Caste as an Impediment to Trade*

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Abstract

We compare outcomes across two types of villages in a poor region of rural India. The two types of villages systematically vary by which caste is *dominant*, i.e., the caste group which owns the majority of land. The *dominant* caste is either from an upper caste or a lower backward caste. The key finding is that income is substantially higher for low caste households residing in villages dominated by a low caste, and that this is because of a trade break-down that occurs across caste groups. Specifically, trade in irrigation water across castes seems to be difficult to maintain even though the potential gains from trade are huge. All else equal, lower caste water buyers have agricultural yields which are 45% higher if they reside in a village where water sellers are of the same caste compared to one where they are not. Many of the usual factors which have previously been thought to adversely effect groups with high social distance: public good provision, political economy considerations, and exploitative tenancy or credit relations, do not seem to be important here. Instead, it is found that social distance reduces economic welfare by precluding the efficient functioning of markets. To our knowledge, this is the first study able to quantify the magnitude of the economic losses that occur due to trade break-down by social distance across groups.

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1. Introduction

This paper investigates the impact of *caste* - an easily measured indicator of social distance - on economic outcomes. Specifically, we investigate the hypothesis that the greater the social distance among farmers, the lower the likelihood of mutually beneficial interactions, and consequently, the lower is average household income. The hypothesis receives strong support in the data which thus provides a concrete example of how a cultural factor can inhibit economic performance by precluding the efficient functioning of market institutions.

The empirical strategy is to compare outcomes across two types of villages in a poor region of rural India. The paper exploits dramatic village level variation in caste composition that is historically and exogenously determined, remaining essentially unchanged for centuries. Villages vary markedly by the identity of their *dominant* caste group.[1] The notion of a *dominant* caste comes from the sociological and anthropological literatures. M.N. Srinivas (1955) first defined the term "dominant caste" to refer to the caste in the village which is numerically strong and also wields preponderant economic and political power. Dumont (1970) later insisted that dominance arises solely from economic power rather than factors like numerical preponderance, and that this power flows exclusively from control of land. This latter definition of caste dominance is the one used here; dominant caste refers to the caste group which owns the majority of land.

Approximately 48% of the Hindu villages in the sample are dominated by an upper caste and 42% are dominated by a lower backward agricultural caste (BAC). The differences across village type are dramatic: in the BAC dominated villages there are almost never upper caste households present. Upper caste dominated villages, in contrast, include all main caste groups in the sample: upper castes, backward agricultural castes (BAC), other backward castes (OBC), and scheduled castes (SC).[2] The analysis compares outcomes of lower caste (BAC, OBC, SC) households residing in both types of villages. Income is systematically and substantially higher for low caste households residing in villages dominated by BACs, and the aim of this paper is to understand why.

It is not that surprising to find that some measure of social fragmentation could significantly impact individual well-being. The variation in caste dominance exploited here could be thought

[1] All Hindus, the major religious group in India, are divided into a number of hereditary caste groups. The emergence of the hierarchical caste system dates back to the Aryan Invasion (1500 BC). Long-standing rules govern interaction within and across caste groups. These include strict endogamy and restrictions on the sharing of food and drinking water and other social interactions (see, Dumont 1970).

[2] The BAC and OBC categories are broadly both from the middle-ranking caste in the overal hierarchy. The BAC group are the traditional farming castes, and the OBC group are the traditional artisan castes. The BAC group is ranked higher than OBC. The SC are the lowest in the caste ranking, formerly known as the untouchable castes.

to imply ethnic heterogeneity: the villages where the upper castes are also present (the upper caste dominated villages) are more ethnically heterogeneous than those where only lower castes reside (the BAC dominated villages). A large literature has demonstrated a negative correlation between ethnic diversity and economic outcomes, consistent with the findings here.[3] It is commonly conjectured that more ethnically diverse communities have greater difficulty sharing public goods and resources, and are less able to impose social sanctions that prevent collective action failures.[4] Previous empirical work particular to India has demonstrated that ethno-linguistic fragmentation, applied to caste and religious divisions, negatively correlates with access to public goods (Banerjee and Somanathan 2004, Banerjee, Iyer, and Somanathan 2005).

An alternative view, particular to India, which also suggests these findings may not be surprising, stems from the hierarchical Indian social structure. The traditional village economy revolved around the hereditary caste hierarchy which was a primary determinant of an individual's occupation. Upper castes were the land owners; middle ranked (backward) castes the farmers and artisans; and the lowest ranked (scheduled) castes the labourers and those responsible for other menial tasks.[5] Given these historical patterns, the finding that lower castes fair better in villages where no upper castes are present may not seem surprising. We might well expect that, via tenancy relations, upper caste landlords are able to exploit the lower, thus making them worse off in comparison with those living in villages where land is exclusively owned by lower castes.

The empirical analysis here, however, does not support low public good access or exploitative tenancy or credit relations as explanations for the large losses visited upon lower castes residing in high caste dominated villages. Moreover, these losses do not appear to be related to the political economy environment where we might expect a breakdown in village level cooperation or law enforcement in villages with more social fragmentation.

The intriguing finding here is that the main cause of poorer low caste outcomes in high caste dominated villages appears to be a pervasive breakdown in the functioning of private groundwater markets. These markets are ubiquitous and highly important in arid areas but the empirical results

[3]Refer to Alesina and La Ferrara (2005) for a summary of this literature.

[4]See, Alesina and La Ferrara (2005) for references.

[5]Traditionally, the upper caste land owning class did not cultivate their land themselves. These castes comprised the *jajman* who were linked through the *jajmani* system with the farmer and artisan castes (now classified as the backward castes) and the service castes (now classified as the scheduled castes). The centuries old *jajmani* system was a reciprocal arrangement between the hereditary farming, artisan, and service castes and the higher landholding castes. The lower castes (*purjans*) provided labour, goods, and services to the upper castes (*jajmans*) in return for land and food. By and large, the traditional reciprocal system of exchange is no longer in place in village India, though the hereditary caste rankings persist. However, it is often still the upper castes who own the land and hire lower caste members as cultivators. See, Beteille (1996), Srinivas (1976), and Marriott (1955).

suggest that upper caste water sellers are unable to easily trade with lower caste water buyers. As a result, in villages where the dominant caste, who own the majority of the private groundwater extraction mechanisms, is an upper caste, there is a severe inefficiency in the distribution of groundwater. The implications of this break-down in trade for the low-caste in this poverty stricken part of India are dramatic: all else equal, lower caste water buyers have agricultural yields which are 45% higher if they reside in a village where the majority of water sellers are of the same caste compared to one where they are not.

The findings here can be interpreted as an example of when culture (the caste system) directly affects the efficient operation of markets.[6] In the light of previous findings this is again not too surprising. Others have examined how the organization of society and its social and moral enforcement institutions may impact its economic performance.[7] The capacity to sustain self-enforcing and mutually beneficial outcomes, where there are multiple equilibria, is something that is likely affected by pre-existing attitudes of trust (or distrust), and it is not surprising that where there are large social affinities (through caste) these are more likely to function smoothly.[8] However, an advantage of markets is that these do not, at least at first pass, depend on altruism or trust to make participants mutually better off. Adam Smith's famous dictum is an early statement of the well-known principal that in properly functioning markets individual pursuit of self-interest without regard to wider social welfare should ensure socially improving outcomes. This has been tempered by the realization, however, that few markets are perfect, and, where contracts are incomplete, even the mere possibility of mutually beneficial trade may require individuals to trust that trading partners will not act overly-opportunistically.[9] But upto now, though this has been widely asserted, to my knowledge, no studies have been able to demonstrate that significant trading opportunities remain unrealized due to social or cultural distance, and to quantify the magnitude of the losses that occur. This would seem important for attempts to accord notions like social capital centre

[6] Akerlof (1976) demonstrates how sanctions of a caste system can prevent efficient outcomes in a theoretical framework. With the use of experiments, Hoff and Pandey (2004) find that when caste identity is public information, low-caste subjects anticipate thier effort will be poorly rewarded.

[7] See, for example, Platteau (2000) and Francois (2002) who both survey this literature. Recent work by Tabellini (2005), provides an attempt to empirically investigate the effect of culture on economic development in a cross-country setting.

[8] Greif (1994), for example, demonstrates how cultural differences across two pre-modern societies lead to stark differences in trading patterns. In a similar vein, Kranton (1996) derives conditions under which reciprocal exchange (informally enforced trade) persists despite the possibility of more efficient market alternatives. Using survey data of agricultural traders from three African countries, Fafchamps and Minten (2001) find that traders with more social contacts have higher output.

[9] Platteau (2000) stresses the idea that in traditional societies, codes of good conduct and honest behavior are often confined to small circles, and that movement towards a more modern market economy requires the diffusion of generalized moral codes.

stage in understanding the functioning of markets (as some recent literature has done).

Relative to trade in complex, heterogeneous, quality varying goods or services, trade in private water markets should be relatively simple. Such trade usually consists of a simple bilateral agreement between two individuals residing within close proximity (a proximity usually shared by their families for generations). The evidence for trade break-down presented here is striking, particularly as the documented gains from trade are enormous, and is at least suggestive that underlying trust may be crucial in the development of markets in other contexts.

The identification strategy of the empirical analysis for this paper relies on village level variation in caste composition. It is therefore crucial to establish the exogeneity of this variation. The next section of the paper provides extensive historical evidence supporting this exogeneity. Section 3 discusses the overall data and undertakes raw comparisons of outcomes across the two types of villages (upper caste dominated versus BAC dominated). Empirical estimations at the household level in Section 4 point to the importance of private groundwater markets in explaining the differences across village types. A more in-depth analysis of groundwater markets is subsequently undertaken in Section 5. Section 6 discusses alternative explanations of the main results and Section 7 concludes.

2. Village Caste Composition

This study rests on the observation that within village caste composition varies across villages located in the same region of northeast India, the two bordering states of Uttar Pradesh and Bihar. There are essentially two dominant castes in this region. Approximately 48% of the Hindu villages in the sample are dominated by (i.e., the majority of the land is owned by) an upper caste (Brahmin or Rajput (Thakur)), whereas 42% are dominated by a backward agricultural caste (Yadav (Ahir)).[10] Villages in India are typically multi-caste, with no two villages being identical in either the number of castes or in the numerical strength and wealth of each resident caste (Srinivas 1987).[11] For example, in Uttar Pradesh an average village with 150 to 300 households may have 15 to 25 castes represented in its population (Ahmad and Saxena 1994). The dominant caste is usually, though not always, a higher ranking caste. Moreover, a given caste group may occupy different positions in neighbouring villages (Srinivas 1987). This is the case in the data used here. The backward agricultural Yadav caste are dominant in close to half of the villages under

[10]The predominantly hindu villages make up 89% of the total sample, the remaining villages are instead dominated by a Muslim caste.

[11]Refer to, amongst others, Srinivas (1987), Mandelbaum (1970), and Marriott (1955).

study, whereas the other half are dominated by an upper caste group. In this region, examples of dominance by non-upper castes are not atypical. Sahay (2001), for example, studies four villages in Central Bihar; one is dominated by Brahmins (an upper caste), another by Rajputs (an upper caste), and the remaining two by Koiris (a backward agricultural caste). Shanker (1988) studies a sample of 100 villages in Uttar Pradesh and Bihar and finds similar variation; villages are either dominated by an upper caste (Brahmin, Rajput) or a backward agricultural caste (Kurmi, Koiri, Yadav). Jha (1991) analyses documentation from the early 1900s on the caste composition of 5475 villages located in Bihar and finds that approximately 30% of the villages have no upper caste members in residence.[12]

The origins of the distribution of caste groups at the village level is a difficult to answer historical question. In general, village case studies reveal that we often need to look back hundreds of years to determine the origins of the caste composition specific to that village.[13] According to surveys, larger castes like Brahmins, Rajputs (Thakurs), and Yadavs tend to be evenly spread throughout both Uttar Pradesh and Bihar.[14] Settlement of this area can be traced back many centuries to Aryan occupation.[15] According to Metcalf (1979), basic elements of the village system and various cultivating castes, such as the Yadavs and Kurmis (both BACs under today's classification), were established early in the sixth century. During subsequent centuries, cultivation slowly extended across the fertile plains. These resident cultivators, together with their artisan (now classified as OBCs) and untouchable dependents (now SCs), generated the wealth that sustained society.[16] Members of the non-cultivating Brahmin caste (priests) were also present in the villages. The Muslim invasion of western India, beginning in the twelfth century, lead to a mass arrival of dispossessed Rajput colonies into the region. During the next three centuries these Rajput exiles successfully spread. By the time the British arrived in the late eighteenth century, the Rajput caste

[12]See also, Mendelsohn (1993), Siddiqui (1993), and Shukla (1976).

[13]For example, in the case of Palanpur, a village in western Uttar Pradesh, some two hundred years ago, there resided a *raja* of the Thakur caste with lower Murao caste tenants cultivating his land. Upon the marriage of his two daughters, the raja evicted some of his tenants to give some land to his Thakur sons-in-law. This is the story told for why Palanpur today is a Thakur dominated village with a strong presence of Murao cultivators (Dreze et. al. 1999). A few Brahmins once resided in the village but were wiped out be an epidemic long before the survey period (1957-8) (Dreze et. al. 1999). Danda (1987) conducts a village study in northwest Uttar Pradesh, where he explains that the current co-existence of Muslims and hindus in the village. The present site of the village was first occupied by a hindu family, that came from somewhere in the southwest, more than 600 years ago. A later member of the family converted to Islam and married out of caste. The Muslim part of the village maintains these origins and follow the caste of that out of caste marriage.

[14]These proportions by caste are according to the 1931 Census, which is the last national Census with detailed information on caste groupings (see, Ahmad and Saxena (1994), and Schwartzberg (1965)).

[15]The Aryan Invasion dates to 1500 BC.

