

An In-depth Analysis of Caste-based Inequity in Welfare Allocation of the National Rural Employment Guarantee Scheme in India

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Abstract

Abstract: Social welfare schemes are essential policy instruments to facilitate livelihood and development of vulnerable populations. To overcome historical patterns of discrimination against marginalized groups, arguments of social justice demand that welfare allocation should be equitable with a priority towards these groups. The rural employment guarantee scheme (MGNREGS) in India espouses such a view and states that scheduled caste (SC) and scheduled tribe (ST) groups should get preferential allocation. In this paper, we build a framework and conduct an (almost) pan-India analysis using publicly available MGNREGS data to determine disparate treatment and disparate impact of different types, towards SC/ST groups, and uncover the prevalence of different processes through which this discrimination may be operating. We introduce disparate treatment and impact metrics for MGNREGS related to the efficiency of scheme coverage, intensity of scheme uptake, and scheme demand. We also build a unique characterization of panchayats (local administrative units) in terms of whether SC/ST population is dominant in the panchayat, and distributed across the villages of the panchayat or concentrated in a few villages or most villages. Analysis of treatment and impact metrics in these different categories of panchayats helps point towards different processes through which discrimination could be operating, such as through local elite capture by dominant castes or through administrative apathy at higher bureaucratic levels. Our paper makes valuable contribution in being the first work to quantitatively analyze inequity in welfare scheme allocation in the largest public works scheme in the world, and in taking a unique approach to evaluate different treatment and impact metrics in different stylized settings. The results can be used to define precise policy actions at the state, district, and panchayat levels, to counter this inequity. Further, even the identification of disparity in welfare allocation can be used to trigger corrective action.

CCS Concepts

• **Computing methodologies** → **Modeling methodologies**; • **Applied computing** → **Economics**.

Keywords

MGNREGA, MGNREGS, Social Welfare allocation, Equity, Disparity, Discrimination, Machine Learning, Data Science, Data Analysis, Propensity matching, Multilayer perceptron, Demand prediction, Socio economic structural models

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1 Introduction

Government-supported welfare schemes are crucial to fulfill basic needs and provide essential services to the poor to realize their capabilities and lead dignified lives [19]. However, the implementation of these schemes may encounter several issues, such as to do with unfair exclusion arising from low budgets or inaccurate targeting, or corrupt or inefficient administrative practices at the last mile, which can especially lead to “discouraged worker” effects [22, 41, 42, 44, 54] when workers become disinclined to demand employment despite the need because of negative experiences in the past in terms of being denied work or their compensation being delayed. These schemes may suffer from *disparate treatment* defined as intentional discrimination [9, p. 694], *disparate impact* defined as discriminatory impact despite neutral treatment [9, p. 701], or both. Quantitative [25, 33, 36] and qualitative studies [47, 55, 57] have analyzed the extent of equity in social welfare allocations and have uncovered a need to improve the efficiency and effectiveness of social welfare programs in India [25] to address the consequences of historical discrimination and to improve the socio-economic conditions of the poorest [48].

In particular, evidence of the empowerment of the poor through the significant social welfare scheme, the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), has been studied extensively in terms of its perceived impact on existing power dynamics between the local elite and the poor [36, 47, 55]. The scheme empowers citizens with the right to demand 100 days



