values move with them, but their external environment remains behind. Exploiting this fact, we examine variation in cultural heritage among second-generation immigrants living in the US. All individuals born and raised in the US have been exposed to the same institutions and markets. In effect, the analysis holds external factors constant, while

[6]For a recent study documenting the link between soil type and plough-use in modern India see Carranza (2010). In particular, she shows that in contemporary India plough technology is more likely to be adopted with deep loamy soils rather than shallow clay soils. She also shows that plough use is associated with less participation of women in agriculture.

[7]See the recent studies by Alesina, Algan, Cahuc and Giuliano (2010), Guiso, Sapienza and Zingales (2008b) and Tabellini (2008) that investigate feedback effects between culture and institutions.

examining variation in individuals' internal beliefs and values. We find that women from cultures that historically used the plough have lower rates of labor force participation in the US. This provides evidence that part of the importance of the plough arises through its impact on internal beliefs and values.

Our focus on a historical determinant of gender roles is not meant to imply that other factors, particularly factors that can change significantly over time, are unimportant. A number of existing studies have examined other important determinants, including economic development, medical progress, and the production structure of the economy (e.g., Iversen and Rosenbluth, 2010, Goldin, 2006, Ross, 2008, and Albanesi and Olivetti, 2007, 2009). As we show in section 4, even accounting for these important factors, there remains a strong persistent impact of the plough on gender norms today.

Our analysis complements a number of descriptive studies from history, anthropology and sociology that also examine the long-term impacts of traditional plough use on gender norms (Goody, 1976, Whyte, 1978 and Braudel, 1998). A particularly interesting example is Fernand Braudel's (1998) description of how gender relations, culture, and society were impacted by the adoption of the plough in Mesopotamia between 4,000 and 6,000 BC. He writes: "Until now, women had been in charge of the fields and gardens where cereals were grown: everything had depended on their tilling the soil and tending the crop. Men had been first hunters, then herdsmen. But now men took over the plough, which they alone were allowed to use. At a stroke, it might seem that the society would move from being matriarchal to patriarchal: that there would be a shift away from the reign of the all-powerful mother goddesses... and towards the male gods and priests who were predominant in Sumer and Babylon... and was accompanied with a move towards male domination of society and its beliefs" (p. 71).

Our results also add to a recent line of research that has emphasized the relevance of cultural norms and beliefs as important factors underlying the persistent differences in gender roles across societies (Alesina and Giuliano, 2010, Fernandez, 2007, Fernandez and Fogli, 2009, and Fortin, 2005, 2009). Although the link between gender norms and female labor force participation is well-established, little is known about the origin of these cultural differences. Our findings suggest that an important determinant of these differences can be found in traditional farming practices. More generally, our findings provide additional evidence showing that historical factors can shape the evolution and persistence of norms and beliefs. Thus, they contribute to an emerging literature

that examines the historical determinants of various cultural characteristics today (e.g., Guiso, Sapienza and Zingales, 2008a, Grosjean, 2010a,b, Becker, Boeckh, Hainz and Woessman, 2010, Nunn and Wantchekon, 2011).

In the next section, we begin our analysis by first documenting that in societies that traditionally used plough agriculture women did in fact participate less in farm-work and other activities outside of the domestic sphere. In section 3, we then explain the procedure used to link the historical use of the plough, which is measured at the ethnicity level, to contemporary data on gender norms or female labor force participation, measured either at the country or individual level. Sections 4 and 5 report OLS and IV estimates of the relationship between traditional plough use and gender outcomes today, examining variation across individuals and countries. In section 6, we then turn to mechanisms, using second-generation US immigrants to test for persistent impacts of the plough through cultural transmission. Section 7 offers concluding thoughts.

2. The historical impacts of traditional plough use

We begin our analysis by first confirming that societies that traditionally used plough agriculture had lower female participation in agricultural activities. We also check whether plough use was associated with differences in other activities within and outside of the domestic sphere.