[16]Chamars, the largest scheduled caste group in the area, and in the data, are also accordingly spatially widespread in present day (see, Ahmad and Saxena (1994), and Schwartzberg (1965)).

owned and controlled the majority of the land. Under colonial rule, the *Zamindari* system of land tenure was in place in Uttar Pradesh and Bihar.[17] The position of the *zamindars* (landlords) was initially determined by their pre-colonial history of domination and the zamindars mainly comprised members of the Rajput caste. New regulations during the colonial period initiated a slow decline of Rajput territorial power and opened up zamindari rights to members of the Brahmin caste, and occupancy rights to the cultivating castes, such as the Yadavs.[18] The land ownership of zamindars varied significantly and often, due to extremely large landholdings covering several villages, these high caste landlords were absentee and resided elsewhere.[19] The Zamindari Abolition, which took place just after independence in the early 1950s, stripped the zamindars of all of their landholdings except that which they had kept unlet as "home farms" or as grove land, and as a result abolished the large scale absentee landlordism. These land rights were transferred to the former permanent tenants (generally the BACs). Abolition subsequently gave rise to a new class of landowners comprised mainly of the BACs.[20] The principal losers were the Rajputs, however, in spite of these major shifts, substantial land remained under the control of the upper castes.[21]

Consequently, the 1950s saw a significant land redistribution across caste groups, though the actual land being cultivated by a given caste did not change. Since then, changes in land ownership and distribution have been mainly driven by the process of inheritance and partition, with the combined ownership of each dynasty remaining fairly constant. The land endowment of a particular household has depended far more on the division of land within that dynasty (generally divided amongst the sons) than between dynasties. Formal sales of land are rare. An in depth village study has been performed by Dreze et. al. (1999), for the village of Palanpur. The amount of land sold each year in Palanpur, between 1957-1993, amounts to only half of 1% of the total village land. Similar turnover rates emerge from data for other villages in western Uttar Pradesh, for the

[17] Zamindars during the Mughal period of India (1526 - 1756) denoted rent collectors from the cultivators. Although zamindaris were allowed to be held hereditarily, the holders were not considered to be the proprietors of their estates. The government always received the right to forfeit the rights of the zamindar in the case of bad conduct. Under the colonial regime the zamindars were declared proprietors of land who paid revenue to the government. The zamindari property could be freely transferred or mortgaged without taking sanction from the authorities.

[18] Permanent tenants could also be from the higher castes, Rajput or Brahmin. In the case where the tenants were of the same caste as the zamindar, they were usually of a different clan. These high caste tenants did not typically till the soil themselves, they employed lower caste share-croppers. This second group of tenants, usually from the scheduled castes, had no customary or fixed rights to the land.

[19] Metcalf (1967), for example, discusses holders of estates comprising from 50 to 350 villages.

[20] An example of this transformation is illustrated for Palanpur, in western Uttar Pradesh, by Dreze et. al. (1999). There, during the British rule, the village land was in the hands of three zamindars (two Thakurs and one Brahmin), all of whom lived in other villages. The lower caste Muraos were the ones who cultivated the land. At the time of the abolition of zamindari, land which was leased out by the Thakurs was transfered to former tenants, the Muraos.

[21] See, for example, Jain (1996), Ahmad and Saxena (1985), Hasan (1989), and Singh (2003).

ICRISAT villages, and villages in West Bengal (see, Dreze et. al. (1999) for references).[22]

There have been no other successful land reforms other than the Zamindari Abolition and no significant land sales in the area.[23] Moreover, given the strict rules which govern the hereditary caste rankings, there is virtually no mobility of individuals across the different caste groups. As recently analysed by Munshi and Rosenzweig (2005), there is also very little caste based migration in India. Women will migrate to different villages for the purpose of marriage within caste groups, however, men seldom do and instead remain with their paternal family in their natal villages. This is primarily due to the reliance on sub-caste networks of mutual insurance which do not transgress village boundaries (Munshi and Rosenzweig 2005). In general, there is relatively little mobility in India. According to the 1991 and 2001 censuses, approximately 24-29% of the Indian population are migrants, where 60% of the migrants move within the same district, and 25% migrate within the same state. In the states of Bihar and Uttar Pradesh, 24% and 21% of the population are migrants respectively. For both states, the majority of migrants are women migrating to other rural areas within the same district for the purpose of marriage. In Bihar, 94% of the migrants are in rural areas, and 89% of migrants are female. For Uttar Pradesh, the respective numbers are 87% and 85%.[24] Tables 1 and 2 list the proportion of the population who are migrants, into the districts of Bihar and Uttar Pradesh where the current data is from, using corresponding data from the 1931, 1951, and 1991 censuses of India. In each case, the first column reports the proportion of the population who are migrants from another district within the same state, and the second column are those from other states in India. We see from these two tables that these migration rates by district have not changed dramatically over time. These tables report the migration rates into the different districts of interest. For the case of Bihar, the early census data also reported the movement from one district to another. Table 3 lists the proportion of the population who have moved to another district within the state, thus reflecting out-migration rates from the different districts. We see that these rates also did not significantly change between 1931 and 1951.

The Zamindari Abolition seems to play a key role in explaining why we observe two dominant land owning castes in the villages of our area of study. Land is in the hands of lower caste groups

[22] A more active land market can develop in some circumstances. For example, from large scale rural-urban migration or the development of non-agricultural opportunities in rural areas, as has occurred in some parts of South India (see Dreze et. al.(1999) for references).

[23] The Zamindari Abolition was successful in putting land into the hands of the backward agricultural castes but has done nothing for the position of the lower scheduled castes.

[24] Rural-urban migration constitutes only one sixth of migration in India. It is even lower in Uttar Pradesh and Bihar, which are low urbanized states relative to the national average. It is predominantly poor young men who migrate to the urban areas in search of employment.

(BACs) in some villages because historically there were no higher caste households residing in these villages, instead higher caste members were absentee landlords who lived elsewhere.[25] Though there is still an econometric concern that there are systematic, unobservable differences across these two types of villages, it seems clear that the caste composition of the villages under question has not changed systematically for some time. To check this, though there is no historical village level data, we can compare the caste composition by district of the current data to that of the 1921 Census, to confirm that the overall caste composition has not altered substantially. The current data reports the top seven castes, in terms of population, in each village. We aggregate these numbers up, in terms of proportion, relative to the total population, by district, and compare these proportions to those for the identical caste groups reported by district in the 1921 Census. Table 4 lists these comparisons aggregated up by caste classification, i.e., upper caste or backward caste.[26] It must be noted that this is quite noisy data. First, the district boundaries do not correspond in the sense that the 1921 Census districts are larger and encompass more than one district in the current data. As a result, the current data may oversample certain districts relative to the Census data. Second, we were not able to match up all castes, that is, some of the castes reported in the current data are not represented in the Census data.[27]

We should expect the proportions of each caste group to change across the different time periods. For one, there are likely differential birth rates by caste and also there was an overall increase in the proportion of Hindus within some districts as significant Muslim populations emigrated to the newly created Pakistan around India's Independence in 1947. We see from Table 4 that there is substantial caste variation across districts. Despite the noise in the data, the numbers match up quite well within districts across the two data sets, in particular the ratio of upper castes to backward castes is fairly consistent across data sets. Exceptions are: Champaran and Purnea (in Bihar) and Allahabad, Faizabad, and Gorakhpur (in Uttar Pradesh). In these cases, the percentage

[25]It is also possible that, in some cases, Yadav castes historically owned the land. For example, Hasan (1989) reports that BACs owned 6% of the land in Uttar Pradesh pre-Independence. Shukla's (1976) village study from Bihar uses historical records to date the origins of the present-day Yadav caste dominance back to the Mughal period, when the original Rajput mortgaged the estates to a Yadav caste member who subsequently transferred them by sale to another Yadav caste member in 1600. Yadava (1971) similarly provides an example of a Yadav dominated village, located in North India, dating back to the seventh or eighth century.

[26]Note for clarification that I only matched the caste names that were present in the current data, I did not add up all of the castes in a given classification (say backward castes) from the census. In other words, we compared the total number of Yadavs in the current data, in a given district, to the total number of Yadavs in the census data in the same district. The numbers reported in the tables below for backward castes comprise these Yadavs and all other backward castes represented in the current data.

[27]Often the names used in the current data do not correspond to those in the 1921 census. However, using caste ethnographies (such as, Singh 2002), it is possible to match up most of them.

of upper castes has fallen across time relative to the percentage of backward castes. In most of these cases, the upper castes are represented by a single caste, Brahmin, whereas the backward castes group is made up of 7-12 caste groups. It is consequently not that surprising that the data is quite noisy for the upper caste group.

The earlier discussion of this section strongly suggests that village level caste composition is historically determined and the empirical analysis will treat the variation in caste composition across villages as exogenous.[28]

3. Data

The data used in this paper were collected by a team of researchers based at the World Bank and in India in 1997-1998.[29] The villages of study are located in south and southeastern Uttar Pradesh and north and central Bihar. Uttar Pradesh and Bihar, together with Madhya Pradesh, have been referred to as India's "poverty belt". All three states are characterized by unusually large populations with per-capita expenditure levels far below the poverty line. Eastern and southern Uttar Pradesh, from where the study villages were drawn, is generally poorer than the western part of the state, and poverty levels have been rising in recent years. Bihar, which lies just east of Uttar Pradesh, has the lowest per capita rural income in India, and is the most rural state in the country. It has suffered from unrest, inter-caste conflict, and political violence in recent times. Overall poverty levels are even higher in Bihar than in Uttar Pradesh, and highest in the Northern region.

The field survey was administered in villages drawn at random from 12 districts in Uttar Pradesh and 13 districts in Bihar. A total of 120 villages, with an overall sample size of 2250 households, were sampled; 57 villages in Bihar and 63 in Uttar Pradesh. All of the study villages are rural. Although small, mostly household-based industries such as wood gathering, bidi making, rope making and liquor brewing exist, the economies in these areas are primarily dependent on agriculture.

Information on the village caste composition is listed in Table 5. The most populous caste is either a BAC or SC. Between the two states, the upper castes are more prominent in Bihar, whereas the scheduled castes are more prominent in Uttar Pradesh. Land ownership is either in the hands

[28] An alternative strategy would have been to use the historical caste composition measures, listed in Table 4, as instruments for current day caste composition (this is the strategy followed by Banerjee and Somanathan 2004). This is not possible here as the caste variation is at the village level in the current data, whereas the caste variation in the historical data is at the district level. It is worth noting that almost all of the districts in the data comprise both high and low caste dominated villages. The empirical analysis will include district controls.

[29] The study team in India was headed by Ravi Srivastava (Allahabad University) who worked with other researchers from Allahabad University and local NGOs. The work was directed by Valerie Kozel at the World Bank.

of the upper castes or the BACs, the distribution across these two caste groups is slightly more equal in Uttar Pradesh. We will compare villages where upper castes own most of the land, to villages where the BACs own most of the land. We will not analyse Muslim dominated villages and also drop Muslim households from the analysis, which comprises only 2% of the sample in Hindu dominated villages.[30]

Household characteristics by caste group are listed in Table 6. The first four categories correspond to the primary source of livelihood for the household, which generally accounted for more than 50% of the household's total income. We see that the upper castes and BACs are primarily own farm cultivators. The lower castes, particularly the SCs, are more likely to be casual labourers. The OBCs are the most likely to be involved in petty business, whereas the upper castes are the most likely to be salaried employees. Literacy of the household head increases with caste rank. The level of schooling attained also increases with caste rank. Of those literate, 79% of the upper castes have achieved at least middle school, 57% for BACs, and approximately 45% for OBCs and SCs. For these two latter castes, approximately 22% of the literate have had no formal schooling. Though not listed in the table, the average age of household head does not vary greatly by caste, ranging between 45 and 50. All castes have, on average, 6 household members (the range, 5.5 to 6.3 members, is slightly increasing in caste rank).

Total annual income is the sum of wage income (for all household members), household enterprise income, total crop income, transfers into the household (typically from relatives), and the total value of home production of in-kind receipts of crops and food.[31] Total income also increases with caste rank. All castes generate the majority of their income from agricultural activities. Though not reported, income per capita also increases with caste. If we look at averages of enterprise income conditional on it being positive, then it too follows caste ranking and the same holds for household wage earnings. Upper castes accordingly have higher annual expenditures, particularly for non-food expenditures.[32] Upper castes also spend more on clothing, medical, and leisure activities, but most significantly on social expenses such as weddings and deaths. The amount of land owned (in acres) reported in Table 6 is conditional on owning land at all. The upper castes are the largest landholders in the overall sample, followed by the BACs. The variable "tenant" is a

[30]The category of scheduled castes (SC) also includes scheduled tribes, however, they are not widespread in the data. The areas where the majority of tribes reside formed independent states in late 2000: Jharkhand (formerly a part of Bihar) and Uttaranchal (formerly a part of Uttar Pradesh). This data set, collected in 1997-98, does not cover these districts.

[31]Income is measured in rupees, there are approximately 40 rupees to the U.S. dollar.

[32]The category of non-food expenditures in Table 6 comprises daily expenses such as gas, electricity, toiletries, transport, etc..

dummy variable equal to one if any of the household land is rented, sharecropped, or received as wage payment. The opposite holds for the variable "landlord". The total amount borrowed and the primary credit lender are reported conditional on borrowing. The current loan for all castes on average comprises significantly more than their annual income (3 to 5 times more). We see from Table 6 that caste relations play an important role in credit markets. Lower castes borrow primarily from upper castes, with the exception of BACs who are most likely to borrow from their own caste, as do the upper castes. Money lenders are also used by lower castes. Relatively few households use formal credit institutions.

3.1. Comparisons across village types

In this section we focus on the differences across the two types of villages, those where total land ownership is dominated by the upper castes (termed high caste villages in the tables that follow) and those where total land ownership is dominated by the BACs (termed low caste villages in the tables that follow).

3.1.1. Village Characterisitcs

We first focus on data from the village level questionnaire. We see from Table 7 that the total number of households does not significantly differ across the two types of villages. There are almost no upper castes residing in villages where the BACs dominate. Instead they themselves tend to be the most numerous caste, followed by the SCs. In the villages where land holdings are dominated by upper castes, either upper castes or SCs are the most numerous, though significant populations of the other castes are also typically present. The variables reflecting village infrastructure reveal that upper caste dominated villages are somewhat more developed.[33] Likewise distance to facilities is lower in those villages. That being said, the differences across the two types of villages are not striking.