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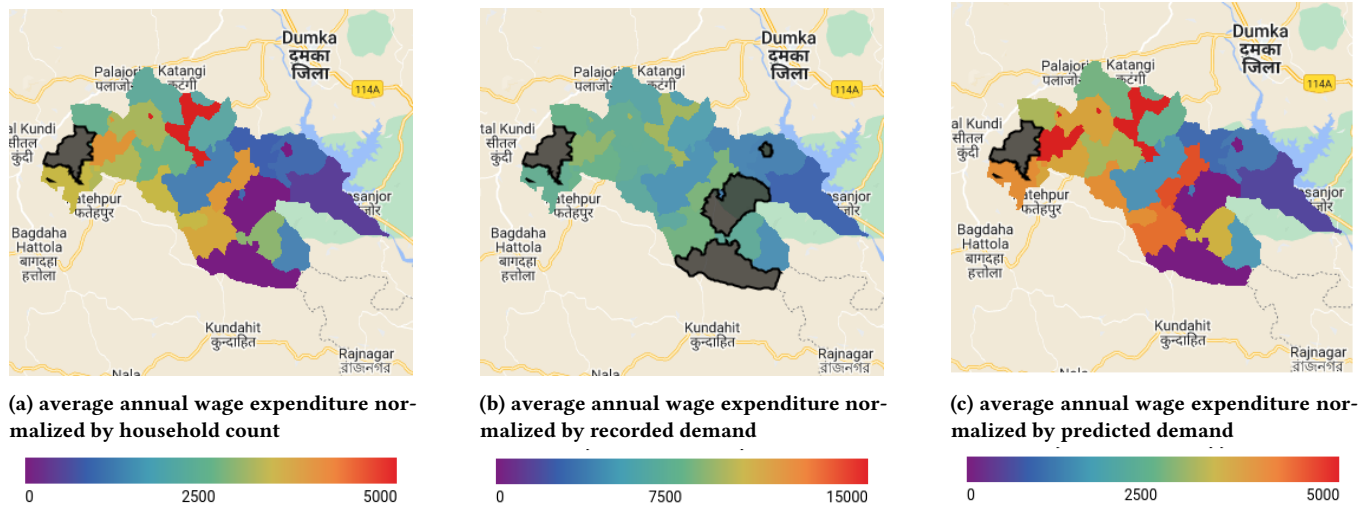


Figure 1: Panchayat-wise MGNREGS expenditure in the Masalia block in the Dumka district of the state of Jharkhand in India

of employment per household per year [44] and employs unskilled labor (143.3 million active workers) to build assets (80.6 million assets so far) [1, 46] such as farm ponds for rainwater harvesting, land-leveling for agriculture, tree plantations, etc. for sustained economic and social benefits to the local community [45]. In this paper, we chose MGNREGS to assess disparate treatment and impact in welfare allocation due to i) the availability of MGNREGS data through a public platform, ii) its stated provisions to prioritize allocation towards marginalized castes, the right to demand work, and self-selection by the beneficiaries, and iii) the pan-India coverage which makes it ideal for equity analysis to explore the extent to which the scheme implementation meets the equity guidelines envisioned in the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) 2005.

We start with a preliminary review of the extent of inequity in MGNREGS fund allocation using publicly available panchayat-level data maintained by The Ministry of Rural Development, Government of India. *Panchayats* are elected local administrative bodies, responsible for planning economic development and social justice. The panchayats (formally referred to as *gram panchayats*) are a group of villages – the smallest administrative units – in rural India.

Since panchayats across India span different caste-based population distributions and socio-economic development levels, they provide an ideal setting of a natural experiment to assess equity in welfare fund allocation. Different metrics can be used for equity and we show some of them in the average annual MGNREGS expenditure (average expenditure from 2014/15 to 2020/21) for the Masalia block in the Dumka district of the state of Jharkhand in Figure 1. The average annual expenditure is normalized by the number of households in a panchayat (based on the 2011 census in India) in Figure 1(a), and by average the demand between 2014/15 to 2020/2021 in Figure 1(b). Since MGNREGS is a demand-driven scheme, it might appear logical that the analysis of fair allocation should be based on the extent to which demand is met rather than the household count since the self-selection nature of MGNREGS to take up unskilled labour work implies that not all households would be interested to