Our analysis relies on information on pre-industrial plough use taken from the *Ethnographic Atlas*, a world wide ethnicity-level database constructed by George Peter Murdock that contains ethnographic information for 1,267 ethnic groups around the world. Information for societies in the sample have been coded for the earliest period for which satisfactory ethnographic data are available or can be reconstructed. The earliest observation dates are for groups in the Old World where early written evidence is available. For the parts of the world without a written history the information is from the earliest observers of these cultures. For some cultures the first recorded information is from the early 20th century. However, even for these observations, the data should capture, to the maximum extent possible, the characteristics of the ethnic group prior to European contact. For all groups in the dataset, the variables are taken from the societies prior to industrialization.

The database contains a measure of the historical use of plough agriculture. Groups are classified into one of three mutually exclusive categories: (*i*) the plough was absent, (*ii*) the plough existed at the time the group was observed but it was not aboriginal, and (*iii*) the plough

was aboriginal and found in the society prior to contact. There are data on plough use for 1,158 of the 1,267 societies in the database. There is no evidence of groups switching from one form of agriculture to another and then back again. In other words, the use of the plough, once adopted, remains stable over time. Using the categorization, we construct an indicator variable for plough use which equals one if the plough was present (whether aboriginal or not) and zero otherwise.

It is possible that the plough has a larger impact on gender norms if it was adopted early. However, because of data limitation, we are unable to test for this. From the database we only know the rough date of adoption if it occurred after European contact. For other plough users we do not have any information on the timing of adoption. Given this, our estimates should be interpreted as the average effect of having adopted the plough among all ethnic groups that did so prior to industrialization. There may be heterogeneity within the group of adopters (e.g. based on date of adoption), but we are only able to estimate an average effect.

We measure traditional female participation in agriculture using information on the gender division of labor in agriculture reported in the *Ethnographic Atlas*. Ethnicities are grouped into one of the following five categories measuring gendered participation in agriculture: (1) males only, (2) males appreciably more, (3) equal participation, (4) female appreciably more, and (5) females only.[8] Using this information, we construct a variable that takes on integer values ranging from 1 to 5 and is increasing in female specialization in agriculture.[9]

When examining the relationship between the gender division of labor in agriculture and plough use, we are careful to control for a number of characteristics of ethnic groups which may be correlated with plough use and gender roles. We control for the presence of large domesticated animals, a measure of economic development, and a measure of political complexity. All measures are from the *Ethnographic Atlas*.[10] The presence of domesticated animals is measured with an indicator variable that equals one if domesticated bovine or equine animals were present. Economic development is measured using the density of ethnic groups' settlements. Ethnicities are grouped into the following categories: (1) nomadic or fully migratory, (2) semi-nomadic, (3) semi-sedentary, (4) compact but not permanent settlements, neighborhoods of dispersed family

[8]The original classification in the *Ethnographic Atlas* distinguishes between "differentiated but equal participation" and "equal participation". Since this distinction is not relevant for our purposes, we combine the two categories into a single category of equal participation.

[9]For 232 ethnic groups agriculture was not practiced and therefore there is no measure of female participation in agriculture. For an additional 315 ethnic groups information for the variable is missing. These ethnic groups (547 in total) are omitted from the analysis.

[10]Full details are provided in the paper's appendix.

homesteads, (5) separate hamlets, (6) forming a single community, (7) compact and relatively permanent settlements and (8) complex settlements. With this information, we construct a variable that takes on integer values, ranging from 1 to 8, and is increasing in settlement density. Political complexity is measured by the number of levels of jurisdictional hierarchies in the society.