Agricultural characteristics across the villages are listed in Table 8. Land inequality, as represented by the Gini index, is higher in high caste dominated villages. This is to be expected given that the upper castes own significantly more land than the lower castes, as seen in Table 6. Correspondingly, more total land is sharecropped in the high caste dominated villages. On average a greater proportion of cultivated land is irrigated in the lower caste villages. The main source of

[33]The single exception is the total number of handpumps, though relative to village population the average is slightly higher in high caste dominated villages.

irrigation for all villages is private tubewells. There are not huge differences in soil quality across the two types of villages nor in cropping patterns and prices.[34]

Variables which capture government and NGO programs targeted at the villages are in Table 9, which first lists information on government supported employment programs in the village during the past year. The second group of variables refers to government or NGO sponsored development programs. The number of employment programs and money allocated is higher in low caste villages. Approximately half of each type of village had an employment project aimed at building a road. The number of development projects did not differ across the two types of villages, neither did the type of project.

Tables 7 through 9 do not reveal strong systematic differences at the village level across low and high caste dominated villages in terms of access to public goods or geographic determinants. The only exception is a larger number of government employment programs in low caste dominated villages. We will see that this variable does not however play a significant role in the estimations.

3.1.2. Household Characteristics

In this section we focus on the differences across the two types of villages in terms of household characteristics by caste group. The data come from the household level questionnaire. The striking result from Table 10 is that BACs fair better, in terms of household income, if they reside in villages where their caste is dominant. This difference in income is mainly driven by agricultural income. In this respect, the BAC's in low caste villages are comparable, to the upper castes in high caste villages. This holds, despite the overall land ownership being smaller for the BAC's relative to both their own caste and the upper castes in the high caste villages. These BACs are also more likely to be literate in the low caste villages. Credit relations again primarily depend on caste. BACs are more likely to borrow from the dominant land holding caste, i.e., their own caste in low caste villages and upper castes in high caste villages.

We see from Table 11, that other lower castes (OBC and SC) also fair better in the low caste dominated villages. Again this difference is driven primarily by agricultural income. This is particularly the case for the SC group, who also own more land in the low caste villages and have higher literacy rates. The primary credit source for both caste groups is higher castes, but money lenders are used more in the low caste villages.

Tables 10 and 11 show that average household income, of all lower castes, is higher if residing

[34]Data on prevailing wages in the villages comprised too many missing variables to be useful. The exception was male skilled work, which also does not vary significantly across the two types of villages.

in a village dominated by a low caste. Households tend to fair better in villages where there is less social distance between themselves and the dominant land owning caste. Table 12 verifies that this systematic relationship only relates to land owning dominance by caste and not instead population numbers or direct political power. In particular, there is no significant positive correlation between household income, for a given caste, and residing in a village where the most populous group is of the same caste, or where the village council leader (*Pradhan*) is of the same caste.[35]

It should be noted that all results pertaining to household income in the above tables also hold for per capita income. More detailed information on the distributions of land ownership and agricultural income is listed in Table 13. Although the number of large landholders of BACs is larger in high caste villages, at each percentile in the agricultural income distribution, their incomes are higher in low caste dominated villages. BACs do not own more land in low caste dominated villages but they do own higher quality land, as represented by the value of their land.[36] The same relationship for crop income holds for the other lower castes, as listed in Table 14, though the effects are stronger for SCs.

These tables beg the question as to why agricultural income, by caste, is higher in low caste dominated villages. We now turn to characteristics of only cultivator households which form 75% of our total sample. The group of non-cultivators are essentially the landless households.[37] The aim is to characterise in more detail the agricultural inputs and outputs of cultivators.

Crop yields are measured as the value of produce sales from each crop per acre of land cultivated under that crop. These yields therefore exclude crops used for household consumption. The majority of households grow paddy (72%) and wheat (91%). Cereal and pulse crops are also common (42% and 55% of households respectively), whereas approximately 30% of households grow bulb and seed crops, and 20% have cash crops. Lower castes are more likely to grow paddy, bulb and cash crops in low caste dominated villages. We see from Table 15 that crop yields are higher for BACs residing in low caste villages for almost all crops (the exception is pulses). The

[35]Information on village pradhans was only available for the 63 villages located in Uttar Pradesh. In high caste dominated villages the caste of the Pradhan is upper caste for 38%, BAC for 35% and SC for 29%. For the low caste dominated villages, the Pradhan is BAC for 72%, and SC for 16%. The caste of the Pradhan is not a perfect measure of caste based political power since not all Pradhans in the sample have been democratically elected, due to reservation policies for scheduled castes and women in village councils (see, Pande 2003 and Duflo and Chattopadhyay 2004)

[36]The value of land is the response to the question of how much would it cost per acre to buy this type of land. Although, actual land sales are few in the area, taxes from land revenue are the most common form of tax for the local governments. Therefore, estimates of the value of land are likely known.

[37]Of the non-cultivators, 90% are landless and 6% own not more than 1 acre of land. The remaining larger land holders who do not cultivate typically operate as landlords who either rent or share-crop thier land.

difference in cash crop yields is particularly striking, the main cash crop grown is sugarcane. The yields reported in Table 15 are not conditional on being positive but the same relationships follow if instead they were. Crop intensity measures the total acres cultivated (which includes crops for home consumption) divided by the total amount of land the household has access to (including land owned, rented, share-cropped, etc.). Crop income per acre is equal to the total value of sales of all crops over the past year divided by the total land. Both of these measures are higher for BACs if they reside in low caste dominated villages. In accord with the higher yields, inputs such as fertilizer and family labour into agricultural production are also higher for BACs residing in low caste villages. The proportion of land irrigated is also somewhat higher and households are more likely to use private tubewell irrigation as their primary source.[38] The proportion of households who own a private tubewell and pump does not substantially differ by caste nor across the two types of villages for BACs. BACs are more likely to be groundwater buyers in low caste dominated villages and sellers in high caste dominated villages. The last five variables list the proportion of households who own at least one of the farm implements listed. We see that there are not strong differences across castes groups or villages for BACs. The final category is the number of buffalo owned. Other livestock ownership variables are not reported as they are unlikely to be inputs into crop production.[39]

From Table 16, we see that a similar relationship between higher yields in low caste dominated villages also holds for the other lower castes residing in these villages. Cropping intensity is also higher for SCs in low caste dominated villages. SCs are more likely to depend on canal irrigation than other castes in low caste villages, though also more likely to own a tubewell and pump and sell water in the private groundwater markets.[40] SCs also own more farming implements in low caste dominated villages.

4. Estimations

We now turn to estimations of crop income aiming to understand why it is higher for lower castes in low caste dominated villages. The main sample for the analysis includes the lower caste groups

[38] This is relative to canal irrigation, as listed in Table 15, and other natural sources not reported in the table.

[39] Also no other livestock variables proved significant in the estimations.

[40] As we see from Tables 15 and 16, private tubewells are the primary source of irrigation in this area. For all castes, the boring and pump set were primary financed by their own resources, approximately 64%. For about 20%, the purchase of a private irrigations system was funded by a government program (Agricultural Department, Minor Irrigation Department, Million Wells Scheme), the remaining 15% relied on loans. The use of loans over own resources increases as we move down the caste hierarchy. Also, lower castes are less likely to use their own resources in high caste villages relative to low caste villages.

who reside in both types of villages (BACs, OBCs, and SCs). However, the tobit estimations of Table 17 confirms the robustness of the relationship when the sample includes all caste groups. That is, controlling for agricultural inputs, household characteristics, and village characteristics, there remains a significant and positive relationship between crop income and residing in low caste dominated villages. The estimation in the first column does not include any additional controls. The estimation in the second column includes crop and state controls. The third estimation includes the same controls with regression disturbance terms clustered at the village level. The final estimation includes crop and district controls. The most important result from Table 17 is that residing in a low caste village has a positive and significant effect on crop income per acre of total land in all three of the estimations. This result is robust to alternative ordinary least squares estimations for the entire sample and also for only those households who received positive revenue for their crops, with Huber robust standard errors and regression disturbance terms clustered at the village level. The results are also robust to estimations where the sample comprises only those who do not share-crop land or only those who do. The same results also persist if the dependent variable is instead yields per acre of cultivated land. Other significant positive determinants of agricultural yields include amount and value of land. When quadratic terms for total land and value of land are included, they enter negatively and significantly. Literate farmers, as well as share-croppers, have higher yields. Other important inputs include fertilizer and irrigation.[41] Private tubewell and pump ownership are also positive determinants of crop income.

The results from estimations analogous to Table 17 including only the lower caste group (BAC, OBC, SC) who reside in both types of villages are listed in Table 18. The most important result from this table is that residing in a low caste village has a positive and significant effect on crop income per acre of total land in all four of the estimations. The only other consistent relationships are positive ones between crop income and value of the land, fertilizer use, and share-cropping.[42] Other relationships are sensitive to the inclusion of different controls.

Similar estimations now including some village level characteristics are listed in Table 19. Again the positive relationship between crop income and residing in a low caste village remains robust. Of the village level characteristics, land prices seem to have a negative effect on crop income. Estimations were run using all of the village level data reported in Section 3.1.1, where the positive relationship between crop income and residing in a low caste dominated village remained robust.

[41] Other inputs such as farming implements proved insignificant and are not reported.

[42] It could be argued that value of land is endogenous to current annual crop yields, however, this relationship seems quite indirect.

Residing in a village where the households' caste was the same as the most populous caste or of the Pradhan (village council leader) were not significant determinants of crop income and neither were measures of public resources such as electricity, drinking water and distance to facilities.[43]

Table 20 reports estimation results where the key variable of low caste village is interacted with the other independent variables. Interestingly, once we include interaction terms, the effect of residing in a low caste village no longer significantly affects crop income on its own. The positive effect seems strictly related to being a water buyer in the private groundwater markets. Relative to high caste dominated villages, the crop income of tenants (share-croppers) is lower in low caste dominated villages. The estimation results in Table 21, show, however, that it is the first relationship, i.e., via water buyers, which is the key to explaining the higher crop income in low caste dominated villages. The positive significant effect of residing in a low caste village drops out once we interact it with water market activities. This held true also if we only interacted it with water buyers. Table 22 demonstrates this key result holds for various caste groupings. The main results reported in Tables 20 to 22 were robust to including additional interaction terms with village characteristics, crop controls, and caste controls.

The main finding of this section is that the functioning of private groundwater seems to be the key to explaining why yields amongst lower castes are so much higher in low caste dominated villages. We now turn to further inquiry into water markets in the area.

5. Groundwater Markets

The study area is located in what is known as the Ganga-Meghna-Brahmaputra basin.[44] This region has enormous groundwater potential and informal groundwater markets have emerged as an extremely important institution over the last three decades.[45] The use of groundwater in historical times was relatively uncommon in this region, there was normally adequate rainfall for crops in the *kharif* (wet) season (Prasad 1989). In the wake of a severe drought in eastern India in 1966-67, the advantages of groundwater irrigation over surface irrigation were poignantly realized. This

[43]The caste of the Pradhan may be endogenous to agricultural yields, where wealthier households are more likely to be of the same caste as the village leader. The gender of the Pradhan (following the strategy of Duflo and Chattopadhyay 2004) can be used as an exogenous source of variation which predicts the caste of the Pradhan. This IV estimation gives similar results.

[44]The Ganga-Meghna-Brahmaputra basin comprises the eastern districts of Uttar Pradesh and the entire states of Assam, Bihar, West Bengal, and Bangladesh.

[45]See, Mukherji (2004) for a review of the literature. Selling groundwater has been prevalent for longer in some areas, even under traditional water extraction technologies. For example, Shah (1989) cites a study in Gujarat which documents well developed water markets for 70-80 years.

boosted the development of groundwater irrigation and a perceptible expansion of private and public tubewells occurred after a later drought in 1972-73 (Prasad 1989, Pant 2004, Singh 1992). Although a number of public tubewells, which are invariably deep units (often greater than 80 meters), were installed in the region in the 1970s and early 1980s, most of them have become non-operational due to erratic and inadequate supply of electricity and a lack of repair and maintenance (Prasad 1989, Shah 1989, Meinzen-Dick and Sullins 1994). As a result, groundwater utilization for agricultural purposes in this region is predominantly through private tubewells, which are typically shallow (generally less than 15 meters) and use diesel-operated pumps.[46] Shah (1989) estimates that more than 95% of the total area served by groundwater in India is irrigated by privately owned irrigation equipment.[47] Pant (2004) documents stupendous growth in private tubewells in Uttar Pradesh, where the estimated total was 3000 in 1951, 600 000 in 1977, and 1.05 million by 1980. Between 1986-87 and 1992-93, the density of tubewell and pump sets increased fourfold in Bihar (Kishore 2004). Some argue that the engine of growth in eastern India over this period was this accelerated diffusion of private shallow tubewells (Fujita and Hossain 1995, Mukherji 2004). The exploitation of groundwater through the use of tubewells converted fallow land of the dry season into fertile paddy fields well suited to the seed-fertilizer technology, available through the wave of the Green Revolution.[48] As a result, both cropping intensities and patterns vastly improved and yield rates witnessed a tremendous upward swing (Pant 2004, Singh 1992, Mukherji 2004, Roy and Shah 2002).

Most of the groundwater development which took place through private water extraction mechanisms was highly skewed in favour of large farmers.[49] Although the majority of landholdings in the area belong to small and marginal farmers, most of the tubewells are owned by farmers with large landholdings and a higher ability to invest (Singh and Singh 2003, Prasad 1989, Fafchamps and Pender 1997, Aggarwal 2005).[50] Groundwater markets are characterised by barriers to entry which

[46]The pumps usually have a 5-8 horsepower capacity and have a pipe diameter of roughly 10 centimeters (Prasad 1989, Pant 2002). The tubewells cylinders are often indigenously constructed from bamboo, but can also be metallic or concrete (Wood 1999, Srinivas and Jalajakshi 2004).

[47]Many claim that groundwater is the backbone of irrigated agriculture in India (Roy and Shah 2002). Dains and Pawar (1987) estimate that 70-80 percent of the value of irrigated production in India may depend on groundwater irrigation. The World Bank and Ministry of Water Resources (1998) estimates that the contribution of groundwater to India's GDP is around 9%.

[48]During this time, the use of chemical fertilizer also increased over the traditional compost manure (Singh 1992).

[49]Almost all private tubewell ownership is individually owned (Mukherji 2004, Pant 2002, Aggarwal 2005).