work under the scheme. Interestingly though, while the Management Information System (MIS) of MGNREGS shows that 98-99% of the demand is being fulfilled, field studies by researchers have highlighted a large gap in meeting demand [31]. This is assumed to be either due to an unwillingness by the people to raise demand because of the “discouraged worker” effect [22, 43], or an unwillingness of field level MGNREGS officials to record all the demand since unmet demand is liable to an unemployment allowance that needs to be provided to the people. Therefore, there is a need to somehow account for the unstated demand and to compare that with the expenditure instead of the recorded demand or the household count. We therefore developed a machine learning-based demand model to predict the number of households that would demand MGNREGS work “*predicted demand*”, based on factors that should drive the demand for work such as the socio-economic development level of the panchayat, irrigation facilities available in the area, alternative employment opportunities, climate risk, demographic factors such as gender, caste composition, and literacy rate [12, 16, 28], the average MGNREGS wage in the state, and compensation given in MGNREGS for wage payment delays as a proxy for the extent to which the administration is efficient in meeting citizen demands. We present this model in detail in Section 5.2, and show in Figure 1(c) the MGNREGS expenditure normalized by this “*predicted demand*” per panchayat. As we can see, the unevenness in MGNREGS expenditure across different panchayats even in the same block suddenly jumps out when we consider this modeled demand output.

What could explain this disparity? Historically, caste has been identified as a significant source of disparity in access to welfare schemes [20, 36, 38] with a higher occurrence of landlessness, ownership of less fertile and extremely small agricultural landholdings, and a very high dependency on agricultural labor work amongst scheduled castes and scheduled tribes [20, 38]. MGNREGS also provides a caste-wise break-up of the expenditure per panchayat. We show further in Figure 2 the difference between the fraction of SC/ST households provided employment under MGNREGS and the

fraction of general caste households provided employment. This indication of potential discrimination provides us with a strong motivation to do a more formal analysis of caste-based disparity in the allocation of MGNREGS funds across panchayats. We present in this paper an overarching framework to estimate the extent of inequity in allocating MGNREGS resources across and within panchayats.

The process causing disparity may operate differently in different settings, and therefore we also create certain stylized settings to understand different processes operating in different areas. We categorize panchayats as having a *Significant SC/ST panchayat population* if the percentage of SC/ST population is more than the average SC/ST population percentage across all panchayats in India. We further categorize *Significant SC/ST panchayat population* panchayats based on the distribution across villages of the SC/ST populations within these panchayats. We identify panchayats having a significant SC/ST population in all villages as *Consolidated significant SC/ST population villages*. Panchayats where only a few villages have a significant SC/ST population while others have lower populations are identified as *Segregated significant SC/ST population villages* and panchayats with a mixed distribution of SC/ST and general castes in the villages, i.e. the SC/ST castes are mixed with other castes in each village, are identified as *Mixed SC/ST population villages*. We present this logic used to sub-categorize panchayats in Section 5.1, and use it to study the extent of disparity within and across panchayats for different panchayat categories to help uncover possible processes that would be operating on the ground to cause disparities.

2 Research Framework

The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) is a large employment guarantee scheme with provisions to ensure caste-based equity in resource allocation. The act provisions for positive action in favor of the scheduled caste (SC) and scheduled tribe (ST) categories through the prioritization of asset creation on the lands of SC/ST communities (schedule 1, para 5, MGNREGA 2005), additional 50 days of work for landless ST workers (section 4.2.2, MGNREGA master circular 2019-20, 2020-21), and prioritization of livelihood interventions for the youth from SC/ST communities through Project LIFE-MGNREGA (section 16.2.2, MGNREGA master circular 2019-20). Marginalized communities are further extremely vulnerable due to the impact of climate change on their income and food security [13, 39]. MGNREGS is, therefore, an important policy instrument to empower marginalized groups through improved livelihood as well as climate risk mitigation [49, 50] and adaptation [21] by improving surface water irrigation, rainwater harvesting, drought proofing, and soil conservation [39]. Therefore, fair and effective implementation of MGNREGS is essential. With this motivation, we build a framework to identify even small incidences of disparate treatment and disparate impact on marginalized caste groups to evaluate the extent to which the social justice criteria enshrined in MGNREGA 2005 are being met in practice.