We also control for two measures of the geographic conditions of ethnic groups. For each ethnicity we know the geographic coordinates of the centroid of the group. Using this information, we calculate the fraction of land within a 200 kilometer radius of the centroid that is defined as suitable for the cultivation of crops. The crop suitability data are from the FAO's *Global Agro-Ecological Zones* (GAEZ) 2002 database (Fischer, van Nelthuizen, Shah and Nachtergaele, 2002), which reports suitability measures for 5 arc minute by 5 arc minute (approximately 56 km by 56 km) grid-cells globally. The suitability of the environment for agriculture is potentially correlated with the use of the plough and may independently affect the gender division of labor. We also use the same procedure to control for the proportion of land within the 200 kilometer radius that is defined as being tropical or subtropical.

OLS estimates examining the impact of the historical plough use on past female participation in agriculture are reported in column 1 of Table 1. The specification includes the five controls variables. The estimates identify a negative relationship between plough use and participation of women in agriculture. The use of the plough is associated with a reduction in the female participation in agriculture variable of 0.86, which is large given that the standard deviation of the variable is 1.0.

A natural question that arises is the exact nature of this decline in female participation in agriculture; specifically, whether the decline is in all agricultural tasks or is it focused on only a few. Unfortunately, the *Ethnographic Atlas* does not provide similar information for specific tasks within agriculture. We therefore complement our analysis by using Murdock and White's (1969) *Standard Cross-Cultural Sample* (SCCS) which does contain this information. The SCCS contains ethnographic information on 186 societies, intentionally chosen to be representative of the full sample and for each ethnicity to be historically and culturally independent from the other ethnic groups in the sample. The database was constructed by first grouping the 1267 societies from the *Ethnographic Atlas* into 186 clusters of closely related cultures. A particularly well-documented and representative ethnic group was then chosen for each cluster and these constitute the observations in the SCCS.

Table 1: Historical plough use and female participation in agriculture and other activities.

	Panel A. Dependent variables: Female participation in the following (agriculture-related) tasks:						
	Participation in agriculture	Land clearance	Soil preparation	Planting	Crop tending	Harvesting	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Historical plough use	-0.861***	-1.133***	-0.414**	-1.164***	-1.244***	-1.033***	-0.770**
	(0.217)	(0.272)	(0.200)	(0.355)	(0.341)	(0.367)	(0.308)
Ethnographic controls	yes	yes	yes	yes	yes	yes	yes
Observations	660	124	129	124	131	122	131
R-squared	0.14	0.22	0.15	0.13	0.13	0.19	0.19
	Panel B. Dependent variables: Female participation in the following (additional) tasks:						
	Caring for small animals	Caring for large animals	Milking	Cooking	Fuel gathering	Water fetching	Burden carrying
	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Historical plough use	0.296	0.173	0.318	-0.006	-0.813*	-0.166	-1.138***
	(0.574)	(0.285)	(0.736)	(0.128)	(0.420)	(0.246)	(0.374)
Ethnographic controls	yes	yes	yes	yes	yes	yes	yes
Observations	88	95	48	173	159	154	135
R-squared	0.04	0.05	0.09	0.04	0.05	0.05	0.16

Notes: The unit of observation is ethnic group. In column 1 ethnic groups are from the *Ethnographic Atlas* and in columns 2-14 they are from the *Standard Cross Cultural Sample*. Each dependent variable measures female participation in a particular activity (e.g., agriculture). The variables take on integer values between 1 and 5 and are increasing in female participation. Coefficients are reported with robust standard errors in brackets. In column 1, we report Conley standard errors adjusted for spatial correlation (assuming a window that is sixty degrees latitude and sixty degrees longitude). ***, ** and * indicate significance at the 1, 5 and 10% levels.

Using the SCCS data, we first replicate the regression reported in column 1 that uses the *Ethnographic Atlas* data. As shown in column 2, we find similar results. Plough use is associated with a decline in female participation in agriculture of 1.13, which is equal to a one standard deviation change in the dependent variable. In columns 3–7, we estimate the association between plough use and female participation in the following agricultural tasks: land clearance, soil preparation, planting, crop tending and harvesting. The estimates show that plough use is associated with less female participation in all agricultural tasks, with the largest declines in soil preparation, planting and crop tending.