[50]According to the World Bank (1984), 70% of tubewells in India are owned by farmers with over 12.5 acres and 50% of all tubewells are owned by farmers with over 25 acres. However, more recent work documents that tubewell ownership has become more diffused and is no longer the hegemony of the rich and upper caste farmers (see, for example, Mukherji 2004).

arise from the lumpiness of the tubewell investment coupled with credit constraints.[51] Nevertheless, the emergence of groundwater markets has been seen as an opportunity for more equitable access to groundwater irrigation for resource poor small and marginal farmers (Shankar 1992). The majority of tubewell and pump owners reported to be water sellers; typically sell their surplus water after meeting the needs of their own fields.[52] In spite of the inequities in terms of pump and tubewell ownership, poorer farmers do tend to fair better with the development of private tubewells, where having access to groundwater at all has been a key to success (Shah 1989, 1991). Several studies show that cropping intensities and yields of tubewell owners and water buyers are comparable, reflecting that buyers are in fact receiving reliable and adequate irrigation water (Shah and Ballabh 1997, Kishore 2004). Shah (1989) cites studies which show that more than half of the total area irrigated by private irrigation systems, in many parts of India, belong to water purchasers.

This being said, there has been significant concern over the potential power of local monopolies of groundwater, or "water-lords" (Shah 1993, Meinzen-Dick and Sullins 1994).[53] Since water transactions are restricted by topography and distance between source and field, market competition is likely to be little (Shah 1991).[54] A given tubewell owner typically accommodates a number of buyers within close physical proximity.[55] Due to conveyance costs involved in irrigating fields that are far, there is only a limited area surrounding the tubewell that can economically be irrigated by a given tubewell, and often water buyers are restricted to the choice of a single seller.[56] Water is generally transported to the buyer's field either through unlined or lined field channels.[57] Empirical research and anecdotal evidence indicate a variety of contract forms and a wide range of prices in groundwater markets. Dubash (2000), for example, finds that water pricing structures

[51] In a study of West Bengal, Rawal (2002) estimates the costs of tubewells with diesel pumps to amount to 8000 to 12 000 Rs.. Tubewell installation cost amount to roughly a year's income for the average rural households in Pakistan (Jacoby et. al. 2004).

[52] An exception is Gujurat where water markets are highly developed and some individuals invest primarly to sell water (Kolavalli and Chicoine 1989). Refer to Meinzen-Dick and Sullins (1994) for references to numerous anecdotal reports and a growing number of studies of private water sales in Uttar Pradesh, Haryana, Punjab, Bihar, West Bengal, Orissa, and Andhra Pradesh. See, also, Mukherji (2004).

[53] Jacoby et. al. (2004) provide a model of groundwater price determination with monopolistic tubewell owners.

[54] Since average pumping costs in India show remarkable uniformity, water price variation can often be inferred to reflect differences in monopoly power (Shah 1989).

[55] Using data from Gujarat, Aggarwal (2005) finds, for example, that each water seller had on average 6 to 7 potential customers and each buyer had access to on average 1 to 2 sellers. In a study from eastern Uttar Pradesh, Shankar (1992) finds that tubewell owners sold water to on average 8 to 9 buyers.

[56] Where landholdings are fragmented, most water sellers are also buyers because most farmers sink tubewells in one or two of their largest and best parcels and use purchased water for irrigating others (Shah 1989).

[57] Where water markets are most developed, underground pipeline networks may be used as in parts of Gujarat (Shah 1989). In areas where submerging tubewells is relatively inexpensive, instead a market for renting pumpsets can emerge (see, for example, Wood (1999), and further references in Mukherji 2004).

vary substantially across villages within close proximity, with similar cropping patterns, soil types, and hydrology.

Bilateral groundwater transactions suffer moral hazard problems on both sides of the market. On the one hand, sellers' are responsible for the timing of the delivery of irrigation, to each of its' buyers, which is crucial to the success of the crop. Buyers, on the other hand, are often credit constrained and payment for the water supply can be made only once the returns from a successful crop are reaped. These two components are central to the structuring of water contracts. Bilateral oral contracts dictate the terms of exchange where pricing structures can differ by crop and season. Although, contracts can be classified into two types: (i) time-rate contracts, where water is sold per hour of watering; and (ii) crop-acre contracts, where the tubewell owner is entrusted with irrigating an area for a crop season.[58] The main responsibility of the tubewell owner is to switch on and off the water pump. Matters of water conveyance, clearing the channel, and closing in between outlets are the responsibility of the water buyer. Payment for irrigation is in the form of cash, kind, credit, or through a tenancy arrangement.[59]

In addition to driving up the price, monopoly power can affect quality of service with regards to adequacy and reliability of supply provided by sellers, where buyers have little recourse. Tubewell owners often follow a schedule of rotation for irrigating the fields of all of the buyers.[60]. Despite this institutionalized system, sellers are often reported to discriminate between buyers, particularly in times of irrigation shortages. There are reports of harassment of water buyers as sellers angle to extract more rents by threatening to reduce the water supply (Rawal 2002). To ensure repayment from water buyers, inter-linkages between water contracts and tenancy or credit contracts are common. Due to the moral hazard problems involved, exchange relationships are retained through village level institutions and norms (Dubash 2000). Studies report that the ability to pay the price does not guarantee access to groundwater, farmers must be networked (Wood 1999). In general, transactions are not impersonal, but are part of inter-linkages where sellers tend to give preference to relatives or members of their own caste, either through lower water rates or priority for service (Mukherji 2004, Meinzen-Dick and Sullins 1994, Ballabh et al. 2002, Dubash 2000, Wood 1999). According to Shah (1989), low prices relative to pumping costs generally imply a more balanced relationship of mutuality between buyers and sellers. Similarly, Pant (1991) observed, in

[58] See, Kaijisa and Sakurai (2000), Rawal (2002)

[59] Some argue that the tendancy is to move toward a cash charge per hour of water supplied as the water markets develop (Shah 1991). Refer to Mukherji (2004) for a summary of contract forms.

[60] See, Rawal (2002). Dubash (2000), and Aggarwal (2005).

Orissa, that the relative social and economic position of buyers and sellers can also affect water rates, where small farmers selling to large farmers charged less than large farmers selling to small farmers. Kajisa and Sakurai (2000), using a sample of villages in Madhya Pradesh, find that 62% of water transactions are conducted between buyers and sellers of the same caste, and of the 38% of transactions which are conducted between different caste groups, trade occurs between groups with the least social distance, as measured by caste rank. In a study from northeast Bihar, Wood (1999) similarly reports that traders operate strictly within their own caste, and in the case of a numerically dominant landholding caste, trade is further restricted within particular extended lineages. Kozel and Parker (1999) report similar concerns prevailing between water seller and buyers throughout the present study area.

The results of Section 4 show that higher yields in low caste villages can be explained by private water markets. Our analysis of why this is so is limited as we do not know the price of water nor the amount of water bought or sold. The act of buying water seems to be important. Either water is being purchased at a lower price in low caste villages or there is greater access (larger amounts available) in these villages. The question is how these scenarios are in turn related to village caste composition. The evidence reported above suggests that caste ties or dominance may play a significant role in the enforcement of informal groundwater contracts within villages and that, in particular, trade is more common between members of the same caste. We now aim to unravel what we can using the data available.

5.1. Aggregate Water Market Activity

We begin by looking at aggregated water market activity. Table 23 attempts to capture the demand and supply in water markets at the village level. The total cultivated and owned land across two types of villages is computed using average land values, from the household level data, multiplied by the total number of households within each village, using the village level data. Similarly, the number of water buyers, sellers, and pump owners relies on averages computed using the household level data of cultivators.[61]

From Table 23, there is no evidence that the total amount of cultivated land is significantly different across the two types of villages. This also held true also if we looked at the total acres cultivated by crop. Nor are there significant differences between the total number of buyers, sellers and pump and tubewell owners.

[61] This aggregated data must be interpreted with caution as the total number of households per village in the household level data is only between 15 and 30.

We now construct the same comparisons using only the lower castes (BAC, OBC, SC) in Table 24. These results, on the other hand, reveal significant differences. In the aggregate, it appears that the number of water sellers (and pump owners) is significantly higher in low caste dominated villages, whereas the number of buyers is significantly lower relative to the high caste dominated villages, if we only consider the lower castes. A plausible explanation arises if we suppose that upper castes do not trade water with lower castes. Then the aggregate information implies that water prices, faced by the lower castes, should be lower in the low caste villages. This could explain why low caste water buyers are able to gain better access to irrigation, and consequently produce significantly higher yields when residing in low caste dominated villages. The implications are that the presence of upper castes, who own a substantial proportion of the private tubewells and pumps, causes an inefficiency in the distribution of groundwater as they do not tend to trade with lower castes in villages.

5.2. Household Water Market Activity

In this section we look to the household level data by water market activity in order to check our conjectures above. Table 25 compares the caste of pump and tubewell owners, water sellers and buyers across the two types of villages. We see that the majority of pump and tubewell owners are from the upper castes in high caste dominated villages. However, conditional on owning a pump, BACs are more likely to sell their water in such villages. Water buyers are also predominantly from the upper caste group in these villages. In the low caste dominated villages, the BACs dominate the water market as both buyers and sellers. The proportion of water buyers who are OBCs or SCs does not substantially differ between low and high caste dominated villages.

Table 26 demonstrates that water buyers in the low caste dominated villages fair much better than their same caste counter-parts in the high caste villages in terms of yields and cropping intensities. Despite owning less land, these BAC water buyers residing in low caste dominated villages perform similarly (if not better) relative to the upper caste water buyers in high caste dominated villages. Comparing the two dominant caste groups, tubewell owners earn higher returns to their land in low caste villages. These results are consistent with greater efficiency in groundwater trade in low caste dominated villages.

Table 27 estimates the probability of being a water buyer or seller among low caste (BAC, OBC, SC) cultivators. The probability of being a water buyer is higher in a low caste dominated village, this holds for all cultivators and also for only those who do not own a pump and tubewell.

Alternatively the probability of being a water seller is higher in high caste dominated villages. These relationships make sense if we reconsider the aggregate results of the previous section. If the price of water is lower for lower caste cultivators residing in low caste villages, then the probability of being a water buyer for those caste members should be higher. Similarly, if the price of water is higher for low caste farmers in high caste dominated villages, then the probability of being a seller for the low caste members should be higher.

6. Alternative Explanations

The empirical analysis above, implies that caste is directly affecting economic outcomes. Our favoured interpretation is that agricultural yields are crucially determined by access to groundwater irrigation which is distributed through private markets. These markets seem to work more efficiently in villages where the caste composition is more homogeneous. There are, however, alternative hypotheses for why agricultural yields may be higher in villages dominated by the lower castes which have nothing to do with caste (or inter-caste relations) per se. For one, yields may be higher in low caste dominated villages simply because lower caste households residing in these villages have higher quality land compared to their low caste counter-parts residing in the high caste dominated villages. Alternatively, one might expect that tenancy relations are worse in high caste dominated villages; perhaps upper caste landlords treat low caste tenants poorly relative to a lower caste landlord. In the empirical analysis, the main results are robust to including controls which capture these two components. That is, the estimations include variables for quality of land (measured by the value of land) and tenancy relations (measured by dummy variables for landlords, tenants, and proportion of share-cropped land). The main estimation results are the same if the sample includes only share-croppers or only those who do not share-crop any land.

It is possible though that these alternative hypothesis do indeed play a central role but are not entering into the estimations significantly on their own but instead are somehow complementary to the groundwater market results. For example, perhaps higher land quality is driving the results and estimations pick up its importance via groundwater markets only because the demand for irrigation is complementary to the quality of land. Although, if there is indeed complementarity between irrigation and land quality, we would expect that the significant determinant of crop yields in low caste dominated villages should not be via water buyers but pump owners. The wealthier households have the higher quality land and can afford to incur the fixed costs of a tubewell boring and hand pump. Nevertheless, the estimations in Table 28 check for such interaction effects. In a

similar vein, we might expect complementarity between water markets and tenancy relations where, as found by Jacoby et al. (2004) for Pakistan, tenants receive lower prices and better access to water relative to other water buyers. In this case, we would expect to the see the complementarity between water buyers and being a tenant driving the results.

Table 28 lists the main estimation results from Section 4 interacted with value of land, land ownership, and the tenant and landlord dummy variables to determine if the complementarity between these variables and water markets is playing a role. From the estimation in the first column, there does not seem to be a complementary relationship between access to groundwater and quality of land. This is particularly the case for water buyers, where the impact of quality of land on crop income is negative for them relative to others. From the estimation in the second column, there does seem to be a complementary relationship between amount of land owned and being a water buyer, however the relationship does not explain why crop yields are significantly higher in low caste dominated villages. Contrary to what we might expect, as seen from the estimation in the final column, there is no evidence of a complementary relationship between being a water buyer and a tenant (or share-cropper).[62] All three of the estimations demonstrate that the positive effect on crop yields from residing in a low caste dominated village seems solely related to being a water buyer in the private groundwater markets. Additional estimates were run with interaction terms representing credit relations, that is who the household borrowed from (money lender, bank, higher, same, or lower caste) and amount borrowed. Again, there were no significant complementary effects.[63] Given that land quality, land ownership, tenancy and credit relations do not play a role in the explanation, the most plausible explanation seems to still be that related to caste relations and trade in the groundwater markets as proposed in the previous section.

The analysis, however, is limited by not having any precise information on water contracts or aggregate water market activity. Another possibility is that land distribution is playing a role that is not being captured in the data.[64] A systematic difference between BAC dominated villages and high caste dominated villages is that upper castes have much larger landholdings, that is, the dominant caste owns larger plots of land in the latter case.[65] Suppose that upper castes curtail the supply of water simply because they have larger landholdings and perhaps deeper tubewells.[66]

[62]The raw data also do not show any significant correlation between tenancy and being a water buyer.
[63]The raw data also do not reveal any noteworthy correlations between being a water buyer and credit relations.
[64]The estimation results in Table 19 do control for a Gini index of village land inequality.
[65]Refer to Table 6.
[66]Foster and Rosenzweig (2005) analyse the relationship between tubewell depth, agricultural productivity, and land distribution.