Caste-based discrimination can often be small and indistinguishable on a single time slice but manifest itself over many years. Further, since MGNREGA demands preferential treatment towards

marginalized caste groups, we, therefore, infer caste-based disparity or discrimination in MGNREGA as the absence of long-term equality rather than the presence of inequality in a given year to assess the extent to which the scheme implementation meets the equity aspired by the act. Using this notion of equity, we attempt to answer three broad research questions: first, is there any evidence of inequity? next, what is the extent of such inequity if it is present? and finally, what is the process through which the inequity might be arising? We categorize panchayats based on the population distribution of marginalized castes within the panchayats and independently assess the extent of disparity for each panchayat category to identify the process of discrimination.

We attempt to answer the above three questions based on disparate treatment and disparate impact along the following parameters: extensive scheme management across panchayats, scheme utilization across panchayats, intensive scheme management across panchayats, extensive scheme management within a panchayat, and intensive scheme management within a panchayat. We measure *extensive management of the scheme* as coverage in terms of the number of households that are provided employment under the scheme. *Intensive management of the scheme* is measured as the uptake of the scheme by measuring the person-days of employment provided under the scheme. The difference in extensive management between marginalized castes and other castes is an indication of disparate treatment, and similarly, the difference in intensive management is another parameter for disparate treatment. We evaluate both these metrics across panchayats (by comparing significant SC/ST population panchayats with other panchayats) and within panchayats (by comparing the allocation for SC/ST population in the panchayat with the allocation for non-SC/ST population). *Scheme utilization*, on the other hand, is measured as the number of households demanding MGNREGS employment. We consider this as an indication of disparate impact arising from disparity in scheme management and evaluate it as the difference in scheme utilization across panchayats between significant SC/ST population panchayats and other panchayats.

Different patterns indicated by these inequity metrics help us identify possible processes of discrimination. For example, higher inequity in extensive management than in intensive management would imply a possibility of systemic discrimination in fund allocation towards panchayats with a significant SC/ST population. Similarly, high inequity in utilization would imply disparate impact as an indicator of prolonged discrimination that led to an unwillingness to participate in the scheme. Similarly, the patterns of disparity along different panchayat categories can further enrich our understanding of the processes causing it. For example, in panchayats with *Consolidated significant SC/ST population villages*, signs of high inequity in extensive management would likely indicate disparity arising from discrimination by the district or block level administration, but otherwise may suggest this as arising from a lack of funding for the scheme. We show that such fine-grained analysis can be done at district level as well, and can help come up with precise policy interventions or corrective actions.

All the above-mentioned MIS parameters are made comparable by normalizing them with the *predicted demand* for each panchayat, and different castes within the panchayat, by using the demand

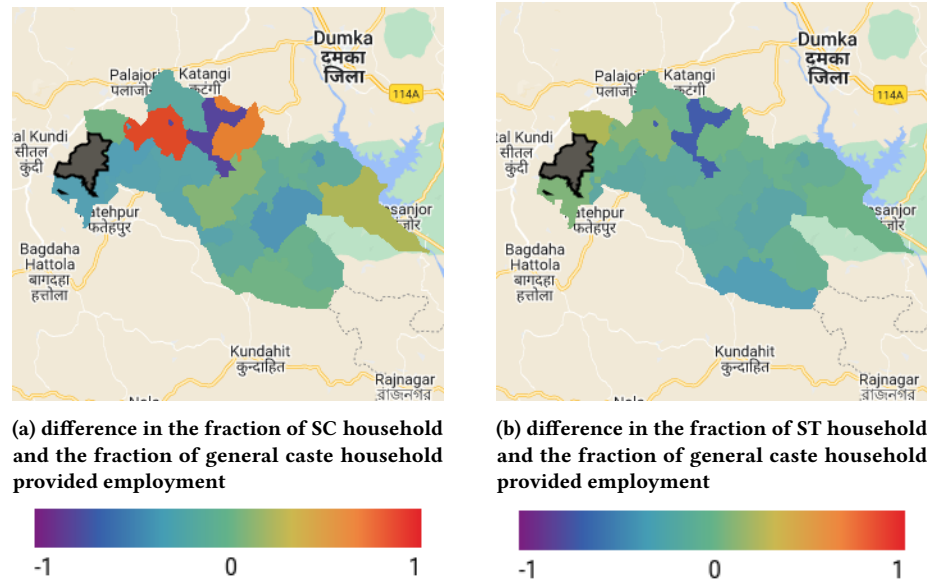


Figure 2: Panchayat-wise equity towards marginalized castes in MGNREGS employment for Masalia, Dumka