In columns 8–14, reported in panel B of Table 1, we consider the relationship between plough use and female participation in non-agricultural activities: care of small and large animals, milking, cooking, fuel gathering, water fetching and burden carrying.[11] We find that the plough is associated with less female participation in fuel gathering, water fetching, and burden carrying (although the coefficient for water fetching is small and not statistically different from zero). We do not find evidence that the plough is associated with a statistically significant increase in the

[11]If an activity is not present in a society, then the dependent variable is coded as missing. This accounts for the varying number of missing observations in each regression.

other activities: caring for large or small animals, milking or cooking. For these activities, with the exception of cooking, the estimated coefficients are positive, but insignificant.

Overall, the ethnographic evidence confirms that women participated less in farm activities in societies that historically practiced plough agriculture. This is consistent with the analysis of Boserup (1970), as well as the observations of anthropologists like Baumann (1928) and Whyte (1978). There is some evidence that the reduced participation coincided with an increase in some activities like milking. However, the increases are not statistically significant.

3. Linking the past to the present: Data and methodology

We next turn to an examination of the long-term impact of historical plough use. To do this, we link historical plough-use, measured at the ethnicity level, with current outcomes of interest, measured at the location-level (either countries or districts within countries) today. This requires an estimate of the geographic distribution of ethnicities across the globe today. We construct this information using the 15th edition of the *Ethnologue: Languages of the World* (Gordon, 2005), a data source that maps the current geographic distribution of 7,612 different languages, each of which we manually matched to one of the 1,267 ethnic groups from the *Ethnographic Atlas*. The *Ethnologue* provides a shape file that divides the world's land into polygons, with each polygon indicating the location of a specific language. We also use the *Landscan 2000* database, which reports estimates of the world's population for 30 arc-second by 30 arc-second (roughly 1 km by 1 km) grid-cells globally.[12] We combine the Ethnologue shape file with the Landscan raster file to obtain an estimate of the global distribution of language groups across the globe today. This information is used to link the historical ethnicity-level data to our current outcomes of interest, measured at the location-level.

We illustrate our procedure with the example of Ethiopia. Figure 1a shows a map of the land inhabited by different ethnic groups, i.e. groups speaking different languages. Each polygon represents the approximate borders of a group (from *Ethnologue*). One should not think of the borders as precisely defined boundaries, but rather as rough measures indicating the approximate locations of different language groups. The map also shows the *Landscan* estimate of the population of each cell within the country. A darker shade indicates greater population.

[12]The *Landscan 2000* database was produced by Oakridge Laboratories in cooperation with the US Government and NASA.

From the *Ethnographic Atlas* we know whether each ethnic group used the plough. We define I_e^{plough} to be a variable equal to one if ethnic group e used plough agriculture and zero otherwise. We first match each of the 7,612 Ethnologue language groups to one of the 1,267 Ethnographic Atlas ethnic groups for which we have traditional plough-use information. After the matching procedure, we know for each language group whether their ancestors engaged in plough agriculture. This information is shown in Figure 1b.