Then we might expect to see a higher price of water just because of the presence of wealthier households with larger landholdings, not because they are upper caste per se. They problem with this explanation is that the cultivation intensity of the upper castes is lower than that of the BACs and therefore, proportionally, they should have more water available to sell.[67] It should only be in their interest to sell off their excess supply of water. Again it would seem that caste distance from potential buyers can better explain why they don't sell.

A final possibility is a political economy explanation. Lower caste households may fair better in low caste dominated villages because the political power is in their hands.[68] The data did not, however, provide any direct evidence for such an explanation in the sense that better access to community level resources played no significant role. Nor was there any significant relationship between income for a given caste household and residing in a village where the same caste forms the most populous group, or where the village council leader is of the same caste, both of which would be correlated with greater political power in the village.

7. Conclusion

The central empirical finding here is that yields are systematically higher for low caste households residing in villages dominated by lower castes (BACs), in terms of total land ownership, compared to villages dominated by upper castes. This difference in yields seems to be explained by better access to irrigation for water buyers through private groundwater markets in the BAC dominated villages. The empirical results suggest that upper caste households do not easily trade water with lower caste households. This conjecture is in accord with anecdotal evidence in the area under study, where it is found that water transactions are strongly interpersonal. Individuals tend to conduct such trade with members of their own caste or close relatives. The presence of the upper castes, who own a substantial proportion of the private tubewells and pumps, therefore causes an inefficiency in the distribution of groundwater. This inefficiency is large and seems to be an example of culture (the caste system) directly affecting the development of markets.

Detailed analysis of the water contracts is limited due to data restrictions. Evidence suggests that water contracts in this region suffer moral hazard problems on both sides of the market. On the one hand, sellers' are responsible for the timing of the delivery of irrigation, which is crucial to the success of the crop. Buyers, on the other hand, are often credit constrained and payment

[67] See Table 15.

[68] Refer, for example, to the work of Pande (2003) who finds that political reservation for scheduled castes and tribes in Indian village councils has increased transfers to these social groups.

for the water supply can be made only once the returns from a successful crop are reaped. The current literature on these contracts has mainly focused on the moral hazard on the buyers side and emphasized the importance of inter-linkages between tenancy and credit relations to solve this enforcement problem.[69] It would seem that if it is moral hazard on the buyers' side which is more of a concern, then we would expect more trade across castes. That is, high caste landlords could potentially use their long-standing power to better enforce agreements with tenants who are of lower caste relative to a higher caste. This reasoning would suggest that because trade seems to break down across castes, it is the moral hazard on the sellers' side which may be the more important limit to water trade.

This being said, identifying which side of the contract suffers more moral hazard is beyond the scope of this paper. Enforcement problems may take many forms. For example, aside from the incentive problems just discussed, Rawal (2002) points out that since landholdings are highly fragmented and that most of the cultivating units are very small, even setting aside land for water delivery channels is often a complicated issue. *Panchayat* (village council) members are usually instrumental in solving disputes associated with this issue. Relatedly, Srinivas (1987) emphasizes the traditional role that dominant castes play in resolving disputes within the village. The paper here mainly emphasizes water distribution inefficiencies in high caste dominated villages simply because high caste households, who are less likely to trade with the lower castes, are the predominant tubewell owners. However, as Srinivas (1987) suggests, possibly the *power* of this dominant caste group is also impacting water contracts: if disputes occur across castes, the dominant caste will preside. This is an independent effect than just the fact that upper castes own the majority of tubewells.

Despite the possibility of several enforcement difficulties, relative to more complex goods or services, these trading relationships are still quite simple. They are bilateral agreements between two individuals who reside within close proximity and likely have done so for generations. That trade can break down under these circumstances is striking, particularly as the gains from trade are enormous for these very poor households.

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Table 1 - Bihar - In-Migration

Districts	1931 Census		1951 Census		1991 Census	
	Across Districts	Across States	Across Districts	Across States	Across Districts	Across States
Bhagalpur	0.03	0.002	0.03	0.003	0.07	0.002
Champaran	0.02	0.01	0.01	0.01	0.03	0.01
Darhbhanga	0.02	0.001	0.02	0.001	0.06	0.002
Gaya	0.02	0.002	0.02	0.003	0.06	0.002
Mungher	0.03	0.003	0.03	0.001	0.06	0.003
Muzaffarpur	0.02	0.001	0.01	0.001	0.06	0.002
Purnea	0.07	0.02	0.05	0.01	0.06	0.01
Sahabad	0.02	0.02	0.02	0.01	0.04	0.01
Saran	0.01	0.01	0.01	0.01	0.05	0.01

Table 2 - Uttar Pradesh - In-Migration

Districts	1931 Census		1951 Census		1991 Census	
	Across Districts	Across States	Across Districts	Across States	Across Districts	Across States
Allahabad	0.04	0.01	0.06	0.02	0.04	0.01
Azamgarh	0.03	0.001	0.05	0.002	0.07	0.003
Bahraich	0.03	0.001	0.03	0.002	0.03	0.003
Banda	0.03	0.02	0.03	0.02	0.03	0.02
Basti	0.02	0.001	0.04	0.001	0.04	0.003
Faizabad	0.05	0.002	0.06	0.003	0.05	0.004
Ghazipur	0.04	0.02	0.05	0.01	0.04	0.01
Gorakhpur	0.01	0.005	0.04	0.006	0.04	0.02
Hamirpur	0.04	0.05	0.05	0.03	0.04	0.02
Jaunpur	0.05	0.001	0.06	0.002	0.05	0.003
Mirzapur	0.04	0.02	0.06	0.02	0.09	0.03

Table 3 - Bihar - Out-Migration[70]

Districts	1931 Census Moved Districts	1951 Census Moved Districts
Bhagalpur	0.05	0.06
Champaran	0.01	0.01
Darhbhanga	0.03	0.02
Gaya	0.04	0.05
Mungher	0.05	0.04
Muzaffarpur	0.03	0.03
Purnea	0.005	0.01
Sahabad	0.02	0.02
Saran	0.02	0.02

[70]Out-migrants do not include displaced persons to Pakistan.

Table 4 - Caste composition by district[71]

	1997-98		1921 Census	
Districts	% Backward	% Upper	% Backward	% Upper
Bhagalpur	21.7	5.7	29.6	8.8
Champaran	35.9	1.0	27.1	4.3
Darhbhanga	20.8	9.3	26.9	13.2
Gaya	33.3	15.7	35.3	16.1
Mungher	33.8	6.8	27.8	8.7
Muzaffarpur	42.6	21.4	33.9	16.4
Purnea	22.5	2.2	8.7	1.5
Sahabad	26.6	36.3	16.9	24.7
Saran	19.8	20.3	24.0	23.3
Allahabad	33.8	5.2	28.3	13.2
Azamgarh	25.4	6.6	29.6	6.8
Bahraich	20.2	8.8	25.5	11.7
Banda	28.6	12.2	23.5	15.4
Basti	32.3	12.5	39.4	16.7
Faizabad	21.0	6.8	22.1	14.2
Ghazipur	30.0	0	28.1	N/A
Gorakhpur	39.6	1.2	40.0	9.6
Hamirpur	29.4	17.1	31.6	16.4
Jaunpur	20.0	10.2	26.3	15.1
Mirzapur	29.5	18.4	26.3	11.9

[71]Since the 1921 districts encompass the current-day districts, they are the ones listed in Table 1. The upper half of the table corresponds to the districts in Bihar, the lower half are those in Uttar Pradesh.

Table 5 - Village caste composition[72]

	All Villages	Bihar	Uttar Pradesh
Number of households	257	285	232
Most populous caste:			
Upper Caste	15 %	21 %	10 %
Backward Agricultural Caste (BAC)	34 %	33 %	35 %
Other Backward Caste (OBC)	13 %	12 %	14 %
Scheduled Caste (SC)	25 %	16 %	33 %
Muslim Upper Caste	8 %	11 %	5 %
Muslim Backward Caste	5 %	7 %	3 %
Caste with highest total amount of land owned:			
Upper Caste	40 %	39 %	41 %
Backward Agricultural Caste (BAC)	35 %	30 %	39 %
Other Backward Caste (OBC)	5 %	7 %	3 %
Scheduled Caste (SC)	3 %	2 %	3 %
Muslim Upper Caste	9 %	12 %	6 %
Muslim Backward Caste	8 %	10 %	6 %
Observations	120	57	63

[72]There is also a middle caste category in the data but only 2% of the sample fall into this category. Those who do are mainly from the Bania (Baniya) merchant caste, who would be more common in market towns. The upper caste group comprises mainly Brahmin and Rajput (Thakur) for both states and also Bhumihar in Bihar. The BAC group is predominantly made up of Yadav (Ahir), less prominent groups include Koiri, Kurmi, and Maurya. By comparison, the OBC category is very mixed, some of the more populous castes are Teli, Mallah, Kumhar, and Kahar. The SC group is mainly comprised of Chamars, less common castes include, Dusadh, Das (Pasi), Paswan, Mushar, and Dhobi.

Table 6 - Caste groups[73]

Variable	Upper	BAC	OBC	SC
Own farm	0.63 (0.48)	0.67 (0.50)	0.38 (0.48)	0.27 (0.45)
Casual labour	0.03 (0.18)	0.15 (0.36)	0.28 (0.45)	0.48 (0.50)
Salaried	0.18 (0.39)	0.09 (0.29)	0.09 (0.28)	0.07 (0.25)
Petty business	0.08 (0.27)	0.07 (0.26)	0.22 (0.41)	0.12 (0.32)
Literate	0.88 (0.33)	0.49 (0.50)	0.48 (0.50)	0.30 (0.46)
Total income	13505.0 (24815.1)	9228.0 (17316.2)	3918.4 (5664.9)	2915.9 (6726.1)
Wage income	1299.8 (2436.7)	712.5 (1350.7)	752.4 (1393.4)	694.1 (1167.6)
Farm income	9844.4 (23732.0)	6658.8 (15842.8)	1695.3 (5195.6)	1193.2 (6089.7)
Enterprise income	949.2 (2590.5)	667.1 (2651.2)	746.4 (1230.2)	395.5 (1300.1)
Transfers	145.5 (521.8)	65.7 (303.5)	41.2 (211.4)	26.1 (155.6)
Home production	1266.1 (1101.1)	1123.9 (837.1)	683.1 (594.4)	606.9 (521.5)
Food expenditure	1101.6 (779.9)	827.4 (573.9)	1000.4 (659.6)	857.1 (512.4)
Non-food expenditure	1483.1 (1997.5)	780.2 (1167.6)	586.7 (826.5)	411.2 (438.5)
Remittances	557.1 (2132.7)	168.1 (1263.3)	75.4 (605.3)	47.5 (285.7)
Social expenditures	4201.3 (17060.1)	1712.4 (8282.7)	1294.8 (6223.9)	619.4 (2678.9)
Landless	0.04 (0.21)	0.10 (0.30)	0.28 (0.45)	0.41 (0.49)
Land owned	5.2 (6.8)	3.5 (5.9)	1.6 (2.0)	1.6 (2.6)
Tenant	0.16 (0.36)	0.28 (0.45)	0.21 (0.41)	0.21 (0.41)
Landlord	0.20 (0.40)	0.07 (0.26)	0.07 (0.26)	0.05 (0.22)
Borrow	0.41 (0.49)	0.52 (0.50)	0.57 (0.50)	0.60 (0.49)
Amount owe	12045.5 (20160.7)	6318.1 (10530.6)	5344.1 (7429.3)	4642.5 (10012.3)
Borrow from employer	0.02 (0.15)	0.04 (0.21)	0.07 (0.26)	0.12 (0.33)
Borrow from money lender	0.12 (0.33)	0.21 (0.41)	0.17 (0.38)	0.20 (0.40)
Borrow from relative	0.19 (0.39)	0.19 (0.40)	0.17 (0.38)	0.11 (0.31)
Borrow from same caste	0.35 (0.48)	0.28 (0.45)	0.15 (0.36)	0.09 (0.29)
Borrow from higher caste	0.06 (0.25)	0.17 (0.37)	0.29 (0.46)	0.38 (0.49)
Borrow from lower caste	0.10 (0.30)	0.04 (0.19)	0.08 (0.27)	0.06 (0.23)
Borrow from bank	0.13 (0.34)	0.06 (0.23)	0.03 (0.18)	0.02 (0.13)
Observations	307	603	435	632

[73]We do not include the middle castes in this table as they account for only 2.5% of the total sample. Standard deviations are in parentheses.

Table 7 - Population and infrastructure

	High Caste Village	Low Caste Village
Number of households	245	278
Most populous caste:		
Upper	37.5 %	0 %
Backward Agricultural	20.8 %	69.0 %
Other Backward	10.4 %	11.9 %
Scheduled	29.2 %	16.7 %
Second most populous caste:		
Upper	29.2 %	2.4 %
Backward Agricultural	18.7 %	23.8 %
Other Backward	18.7 %	9.5 %
Scheduled	29.2 %	50.0 %
Infrastructure:		
Main drinking source - hand pump	44.7 %	35.7 %
Main drinking source - well	55.3 %	64.3 %
Number of handpumps	10.9	12.9
Not accessible by road	6.4 %	19.0 %
No waste disposal system	72.3 %	88.1 %
Electrified	61.7 %	52.4 %
Distance to facilities (km):		
Bus stop	3.6 (3.9)	3.9 (2.9)
Telephone service	5.4 (6.2)	7.9 (8.5)
Police station	7.7 (4.6)	8.2 (5.3)
Bank	5.1 (4.5)	5.3 (5.0)
Primary school	0.5 (0.7)	0.7 (1.0)
Middle school	2.8 (2.3)	2.9 (2.5)
Secondary school	5.1 (4.1)	5.5 (4.5)
Hospital	20.7 (15.7)	20.7 (16.4)
Observations	48	42

Table 8 - Land and irrigation[74]

Variable	High Caste Village	Low Caste Village
% landless households	21.8 (18.4)	21.9 (20.5)
Land inequality (Gini)	0.65 (0.12)	0.59 (0.12)
Price of irrigated land (per acre)	119213.5 (82923.5)	123366.7 (142281.5)
Price of non-irrigated land (per acre)	57140.4 (33888.8)	55581.1 (33895.2)
Percentage of land on crop share/rent	21.0 (20.5)	10.6 (10.2)
Sharecropping Contract	83 %	89 %
Fixed rent Contract	17 %	11 %
No cultivatable is irrigated	4.2 %	7.1 %
<25% of cultivatable is irrigated	18.7 %	0 %
25-50% of cultivatable is irrigated	12.5 %	19.0 %
50-75% of cultivatable is irrigated	37.5 %	35.7 %
75-100% of cultivatable is irrigated	27.1 %	38.1 %
>50% land irrigated by canal	16.7 %	14.3 %
>50% land irrigated by public tubewell	4.2 %	4.8 %
>50% land irrigated by private tubewell	58.3 %	57.1 %
>50% land irrigated by lakes, ponds	0 %	0 %
>50% land irrigated by river	6.2 %	2.4 %
>50% land irrigated by traditional well	0 %	0 %
Almost no land suffers from floods	45.8 %	40.5 %
Almost no land suffers from alkalinity	70.8 %	73.8 %
Almost no land suffers from waterlogging	47.9 %	57.1 %
Almost no land suffers from soil erosion	75.0 %	71.4 %
Main crop is paddy	62.5 %	61.9 %
Main crop is wheat	20.8 %	21.4 %
Price of paddy (Rs/100 kg)	323.4 (56.8)	344.2 (109.1)
Price of wheat (Rs/100 kg)	455.7 (70.6)	455.0 (71.5)
Observations	48	42

[74] All data listed in this section come from the village questionnaire with the exception of the Gini coefficient for land distribution. This was computed using the household level data, so should be not be weighted too highly as the number of households, in the household level data, per village is only between 15 and 30.