model described in Section 5.2. The demand for MGNREGS employment is assumed to depend on census variables such as the literacy rate and the percentage of marginalized population; the socio-economic development level of the panchayat; irrigation facilities; availability of alternate employment opportunities; vulnerability to climate change; and also on the MGNREGS wage rate and the experience with delayed payments in the panchayat. To build the demand model, we therefore create six sets of data. First, we obtain official data related to MGNREGS from the publicly accessible Management Information System (MIS) website maintained by the government, carrying data for all states, districts, and panchayats, over the years ¹. Second, we obtain village-level demographic data from the 2011 census which includes details of caste-wise population, different types of employment, literacy rate, etc., for various villages. Third, we use an indicator of socio-economic development at a village level called the aggregate development index, which is computed based on underlying components such as the extent to which rudimentary or advanced forms of fuel are used for cooking, the type of bathroom facilities used in the village, the main source of lighting, asset ownership, construction material used in the houses, etc. [6]. Fourth, we obtain sub-district level irrigation data from the agriculture census. Fifth, we use a district-level climate vulnerability index developed by the Council on Energy, Environment, and Water [37]. Finally, we use data from the Annual Survey of Industries to obtain industrialization data as a boolean variable indicating the presence of any industry in the village or not.

After initial work to collect these datasets through web scraping, followed by data cleaning, and mapping villages to panchayats through name resolution applied on the Local Government Directory (LGD) to build panchayat-level datasets, we use a multi-layer perceptron to train a machine learning model to predict the demand

for MGNREGS employment at the panchayat level as well as for different castes within each panchayat.

Finally, to test for discrimination, we use the same variables for propensity score matching to obtain pairs of *treated* and *control* panchayats, based on whether the panchayat has a significant SC/ST population or not. Thus, we construct pairs of panchayats which are similar to each other on various variables like literacy rate, socio-economic development, etc. except for the treated panchayat having a significant SC/ST population and the control panchayat not having a significant SC/ST population. This pairwise comparison helps us isolate discrimination as the average treatment effect arising solely from the difference in SC/ST population across panchayats.

We use this framework to answer the following research questions:

- RQ-1: Is there any evidence of inequity in scheme outreach (extensive scheme management) towards significant SC/ST population panchayats? If there is such evidence, what is the extent? How does it differ across different panchayat categories?
- RQ-2: Is there any evidence of lower interest in scheme utilization in significant SC/ST population panchayats as compared to other (general) panchayats? If there is such evidence, what is the extent? How does it differ across different panchayat categories?
- RQ-3: Is there any evidence of inequity in intensive scheme management towards significant SC/ST population panchayats? If there is such evidence, what is the extent? How does it differ across different panchayat categories?
- RQ-4: Is there any evidence of inequity in scheme outreach (extensive scheme management) towards SC/ST population within a panchayat? If there is such evidence, what is the extent? How does it differ across different panchayat categories?