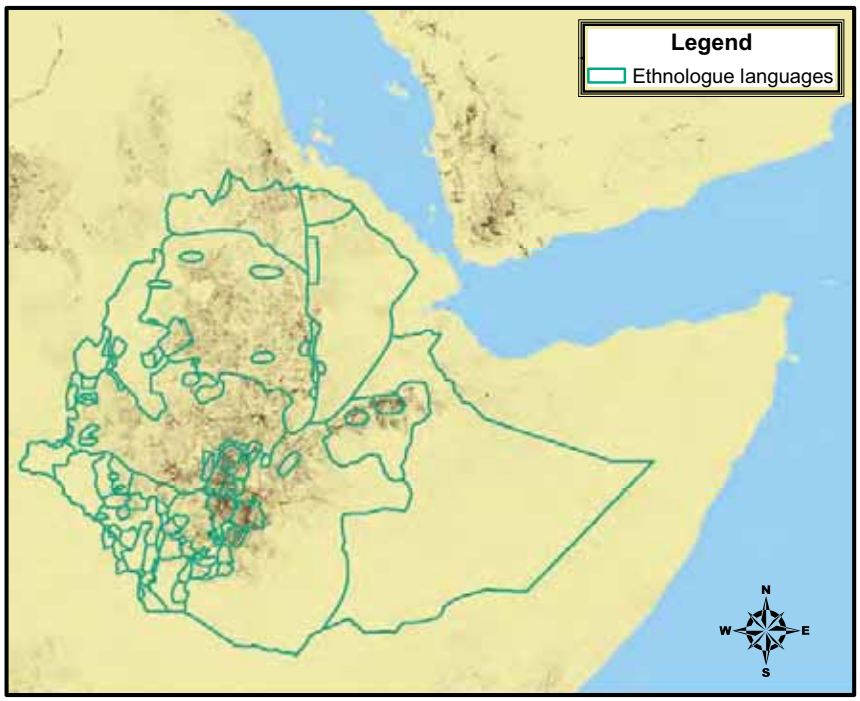
We then use information on the location of modern district and country boundaries to construct district-level and country-level averages of the historical plough measure. The procedure is shown visually for the district-level averages in Figures 2a and 2b. Intuitively, the procedure creates a population-weighted average plough measure for all grid-cells within a district (or country). This provides an estimate of the fraction of the population currently living in a district (or country) with ancestors that traditionally engaged in plough agriculture.

To be more precise, let $N_{e,i,d,c}$ denote the number of individuals of ethnicity e living in grid-cell i located in district d in country c. We then construct a population-weighted average of I_e^{plough} for all ethnic groups living in a district d. The district-level measure of the fraction of the population with ancestors that traditionally used the plough, $\text{Plough}_{d,c}$, is given by:

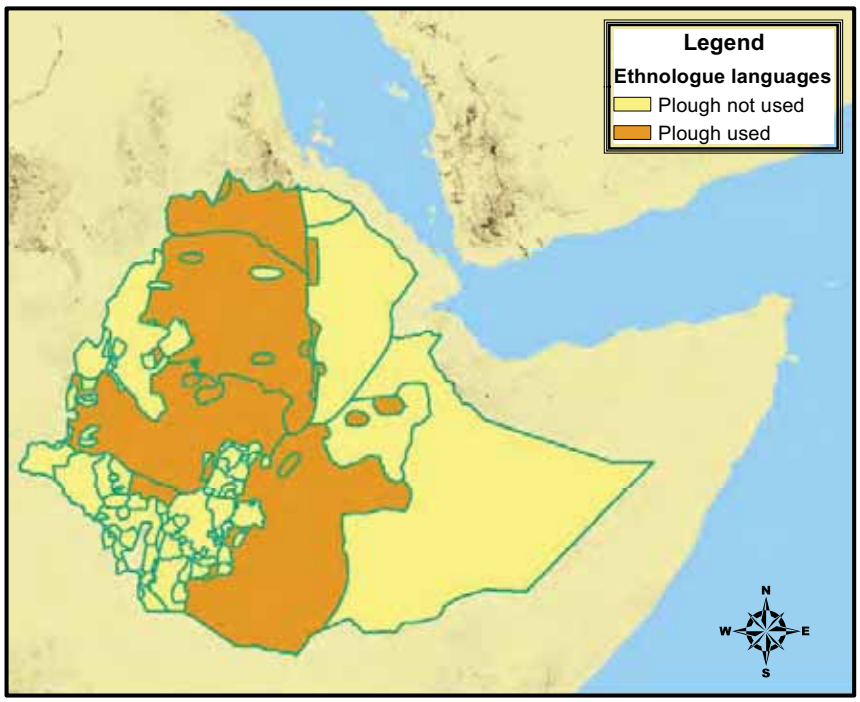
$$\text{Plough}_{d,c} = \sum_e \sum_i \frac{N_{e,i,d,c}}{N_{d,c}} \cdot I_e^{plough} \tag{1}$$

where $N_{d,c}$ is the total number of people living in district d in country c. The same procedure is used to construct a country-level measure Plough_c as well, except that an average is taken over all grid-cells in country c.