Table 9 - Government or NGO Development Programs

Variable	High Caste Village	Low Caste Village
No. Government employment programs	1.1 (1.3)	1.4 (1.5)
Money allocated	46856.1 (79262.1)	82237.2 (129674.2)
Project to build road	0.44 (0.50)	0.52 (0.50)
Project to build drinking water system	0.27 (0.45)	0.19 (0.40)
Project to build housing	0.08 (0.28)	0.17 (0.38)
No. Government or NGO development programs	0.64 (1.2)	0.62 (1.0)
Education Program	0.15 (0.36)	0.17 (0.38)
Health program	0.02 (0.14)	0.02 (0.15)
Irrigation Program	0	0.05 (0.21)
Drinking Water Program	0.15 (0.36)	0.14 (0.35)
Observations	48	42

Table 10 - Household characteristics - Upper and Backward Agricultural Castes[75]

	Upper	BAC	BAC
Variable	High Caste Village	High Caste Village	Low Caste Village
Own farm	0.62 (0.49)	0.71 (0.46)	0.69 (0.46)
Casual labour	0.04 (0.19)	0.11 (0.31)	0.15 (0.35)
Salaried	0.19 (0.39)	0.09 (0.29)	0.09 (0.28)
Petty business	0.08 (0.27)	0.08 (0.27)	0.06 (0.23)
Literate	0.88 (0.33)	0.36 (0.48)	0.54 (0.50)
Total income	13286.5 (25317.4)	7452.9 (10642.9)	10958.4 (20584.2)
Wage income	1288.1 (2362.6)	698.6 (1398.6)	751.0 (1421.6)
Farm income	9605.4 (24250.1)	4891.3 (9822.6)	8285.5 (18694.9)
Enterprise income	986.5 (2644.1)	554.0 (1126.3)	718.7 (3065.8)
Transfers	147.0 (544.1)	85.3 (361.6)	66.6 (303.0)
Home production	1259.6 (1119.6)	1223.5 (911.0	1136.5 (826.3)
Landless	0.05 (0.22)	0.08 (0.27)	0.10 (0.29)
Land owned	5.1 (6.7)	4.8 (5.9)	3.8 (4.9)
Land value	94676.0 (72236.6)	82119.1 (54854.5)	90617.2 (49034.9)
Tenant	0.16 (0.36)	0.32 (0.47)	0.28 (0.45)
Landlord	0.20 (0.40)	0.07 (0.26)	0.07 (0.25)
Borrow	0.40 (0.49)	0.48 (0.50)	0.54 (0.50)
Amount owe	11718.0 (18585.6)	6850.0 (11708.4)	6158.9 (10636.5)
From employer	0.02 (0.13)	0.08 (0.28)	0.03 (0.16)
From money lender	0.13 (0.33)	0.15 (0.35)	0.23 (0.42)
From relative	0.17 (0.38)	0.17 (0.38)	0.18 (0.39)
From same caste	0.37 (0.48)	0.16 (0.37)	0.33 (0.47)
From higher caste	0.07 (0.26)	0.32 (0.47)	0.10 (0.30)
From lower caste	0.09 (0.29)	0.06 (0.24)	0.04 (0.19)
From bank	0.10 (0.30)	0.05 (0.22)	0.08 (0.27)
Observations	274	170	345

[75]The amount of land owned reported is conditional on it being positive. Similarly, the amount borrowed and the primary credit lender is reported conditional on borrowing.

Table 11 - Household characteristics - Other Backward and Scheduled Castes

Variable	OBC High Caste Village	OBC Low Caste Village	SC High Caste Village	SC Low Caste Village
Own farm	0.40 (0.49)	0.30 (0.46)	0.22 (0.42)	0.27 (0.45)
Casual labour	0.26 (0.44)	0.30 (0.46)	0.53 (0.50)	0.48 (0.50)
Salaried	0.09 (0.28)	0.07 (0.25)	0.06 (0.23)	0.05 (0.22)
Petty business	0.21 (0.41)	0.27 (0.45)	0.11 (0.31)	0.15 (0.36)
Literate	0.46 (0.50)	0.46 (0.50)	0.24 (0.43)	0.36 (0.48)
Total income	3458.9 (3667.8)	4599.7 (6706.0)	2092.9 (2288.6)	3989.7 (10557.4)
Wage income	808.9 (1317.2)	844.8 (1791.1)	706.9 (1166.9)	614.7 (1114.5)
Farm income	1166.2 (3310.5)	2148.4 (6242.1)	391.2 (1348.7)	2301.1 (9893.9)
Enterprise income	733.9 (1214.4)	844.0 (1325.2)	357.6 (863.8)	428.9 (1326.1)
Transfers	65.2 (239.7)	33.1 (248.7)	24.5 (113.3)	33.8 (221.5)
Home production	684.7 (580.0)	729.4 (607.0)	612.6 (537.9)	602.2 (494.2)
Landless	0.31 (0.46)	0.28 (0.45)	0.44 (0.50)	0.44 (0.50)
Land owned	1.4 (1.9)	1.4 (1.6)	1.1 (1.4)	2.1 (3.2)
Tenant	0.28 (0.45)	0.19 (0.40)	0.24 (0.43)	0.18 (0.39)
Landlord	0.09 (0.29)	0.08 (0.28)	0.03 (0.18)	0.07 (0.25)
Borrow	0.56 (0.50)	0.60 (0.49)	0.62 (0.49)	0.59 (0.49)
Amount owe	5853.4 (8393.2)	5404.5 (7796.6)	3974.7 (5443.1)	4653.6 (14531.5)
From employer	0.04 (0.21)	0.09 (0.29)	0.12 (0.33)	0.13 (0.33)
From money lender	0.17 (0.38)	0.22 (0.42)	0.13 (0.34)	0.28 (0.45)
From relative	0.09 (0.29)	0.17 (0.38)	0.10 (0.30)	0.09 (0.29)
From same caste	0.17 (0.38)	0.14 (0.35)	0.08 (0.27)	0.09 (0.28)
From higher caste	0.44 (0.50)	0.22 (0.42)	0.50 (0.50)	0.35 (0.48)
From lower caste	0.04 (0.21)	0.10 (0.31)	0.05 (0.22)	0.03 (0.17)
From bank	0.02 (0.15)	0.03 (0.18)	0.01 (0.11)	0.02 (0.12)
Observations	159	144	263	216

Table 12 - Income comparisons by village type[76]

	Crop Income	Equivalence of Means
BAC - High Caste Village	4891.3 (9822.6)	
BAC - Low Caste Village	8285.5 (18694.9)	3394.2 (1528.7)**
OBC - High Caste Village	1166.2 (3310.5)	
OBC - Low Caste Village	2148.4 (6242.1)	982.2 (566.7)*
SC - High Caste Village	391.2 (1348.7)	
SC - Low Caste Village	2310.1 (9893.9)	1918.8 (616.8)***
Upper - Highest Population	11414.7 (31310.1)	2975.8 (2712.2)
Upper - Not Highest Population	8438.9 (13763.2)	
BAC - Highest Population	6456.6 (15321.3)	-556.8 (1342.5)
BAC - Not Highest Population	7013.4 (16748.0)	
OBC - Highest Population	1347.9 (4375.9)	-514.1 (532.3)
OBC - Not Highest Population	1862.0 (5545.2)	
SC - Highest Population	946.2 (3052.9)	-425.5 (491.0)
SC - Not Highest Population	1371.6 (7558.9)	
Upper - Upper Pradhan	16590.4 (41984.9)	4255.3 (4983.8)
Upper - Not Upper Pradhan	12335.1 (16810.0)	
BAC - BAC Pradhan	9923.6 (20769.1)	2836.2 (2027.3)
BAC - Not BAC Pradhan	7087.5 (14793.1)	
OBC - OBC Pradhan	2315.4 (3481.8)	-233.2 (1897.7)
OBC - Not OBC Pradhan	2548.6 (6780.7)	
SC - SC Pradhan	973.6 (3413.0)	-1317.2 (846.0)
SC - Not SC Pradhan	2290.7 (10146.0)	

[76]Standard deviations are in parentheses in the first column and standard errors are in parentheses in the second column. A single asterix denotes significance at the 10% level, double for 5%, and triple for 1%.

Table 13- Land and crop income - Upper and Backward Agricultural Castes[77]

	Upper High Caste Village	BAC High Caste Village	BAC Low Caste Village
Total Land:			
0-2 Acres	0.28 (0.45)	0.35 (0.48)	0.38 (0.48)
2-5 Acres	0.39 (0.49)	0.38 (0.49)	0.36 (0.48)
>5 Acres	0.30 (0.46)	0.25 (0.44)	0.19 (0.39)
Land Value:			
25th percentile	46000	35000	51000
50th percentile	80000	78500	90000
75th percentile	120000	110000	120000
Crop Income:			
25th percentile	3000	1800	2200
50th percentile	7500	3950	6400
75th percentile	19600	9000	15400
Observations	251	154	306

Table 14- Land and income - Other Backward and Scheduled Castes

	OBC High Caste Vill.	OBC Low Caste Vill.	SC High Caste Vill.	SC Low Caste Vill.
Total Land:				
0-2 Acres	0.68 (0.47)	0.73 (0.45)	0.75 (0.43)	0.57 (0.50)
2-5 Acres	0.23 (0.42)	0.14 (0.35)	0.18 (0.38)	0.26 (0.44)
>5 Acres	0.07 (0.25)	0.09 (0.29)	0.05 (0.21)	0.13 (0.34)
Land Value:				
25th percentile	56500	45000	25000	32500
50th percentile	100000	81000	60000	55750
75th percentile	120000	120000	100000	100000
Crop Income:				
25th percentile	1150	1200	800	1050
50th percentile	2200	2500	1580	3500
75th percentile	5000	6500	3100	10650
Observations	104	101	147	113

[77] Agricultural income is income generated from the selling of crops and excludes home production. Agricultural income and land values are reported conditional on being positive.

Table 15 - Agricultural inputs and outputs - Upper and Backward Agricultural Castes

Variable	Upper High Caste Village	BAC High Caste Village	BAC Low Caste Village
Total land	5.4 (6.9)	4.8 (5.9)	3.8 (4.9)
% land share-cropped	0.08 (0.19)	0.17 (0.28)	0.15 (0.27)
Total yields	1218.3 (2477.0)	642.5 (844.4)	1277.7 (1865.5)
Paddy yields	675.6 (1654.1)	374.7 (912.2)	707.4 (1861.0)
Wheat yields	784.3 (1597.0)	487.1 (987.6)	648.2 (1341.9)
Cereal yields	356.3 (1257.9)	151.0 (454.0)	283.6 (1460.6)
Pulse yields	1025.5 (2265.7)	1296.6 (3304.3)	848.4 (2561.4)
Bulb yields	915.7 (3003.2)	23.3 (208.2)	1001.1 (3029.6)
Seed yields	525.9 (2114.9)	375.3 (1580.2)	573.7 (3524.5)
Cash crop yields	1298.0 (4818.2)	458.5 (1704.5)	2233.6 (5250.1)
Crop intensity	2.1 (6.7)	2.0 (2.1)	2.5 (7.5)
Crop income/acre	1805.8 (3470.3)	1030.0 (1593.8)	2014.1 (3152.0)
% land irrigated	80.2 (27.6)	78.9 (29.4)	86.2 (23.7)
% irrigated all year	79.8 (32.8)	72.4 (38.8)	80.7 (34.0)
Tubewell irrigation	0.71 (0.46)	0.60 (0.49)	0.69 (0.46)
Canal irrigation	0.12 (0.33)	0.20 (0.40)	0.17 (0.38)
Own pump	0.31 (0.46)	0.27 (0.45)	0.30 (0.46)
Sell water	0.14 (0.35)	0.20 (0.40)	0.14 (0.35)
Buy water	0.69 (0.46)	0.58 (0.50)	0.75 (0.43)
Fertilizer/acre	561.6 (520.3)	503.4 (418.9)	735.6 (584.5)
Family labour/acre	476.1 (774.0)	642.0 (882.8)	846.1 (1272.0)
Tractor	0.05 (0.22)	0.03 (0.16)	0.04 (0.20)
Plough	0.33 (0.47)	0.49 (0.50)	0.54 (0.50)
Cart	0.07 (0.25)	0.12 (0.32)	0.09 (0.28)
Thresher	0.15 (0.36)	0.11 (0.31)	0.16 (0.37)
Cutter	0.51 (0.50)	0.53 (0.50)	0.52 (0.50)
Buffalo	0.47 (0.50)	0.76 (0.43)	0.66 (0.47)
Observations	251	154	306