¹with the MIS website <https://mnregaweb4.nic.in/netnrega/MISreport4.aspx>

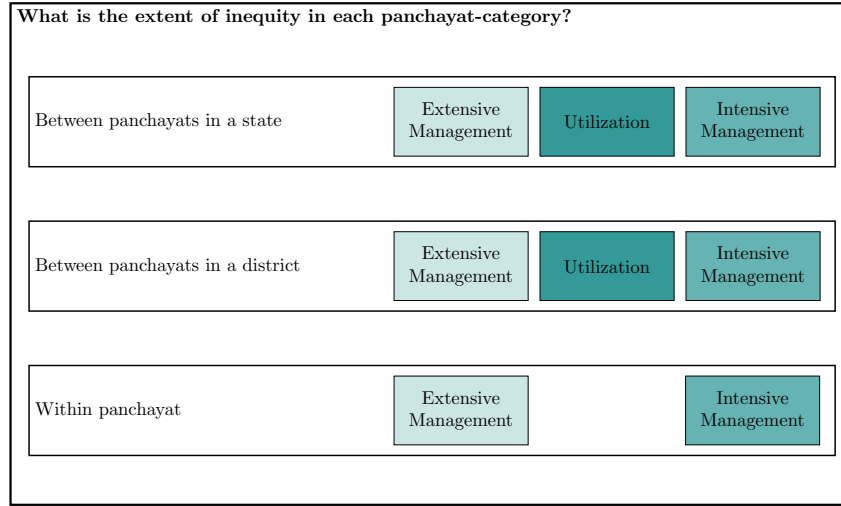


Figure 3: Interaction of inequity assessment

- RQ-5: Is there any evidence of inequity in intensive scheme management towards SC/ST population within a panchayat? If there is such evidence, what is the extent? How does it differ across different panchayat categories?

These interactions at which we assess inequity for each sub-category of panchayats are presented visually in Figure 3, at different levels - state, district, and panchayat. Studying these patterns of different types of inequities at different levels in different types of panchayats can help us identify potential processes through which the inequities might be arising and can help suggest precise policy action.

We make several novel contributions in this work: first, we offer a technique to predict demand that would be raised by a panchayat, which can be directly used to make fairer budget allocations; next, we present a framework to get a broad perspective of the extent of inequity, and open the possibility for a deeper analysis to identify processes causing inequities that can help in precise policy action; finally, our framework is largely dependent on publicly available quantitative data and provides an economical solution to analyze a broad range of panchayats without requiring any additional data collection. Further, while we have studied the extent of inequity in the caste dimension, the framework can be extended to study other causes of inequity, such as the distances of panchayats from the block administrative center where panchayats further away are often starved of funds [6], or the influence of caste and political alignment of locally elected representatives [2, 3, 7, 32]. All data used for the analysis is available at https://github.com/AshimaITD/Equity_analysis_dataset.

The rest of the paper is organized as follows. In Section 3, we present related work; in Section 4, we describe the datasets; the methodology is described in more detail in Section 5; Section 6 presents the results; in Section 7, we present a brief discussion and conclusion of this work along with highlighting limitations of our study; and in Section 8, we present possible applications of the work.

3 Related Work

3.1 MGNREGS's role in social welfare

Research shows the impact of MGNREGS on a variety of aspects such as women empowerment [19], child nutrition [19], wages [18], migration [18], creation of productive assets [18, 45] such as farm ponds, rainwater harvesting structures, etc. Fischer highlighted the effectiveness of employment guarantee, community involvement in building assets, and the bottom-up planning and governance approach of MGNREGS to help improve climate risk adaptability through a qualitative survey in Himachal Pradesh [21]. Kaur et al. found a positive impact of farm ponds on agricultural productivity in Northern India [29]. Ravindranath and Murthy estimated the climate risk mitigation benefits of MGNREGS works by measuring CO_2 sequestration due to different types of MGNREGS works using stratified samples of MGNREGS works across 18 out of 20 agro-ecological regions in the country and find a measurable contribution of MGNREGS works towards climate risk mitigation [49, 50]. Narayanan et al. confirmed existence of assets created through MGNREGS in their qualitative survey of 100 panchayats in 20 blocks in Maharashtra. The survey found that the beneficiaries considered the assets to be useful [45].

Many researchers, on the other hand, have also studied the outcome of MGNREGS in terms of improvement in wages [5], ability to mitigate economic shocks due to weather disruptions [26], consumption, nutrition intake, and personal assets [17]. Deiniger and Liu found improved nutritional intake as a short-term impact and asset accumulation as a medium-term impact of MGNREGS through their three-round panel study of 4000 households in Andhra Pradesh. Azam found a significant impact of MGNREGS on the wage rate for women workers [5].