Figure 3a shows the global distribution of languages based on the *Ethnologue* data, as well as historical plough use for each group. (The figure also shows uninhabited land in dark grey.) One shortcoming of the *Ethnologue* data is that information is missing for some parts of the world. This is due to uncertainty or a lack of information about the boundaries of language groups in that location. As it is apparent from the map, this primarily occurs in South America. We undertake three strategies to address this issue. The first is to ignore the missing languages and calculate country and district measures using the data that exist. This is the strategy that has been undertaken by other studies using the *Ethnologue* language data (e.g., Michalopoulos, 2008). Our second strategy is to assume that all inhabitants in the unclassified territories speak the national language of the country. The spatial distribution of historical plough use using this

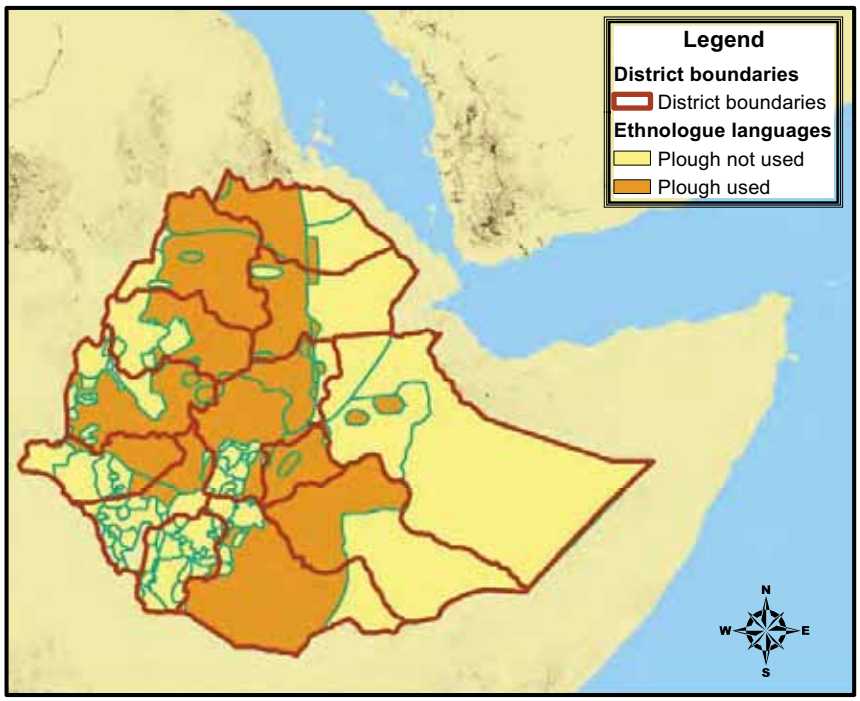


(a) Population density and language groups

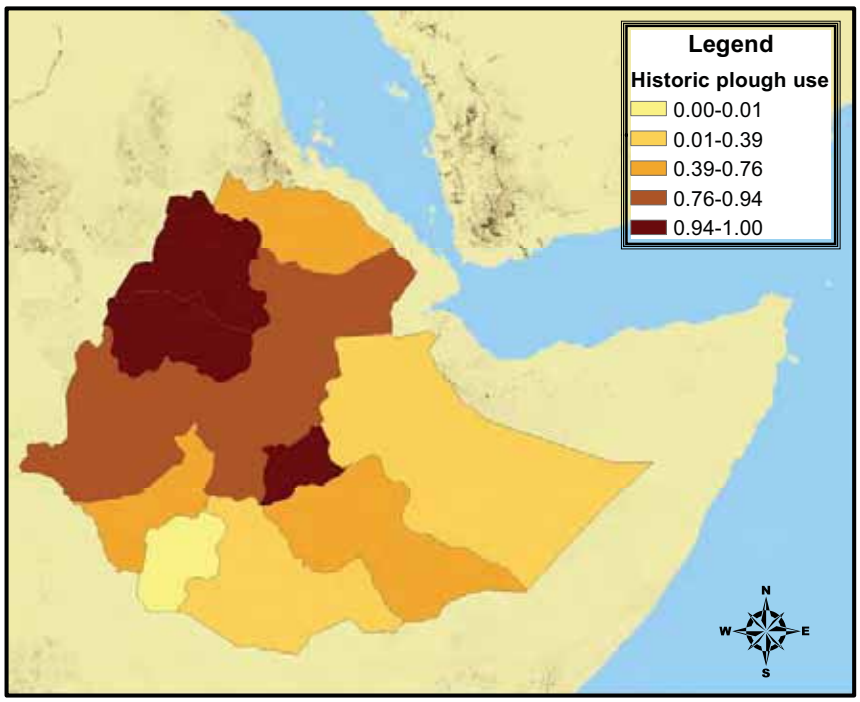


(b) Population density, language groups and their traditional plough use

Figure 1: Populations, language groups, and historical plough-use within Ethiopia.

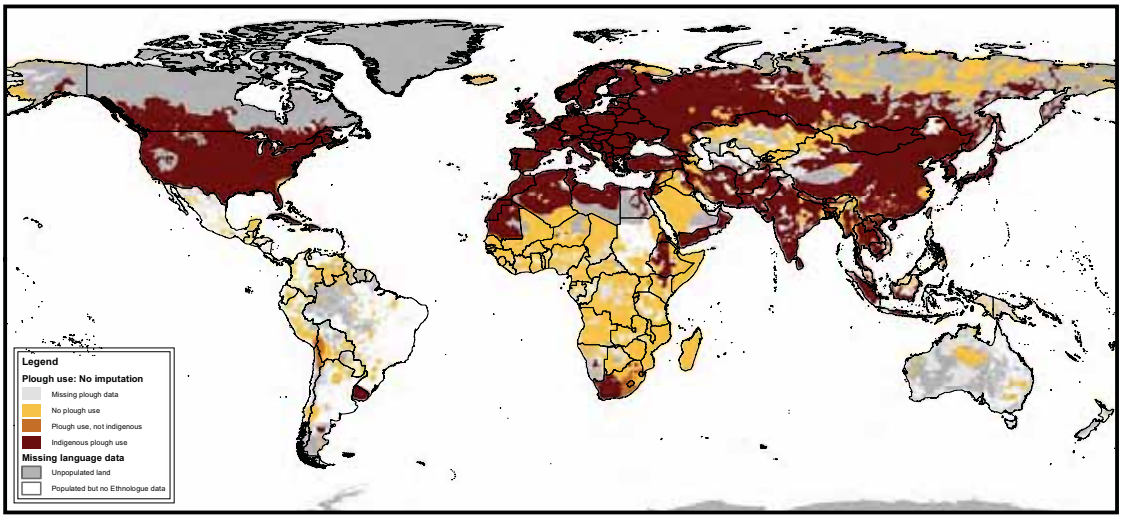


(a) Population density, language groups their traditional plough use, and districts today