Table 16 - Agricultural inputs and outputs - Other Backward and Scheduled Castes

Variable	OBC High Caste Vill.	OBC Low Caste Vill.	SC High Caste Vill.	SC Low Caste Vill.
Total land	1.9 (2.2)	2.1 (2.8)	1.5 (1.7)	2.8 (4.7)
% land share cropped	0.28 (0.39)	0.15 (0.28)	0.28 (0.39)	0.21 (0.33)
Total yields	393.9 (736.1)	919.2 (1678.7)	279.4 (698.2)	721.8 (1094.2)
Paddy yields	237.1 (713.8)	247.6 (713.6)	53.1 (325.7)	252.3 (681.0)
Wheat yields	202.7 (571.1)	470.8 (2561.1)	32.5 (238.4)	224.6 (664.5)
Cereal yields	101.7 (484.0)	21.5 (216.3)	49.5 (438.5)	70.8 (364.9)
Pulse yields	380.0 (1169.3)	463.3 (1404.1)	426.2 (1157.2)	1210.7 (2924.6)
Bulb yields	97.8 (452.5)	521.3 (1970.5)	56.7 (687.3)	235.2 (1352.4)
Seed yields	36.9 (231.4)	179.7 (765.9)	49.1 (317.7)	316.4 (1246.6)
Cash crop yields	848.6 (4563.8)	1018.6 (3025.9)	160.8 (1390.2)	490.1 (1993.4)
Crop intensity	2.7 (4.5)	1.8 (0.6)	2.7 (8.6)	3.1 (10.1)
Crop income/acre	853.6 (2349.3)	1299.5 (2012.0)	343.0 (774.0)	959.8 (1517.7)
% land irrigated	80.0 (33.0)	81.5 (32.6)	76.3 (38.3)	83.1 (29.3)
% irrigated all year	70.8 (38.9)	73.4 (39.6)	66.2 (43.8)	67.8 (44.4)
Tubewell irrigation	0.72 (0.45)	0.69 (0.46)	0.65 (0.48)	0.40 (0.49)
Canal irrigation	0.13 (0.34)	0.15 (0.36)	0.19 (0.39)	0.32 (0.47)
Own pump	0.08 (0.27)	0.13 (0.34)	0.02 (0.14)	0.15 (0.36)
Sell water	0.06 (0.23)	0.06 (0.24)	0.01 (0.12)	0.06 (0.24)
Buy water	0.76 (0.43)	0.74 (0.44)	0.70 (0.46)	0.73 (0.44)
Fertilizer/acre	726.4 (647.4)	874.6 (819.7)	620.6 (738.6)	569.3 (639.2)
Family labour/acre	813.3 (856.8)	1112.5 (1204.6)	752.1 (1317.9)	867.0 (1337.6)
Tractor	0	0.01 (0.10)	0	0.01 (0.09)
Plough	0.27 (0.45)	0.31 (0.46)	0.23 (0.42)	0.40 (0.49)
Cart	0.05 (0.21)	0.05 (0.22)	0.01 (0.12)	0.10 (0.30)
Thresher	0.06 (0.23)	0.05 (0.22)	0.01 (0.08)	0.04 (0.21)
Cutter	0.38 (0.49)	0.37 (0.48)	0.15 (0.36)	0.26 (0.44)
Buffalo	0.44 (0.50)	0.36 (0.48)	0.28 (0.45)	0.19 (0.40)
Observations	104	101	147	113

Table 17 - Tobit estimations of crop income/acre - All castes[78]

Variable	(1)	(2)	(3)	(4)
Literate	309.9 (237.3)	443.2 (237.1)*	443.2 (241.8)*	612.7 (233.8)***
Total land	174.7 (32.5)***	109.4 (26.7)***	109.4 (36.1)***	40.8 (18.0)**
Value of land	0.009 (0.002)***	0.008 (0.002)***	0.008 (0.003)**	0.009 (0.002)***
Fertilizer/acre	2.9 (0.6)***	2.3 (0.5)***	2.3 (0.4)***	0.9 (0.4)**
Labour/acre	0.06 (0.15)	0.12 (0.16)	0.12 (0.18)	0.21 (0.14)
Landlord	113.0 (357.2)	120.2 (325.4)	120.2 (335.2)	183.8 (299.6)
Tenant	405.6 (238.9)	454.7 (234.7)*	454.7 (249.5)*	390.6 (217.9)*
% land irrigated	6.8 (4.0)	5.1 (4.3)	5.1 (5.0)	10.7 (3.8)***
Own pump	1622.2 (433.5)***	1029.2 (407.9)**	1029.2 (346.3)***	690.9 (343.4)**
Sell water	694.2 (441.4)	236.7 (426.2)	236.7 (438.9)	600.6 (357.0)*
Buy water	855.6 (274.3)***	313.0 (278.0)	313.0 (358.3)	218.6 (249.5)
Tubewell	-607.0 (289.2)**	-622.5 (288.7)	-622.5 (543.0)	-67.9 (274.6)
Cutter	1072.6 (221.0)***	354.4 (208.1)*	354.4 (206.5)*	518.0 (196.9)***
Buffalo	741.7 (230.9)***	331.9 (226.4)	331.9 (306.6)	322.8 (206.3)
Low caste	-766.9 (343.0)**	-865.4 (349.1)**	-865.4 (593.3)	-647.8 (292.7)**
Low Caste Village	948.4 (237.0)***	847.7 (235.6)***	847.7 (424.6)**	701.9 (286.5)**
Constant	-4476.7 (450.4)***	-4286.4 (456.7)***	-4286.4 (664.4)***	-6852.6 (698.6)***
Observations	1623	1623	1623	1623
$\overline{R}^2$	0.03	0.04	0.04	0.06

[78] A single asterix denotes significance at the 10% level, double for 5%, and triple for 1%. Huber robust standard errors are in parentheses.

Table 18 - Tobit estimations of crop income/acre - Low castes[79]

Variable	(1)	(2)	(3)	(4)
Literate	77.1 (242.3)	209.8 (238.1)	209.8 (241.2)	377.9 (228.1)*
Total land	211.7 (44.7)***	124.8 (32.5)***	124.8 (44.2)***	34.5 (22.2)
Value of land	0.009 (0.003)***	0.006 (0.003)**	0.006 (0.003)*	0.01 (0.003)***
Fertilizer/acre	2.6 (0.4)***	2.3 (0.4)***	2.3 (0.4)***	1.3 (0.30)***
Labour/acre	0.12 (0.15)	0.14 (0.16)	0.14 (0.18)	0.19 (0.15)
Landlord	490.3 (422.5)	238.8 (378.8)	238.8 (340.0)	253.1 (383.7)
Tenant	444.3 (239.8)*	513.2 (251.1)**	513.2 (273.6)*	384.7 (233.8)*
% land irrigated	5.1 (4.2)	8.5 (4.8)*	8.5 (5.0)*	15.1 (4.3)***
Own pump	1254.2 (460.7)***	773.8 (435.8)*	773.8 (435.2)*	305.6 (381.3)
Sell water	1262.8 (521.5)**	688.2 (489.5)	688.2 (452.5)	900.7 (416.9)**
Buy water	821.5 (296.5)***	366.1 (312.0)	366.1 (396.5)	304.6 (276.0)
Tubewell	-463.5 (284.4)	-409.4 (275.1)	-409.4 (410.7)	46.7 (268.0)
Cutter	1159.8 (265.2)***	382.2 (263.6)	382.2 (270.8)	612.4 (259.3)**
Buffalo	464.9 (252.9)*	-128.6 (257.1)	-128.6 (354.2)	-140.4 (241.0)
Low Caste Village	1075.5 (234.4)***	883.2 (235.2)***	883.2 (388.2)**	679.3 (288.7)**
Constant	-4907.3 (470.2)***	-3912.8 (461.1)***	-3912.8 (621.5)***	-5610.9 (875.9)***
Observations	1295	1295	1295	1295
$\overline{R}^2$	0.04	0.05	0.05	0.07

[79]The sample is the lower castes (BAC, OBC, SC). The estimation in the first column does not include any additional controls. The estimation in the second column includes crop, caste, and state controls. The third estimation includes the same controls with regression disturbance terms clustered at the village level. The estimation in column four includes crop, caste, and district controls.

Table 19 - Tobit estimations of crop income/acre with village variables[80]

Variable	(1)	(2)	(3)	(4)
Literate	116.0 (250.0)	207.3 (242.6)	207.3 (243.2)	431.5 (232.4)*
Total land	167.0 (41.2)***	101.8 (30.4)***	101.8 (41.2)**	21.7 (21.3)
Value of land	0.02 (0.003)***	0.01 (0.003)***	0.01 (0.004)***	0.01 (0.003)***
Fertilizer/acre	2.7 (0.4)***	2.3 (0.4)***	2.3 (0.4)***	1.4 (0.3)***
Labour/acre	0.11 (0.15)	0.16 (0.15)	0.16 (0.16)	0.19 (0.15)*
Landlord	245.9 (422.8)	130.7 (385.5)	130.7 (356.5)	154.4 (390.3)
Tenant	370.7 (248.0)	501.0 (258.7)*	501.0 (286.8)	427.7 (244.9)
% land irrigated	2.1 (4.4)	6.9 (4.9)	6.9 (5.0)	16.6 (4.4)***
Own pump	1303.5 (469.0)***	947.2 (457.3)**	947.2 (494.1)*	280.1 (406.1)
Sell water	1068.1 (521.3)**	549.5 (492.2)	549.5 (439.5)	917.2 (438.5)**
Buy water	654.3 (299.7)**	445.6 (309.3)	445.6 (384.6)	589.1 (280.8)**
Tubewell	-171.1 (286.8)	-324.8 (282.8)	-324.8 (407.8)	26.0 (280.4)
Cutter	1077.9 (278.3)***	424.2 (274.9)	424.2 (270.5)	546.2 (258.6)**
Buffalo	557.7 (257.8)**	12.7 (262.3)	12.7 (365.1)	32.6 (249.0)
Low Caste Village	965.8 (244.0)***	1012.6 (248.6)***	1012.6 (420.0)***	992.4 (312.9)***
Gini (land distribution)	-2973.5 (1056.9)***	1122.2 (1187.9)	1122.2 (2163.2)	2875.3 (1399.4)**
Total Govt. Programs	45.3 (51.5)	-91.3 (66.3)	-91.3 (89.5)	-425.3 (90.8)***
Price of irrigated land	-0.004 (0.001)***	-0.004 (0.001)***	-0.004 (0.001)***	0.002 (0.001)
Price of non-irrigated land	-0.01 (0.004)***	-0.02 (0.004)***	-0.02 (0.007)**	-0.02 (0.006)***
Skilled male wage	-8.7 (8.2)	-7.5 (9.0)	-7.5 (16.1)	25.6 (9.4)***
Constant	-1704.9 (996.6)*	-2958.1 (995.6)***	-2958.1 (1757.9)	-9289.4 (1512.9)***
Observations	1295	1295	1295	1295
$\overline{R}^2$	0.04	0.06	0.06	0.08

[80]The sample is the lower castes (BAC, OBC, SC). The estimation in the first column does not include any additional controls. The estimation in the second column includes crop, caste, and state controls. The third estimation includes the same controls with regression disturbance terms clustered at the village level. The estimation in column four includes crop, caste, and district controls.

Table 20 - Tobit estimations of crop income/acre with interaction variables[81]

Variable	(1)	(2)	(3)	(4)
Literate	-268.0 (363.5)	-7.9 (353.5)	-7.9 (380.0)	361.5 (331.5)
Total land	205.8 (47.8)***	105.8 (39.3)***	105.8 (51.2)**	37.3 (33.7)
Value of land	0.005 (0.004)	0.003 (0.004)	0.003 (0.004)	0.005 (0.004)
Fertilizer/acre	1.5 (2.6)	2.6 (2.6)	2.6 (2.8)	-0.12 (2.3)
Labour/acre	0.001 (0.3)	0.03 (0.30)	0.03 (0.3)	0.14 (0.24)
Landlord	1206.9 (588.8)**	598.8 (525.4)	598.8 (489.8)	-8.2 (436.7)
Tenant	1103.3 (339.1)***	1209.3 (356.2)***	1209.3 (362.0)***	785.7 (353.1)**
% land irrigated	5.1 (6.6)	8.5 (6.5)	8.5 (6.1)	12.6 (6.2)**
Own pump	699.3 (659.1)	181.4 (684.2)	181.4 (684.8)	88.1 (602.6)
Sell water	1226.8 (870.1)	891.6 (857.6)	891.6 (915.0)	1284.2 (742.2)*
Buy water	-214.7 (430.8)	-420.2 (407.6)	-420.2 (498.1)	-227.7 (374.8)
Tubewell	167.3 (450.9)	126.8 (439.9)	126.8 (514.9)	790.6 (383.7)**
Cutter	1239.2 (361.6)***	625.5 (344.5)*	625.5 (353.5)*	590.1 (327.7)*
Buffalo	455.5 (365.9)	-233.0 (358.4)	-233.0 (425.0)	-449.6 (338.7)
Low Caste Village	-267.6 (494.0)	64.3 (501.0)	64.3 (757.0)	-610.7 (547.7)
Low Caste Vill*Literate	560.4 (491.1)	350.4 (501.0)	350.4 (525.5)	2.0 (463.9)
Low Caste Vill*Total land	2.4 (77.6)	31.5 (58.8)	31.5 (69.0)	-9.2 (43.4)
Low Caste Vill*Value of land	0.007 (0.006)	0.005 (0.006)	0.005 (0.006)	0.01 (0.005)*
Low Caste Vill*Fertilizer/acre	1.0 (2.6)	-0.46 (2.6)	-0.46 (2.8)	1.40 (2.4)
Low Caste Vill*Labour/acre	0.2 (0.4)	0.15 (0.36)	0.15 (0.37)	0.07 (0.30)
Low Caste Vill*Landlord	-1265.8 (833.8)	-579.5 (753.8)	-579.5 (745.7)	443.9 (700.4)
Low Caste Villa*Tenant	-1140.0 (491.5)**	-1184.5 (492.5)**	-1184.5 (592.2)*	-666.3 (462.6)
Low Caste Vill*% land irrig.	2.4 (8.8)	1.3 (8.5)	1.3 (8.3)	4.9 (8.2)
Low Caste Vill*Own pump	875.1 (892.1)	917.1 (900.4)	917.1 (849.1)	449.1 (773.8)
Low Caste Vill*Sell water	-102.1 (1060.4)	-311.3 (1048.9)	-311.3 (1038.2)	-747.5 (900.1)
Low Caste Vill*Buy water	1747.1 (599.6)***	1403.0 (551.2)***	1403.0 (679.5)**	1081.6 (490.5)**
Low Caste Vill*Tubewell	-875.5 (579.0)	-767.4 (567.6)	-767.4 (723.1)	-1206.4 (531.8)**
Low Caste Vill*Cutter	-199.0 (491.9)	-380.5 (481.8)	-380.5 (515.4)	-51.9 (472.8)
Low Caste Vill*Buffalo	28.5 (487.4)	147.1 (468.1)	147.1 (624.6)	579.6 (429.6)
Constant	-4262.8 (446.7)***	-3502.8 (499.0)***	-3502.8 (661.5)***	-4806.6 (873.2)***
Observations	1295	1295	1295	1295
$\overline{R}^2$	0.04	0.06	0.06	0.07

[81]The sample is the lower castes (BAC, OBC, SC). Similar to the previous tables, the estimation in the first column does not include any additional controls. The estimation in the second column includes crop, caste, and state controls. The third estimation includes the same controls with regression disturbance terms clustered at the village level. The estimation in column four includes crop, caste, and district controls.

Table 21 - Tobit estimations of crop income/acre with interaction variables[82]

Variable	(1)	(2)
Literate	220.2 (237.6)	180.2 (238.0)
Total land	127.0 (32.7)***	120.6 (31.8)***
Value of land	0.006 (0.003)**	0.007 (0.003)**
Fertilizer/acre	2.2 (0.4)***	2.2 (0.4)***
Labour/acre	0.13 (0.16)	0.15 (0.16)
Landlord	527.2 (535.5)	228.8 (379.3)
Tenant	1096.4 (363.6)***	498.2 (250.3)**
% land irrigated	9.2 (4.8)*	9.3 (4.7)**
Own pump	746.0 (432.9)*	217.0 (702.5)
Sell water	722.1 (485.6)	898.2 (866.8)
Buy water	382.4 (310.7)	-384.6 (363.4)
Tubewell	-368.9 (276.8)	-402.2 (273.8)
Cutter	419.8 (264.0)	336.4 (261.7)
Buffalo	-162.1 (256.1)	-106.7 (258.1)
Low Caste Village	1257.9 (315.2)***	-19.6 (366.3)
Low Caste Village*Landlord	-513.0 (751.4)	
Low Caste Village*Tenant	-1026.5 (494.2)**	
Low Caste Village*Own pump		939.1 (832.6)
Low Caste Village*Sell water		-405.7 (1062.3)
Low Caste Village*Buy water		1303.0 (451.0)***
Constant	-4127.6 (476.3)***	-3466.6 (480.5)***
Observations	1295	1295
$\overline{R}^2$	0.05	0.05

[82]The sample is the lower castes (BAC, OBC, SC). All estimations include caste, crop and state controls.

Table 22 - Tobit estimations of crop income/acre with interaction variable[83]

Variable	All Castes	BAC	SC
Literate	431.2 (234.0)*	329.8 (339.7)	249.1 (366.0)
Total land	107.0 (26.5)***	105.8 (31.9)***	98.0 (55.5)*
Value of land	0.008 (0.002)***	0.01 (0.004)***	-0.001 (0.005)
Fertilizer/acre	2.3 (0.5)***	2.6 (0.6)***	-0.8 (2.1)
Labour/acre	0.12 (0.16)	-0.07 (0.2)	0.32 (0.15)**
Landlord	110.0 (324.5)	-205.2 (456.3)	1583.3 (630.3)***
Tenant	441.2 (234.8)*	-44.2 (319.1)	1037.0 (445.7)**
% land irrigated	5.1 (4.3)	8.4 (6.5)	5.0 (5.2)
Own pump	1114.4 (413.3)***	960.3 (556.8)	1409.6 (787.9)*
Sell water	154.7 (424.7)	820.9 (573.8)	-2263.3 (1064.3)**
Buy water	-102.9 (332.9)	-468.8 (533.6)	-74.8 (573.0)
Tubewell	-626.7 (289.4)	-447.0 (345.3)	-406.7 (519.4)
Cutter	349.1 (207.4)	246.3 (338.9)	201.9 (557.9)
Buffalo	336.1 (226.9)	561.2 (370.6)	-354.0 (440.9)
Low Caste	-904.1 (352.0)***		
Low Caste Village	251.5 (344.6)	-304.7 (529.2)	346.7 (468.4)
Low Caste Village*Buy water	956.3 (476.4)**	1566.5 (690.5)**	1233.0 (614.3)**
Constant	-3995.2 (454.3)***	-2997.1 (734.4)***	-3731.8 (523.4)***
Observations	1623	513	479
$\overline{R}^2$	0.05	0.03	0.10

Table 23 - Water markets at the village level - all castes[84]

	High Caste Villages	Low Caste Villages	Equivalence of Means
Acres cultivated	883.8 (825.7)	915.2 (803.2)	-31.3 (172.3)
Acres owned	468.6 (436.5)	436.4 (414.4)	32.2 (90.1)
Population	208.1 (127.2)	236.9 (140.1)	-28.7 (28.2)
Buyers per capita	0.70 (0.27)	0.75 (0.22)	-0.05 (0.05)
Buyers/land cultivated	0.21 (0.24)	0.21 (0.15)	-0.005 (0.04)
Buyers/land owned	0.62 (1.90)	0.45 (0.32)	0.17 (0.30)
Sellers per capita	0.10 (0.11)	0.11 (0.11)	-0.02 (0.02)
Sellers/land cultivated	0.02 (0.03)	0.03 (0.01)	-0.009 (0.007)
Sellers/land owned	0.05 (0.07)	0.06 (0.06)	-0.01 (0.01)
Pumps per capita	0.19 (0.13)	0.24 (0.17)	-0.05 (0.03)
Pumps/land cultivated	0.04 (0.03)	0.06 (0.06)	-0.016 (0.010)
Pumps/land owned	0.09 (0.08)	0.11 (0.08)	-0.027 (0.018)
Observations	48	42	

[83]The first estimation includes the entire sample of castes (Upper, BAC, OBC, SC). All estimations include crop and state controls.

[84]Standard deviations are in parentheses in first and second columns. Standard errors are in parentheses in the third column.

Table 24 - Water markets at the village level - lower castes

	High Caste Villages	Low Caste Villages	Equivalence of Means
Acres cultivated	433.4 (571.8)	886.0 (784.7)	-452.6 (143.5)***
Acres owned	172.3 (277.5)	415.8 (403.8)	-243.5 (72.3)***
Population	140.0 (92.9)	230.8 (136.6)	-90.7 (24.4)***
Buyers per capita	0.73 (0.31)	0.75 (0.23)	-0.02 (0.06)
Buyers/land cultivated	0.40 (0.53)	0.22 (0.15)	0.19 (0.08)**
Buyers/land owned	1.43 (2.31)	0.46 (0.32)	0.97 (0.36)***
Sellers per capita	0.06 (0.11)	0.11 (0.11)	-0.05 (0.02)**
Sellers/land cultivated	0.02 (0.03)	0.03 (0.04)	-0.014 (0.007)**
Sellers/land owned	0.04 (0.08)	0.06 (0.06)	-0.02 (0.01)
Pumps per capita	0.09 (0.13)	0.23 (0.17)	-0.14 (0.03)***
Pumps/land cultivated	0.02 (0.03)	0.06 (0.06)	-0.03 (0.01)***
Pumps/land owned	0.06 (0.09)	0.11 (0.09)	-0.05 (0.02)**
Observations	48	42	

Table 25 - Caste composition by water market activity

	High Caste Village			Low Caste Village		
	Own pump	Sell water	Buy water	Own pump	Sell water	Buy water
Upper	59.5 %	47.3 %	38.2 %	6.0 %	5.1 %	3.7 %
BAC	32.1 %	41.9 %	19.5 %	69.9 %	72.9 %	56.2 %
OBC	6.1 %	8.1 %	17.3 %	9.8 %	10.2 %	18.3 %
SC	2.3 %	2.7 %	22.6 %	12.8%	11.9 %	20.3 %
Obs.	131	74	456	133	59	410

Table 26 - Household characteristics by water market activity and caste

	Own pump	Sell water	Buy water
Upper caste - High Caste Village:			
Acres cultivated	10.9 (7.6)	10.0 (8.6)	6.3 (7.4)
Crop intensity	3.0 (11.5)	1.9 (3.5)	2.3 (7.9)
Total yields	1568.4 (1824.0)	1444.6 (1197.6)	1152.2 (1884.9)
Land owned	7.8 (6.5)	7.5 (7.1)	4.3 (4.4)
Value of land	98955 (51315)	91557 (56164)	97815 (77024)
BAC - High Caste Village:			
Acres cultivated	11.4 (10.2)	12.8 (10.0)	4.9 (6.6)
Crop intensity	2.6 (2.9)	2.8 (3.3)	1.8 (1.4)
Total yields	915.5 (940.3)	1061.7 (886.2)	467.8 (776.6)
Land owned	6.1 (7.3)	6.9 (7.7)	3.0 (2.7)
Value of land	101505 (44537)	103274 (47626)	94350 (55127)
BAC - Low Caste Village:			
Acres cultivated	9.7 (12.6)	10.0 (15.6)	6.5 (10.7)
Crop intensity	2.6 (9.9)	3.9 (14.7)	2.8 (8.7)
Total yields	1911.4 (1882.8)	2488.4 (1864.2)	1261.7 (1956.2)
Land owned	6.0 (7.2)	5.3 (5.0)	3.2 (3.5)
Value of land	97753 (42799)	106302 (48071)	93084 (50161)

Table 27 - Probit estimations of water activity [85]

Variable	Water buyer (All cultivators)	Water buyer (No pump)	Water seller (All cultivators)	Water seller (Own pump)
Land own	-0.04 (0.02)**	-0.06 (0.02)***	-0.002 (0.02)	-0.001 (0.02)
Tenant	-0.04 (0.11)	-0.04 (0.13)	0.43 (0.22)**	0.39 (0.23)*
Landlord	0.004 (0.17)	-0.01 (0.19)	-0.07 (0.39)	-0.06 (0.43)
Literate	0.22 (0.11)**	0.25 (0.12)**	0.19 (0.20)	0.27 (0.22)
Borrow	0.15 (0.11)	0.18 (0.12)	0.03 (0.20)	0.002 (0.22)
Own pump	-1.8 (0.17)***		3.4 (0.35)***	
Low caste village	0.27 (0.11)**	0.24 (0.12)**	-0.85 (0.23)***	-0.86 (0.26)***
Constant	-0.08 (0.24)	-0.001 (0.25)	-4.1 (0.7)***	-0.8 (0.7)
$\overline{R}^2$	0.31	0.25	0.64	0.14
Observations	919	744	919	175

[85] All of the estimations include crop, caste, and state controls. Huber robust standard errors are in parentheses.

Table 28 - Tobit estimations of crop income/acre with interaction variable[86]

Variable	(1)	(2)	(3)
Literate	174.1 (238.2)	223.9 (239.9)	197.4 (236.0)
Total land	119.6 (29.3)***	138.7 (41.3)***	115.7 (29.7)***
Value of land	0.03 (0.007)***	0.007 (0.003)**	0.005 (0.003)*
Fertilizer/acre	2.3 (0.4)***	2.3 (0.4)***	2.1 (0.4)***
Labour/acre	0.12 (0.16)	0.17 (0.16)	0.16 (0.16)
Landlord	0.93 (395.0)	218.6 (379.1)	1371.9 (735.0)*
Tenant	433.2 (251.1)*	570.7 (269.4)**	2434.8 (469.5)***
% land irrigated	3.3 (4.6)	10.5 (4.8)**	8.9 (4.7)*
Own pump	695.8 (1032.6)	811.1 (828.1)	1473.6 (836.4)*
Sell water	614.2 (506.8)	591.9 (499.2)	768.7 (492.1)
Buy water	1355.7 (539.0)**	-885.2 (468.9)*	394.7 (485.3)
Tubewell	-509.7 (267.7)*	-350.4 (277.8)	-454.3 (274.5)*
Cutter	415.5 (261.1)	304.7 (262.2)	515.7 (264.4)*
Buffalo	-130.1 (255.7)	-127.9 (259.4)	-104.9 (255.2)
Low Caste Village	-349.1 (407.4)	-27.8 (366.8)	220.8 (371.6)
Buy water*Value of land	-0.03 (0.007)***		
Own pump*Value of land	-0.01 (0.01)		
Low Caste Vill*Buy water*Value of land	0.006 (0.01)		
Low Caste Vill*Own pump*Value of land	0.003 (0.006)		
Buy water*Land own		207.0 (89.9)**	
Own pump*Land own		-116.6 (80.1)	
Low Caste Vill*Buy water*Land own		52.4 (90.9)	
Low Caste Vill*Own pump*Land own		-128.6 (107.4)	
Buy water*Tenant			-1375.7 (600.0)**
Buy water*Landlord			-1278.4 (828.4)
Own pump*Tenant			-2679.5 (1071.5)**
Own pump*Landlord			535.5 (1648.4)
Low Caste Vill*Buy water*Tenant			-1185.0 (627.4)*
Low Caste Vill*Buy water*Landlord			-545.3 (819.8)
Low Caste Vill*Own pump*Tenant			-94.1 (1128.7)
Low Caste Vill*Own pump*Landlord			-56.3 (2026.2)
Low Caste Vill*Own pump	644.9 (1153.3)	466.7 (900.2)	476.9 (840.9)
Low Caste Vill*Buy water	1328.0 (620.4)**	1491.3 (547.2)***	1499.5 (521.1)***
Constant	-3676.2 (485.0)***	-3540.3 (486.8)***	-3975.1 (521.0)***
Observations	1295	1295	1295
$\overline{R}^2$	0.06	0.06	0.06

[86]The sample is the lower castes (BAC, OBC, and SC). All estimations include caste, crop, and state controls.