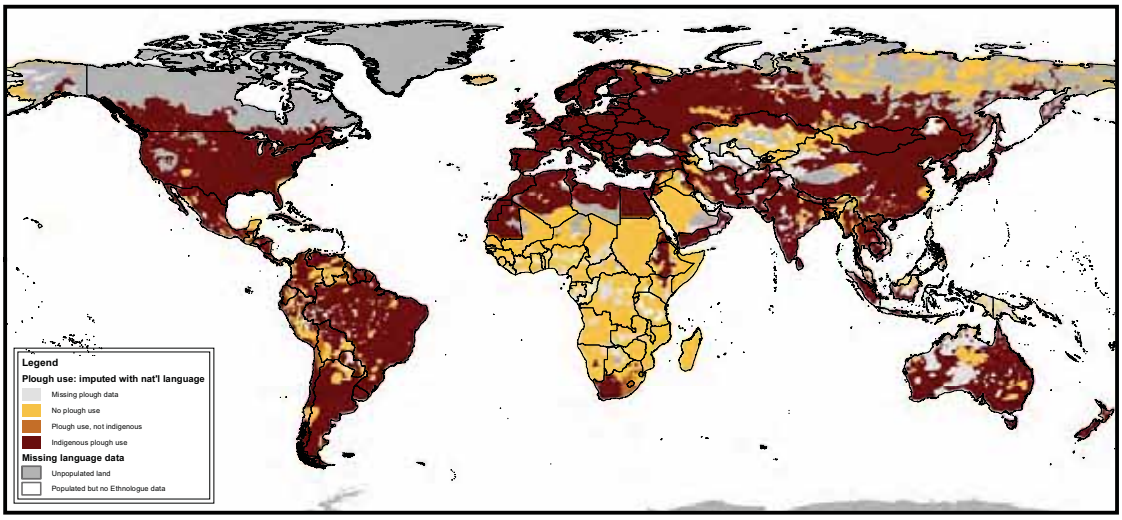


(b) District averages of plough use among inhabitants' ancestors

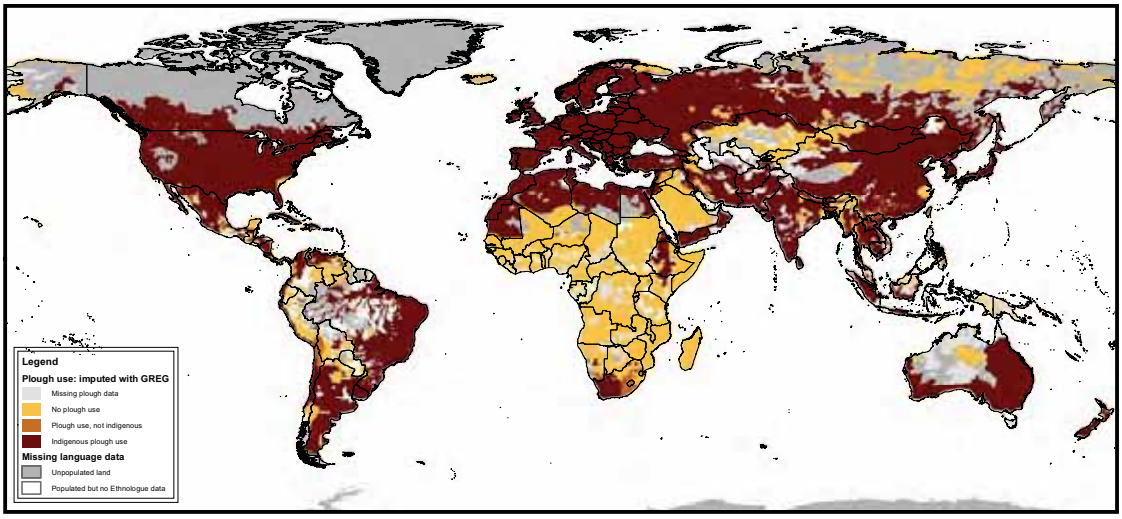
Figure 2: Traditional plough-use across districts within Ethiopia



(a) Missing language information not imputed



(b) Missing language information imputed using the country's official language



(c) Missing language information imputed using GREG ethnic groups

Figure 3: Historical plough use among the ethnic/language groups globally