All such studies motivate us to analyze MGNREGS in more detail in terms of the equity in marginalized groups benefiting from MGNREGS.

3.2 Equity in social welfare allocation

Social welfare functions generally measure social welfare as an aggregate of the welfare of individual agents. While such a utilitarian function of social welfare uses some aggregate function of gain in the utility for individual agents [27], the Rawlsian measure of social welfare relies on maximizing the minimum welfare achieved by an agent [51]. Sen's social welfare function balances productivity along with equality [53]. Economists and mathematicians have long delved into the problem of constructing welfare functions and fairness criteria to bring about a fair allocation of goods amongst individuals [8, 10] and groups [11, 15, 23]. Our own work takes a group-based approach to study fairness in the distribution of welfare funds and essentially considers a uniform utility function linear in the allocation made to a group normalized by the demand from the group.

Government-supported welfare schemes typically have a social justice component to guide equitable allocation, but the implementation can encounter several issues such as unfair exclusion arising from low budgets or inaccurate targeting, corrupt or inefficient administrative practices especially at the last mile, or underlying design issues with the programme itself, especially if programmes are designed to benefit specific social groups [30]. In MGNREGS, the allocations are designed to be driven by self-selection and therefore may be expected to be free from unfairness. However, Liu and Barrett found evidence of unfairness through the estimation of demand for work, participation, and rationing using the 66th round of the National Sample Survey (NSS) data [34]. Incidents where no member of a given household demanding work actually got MGNREGS employment during the past 12 months were counted as *rationing*, and a significant variance was found in the extent and type (progressive or regressive) of rationing between different states. Progressive rationing refers to prioritization of MGNREGS employment towards marginalized groups while regressive rationing refers to prioritization towards upper caste and politically connected groups.

Misra similarly identified the influence of historical inequalities in land ownership and political power as persisting in the commissioning of MGNREGS works especially on private land, and found that the elite upper caste are able to manipulate local governance institutions (gram panchayats) to corner greater resources for themselves [36]. This contradicts the role that MGNREGS is meant to serve as a livelihood intervention for the marginalized to specifically facilitate the reversal of the effects of historical inequalities, and motivates us to study the extent of discrimination more rigorously.

Further, this philosophical argument for social justice puts the burden of proof of fair treatment on the bureaucracy to demonstrate that the allocations are positively discriminated towards marginalized groups, rather than to demonstrate that marginalized groups are benefiting less than others [40]. We have therefore designed our framework to measure equity rather than equality, by taking resource allocation made over a long time period of a year and to study if the allocation is proportionally more towards SC/ST groups.

3.3 Impact analysis of MGNREGS

MIS systems of social welfare schemes are meant to make data available about the resource inputs provided and the outputs obtained from the schemes, to ensure transparency and withstand scrutiny. Chopra, et al. used MIS data to highlight the issue of MGNREGS delayed wage payments in the state of Andhra Pradesh [14]. Narayanan, et al. drew attention to the unmet demand for MGNREGS work in districts with high multidimensional poverty and high rates of out-migration [44]. Deininger and Liu performed quantitative analysis of administrative data, MGNREGS works data, and three-rounds of panel data from Andhra Pradesh to study the impact of the scheme on key performance indicators and found the scheme to be well targeted, with more impact than the value of transfers in terms of both short term impact like higher nutritional intake, and medium term impact such as accumulation of non-financial assets [17].

Quantitative analysis using statistical methods has also been used to identify issues in the implementation of MGNREGS [14, 22, 44]. Chopra, et al. used statistical methods to analyze MGNREGS wage payments available at Andhra Pradesh MIS to explore the reasons for delay in wage payments and the impact of automated delay compensation on delayed payments in Andhra Pradesh [14]. They found the final stage of disbursement of wages to beneficiaries by their banking correspondent accounts for about 21% of the payments being delayed. However, such delays are not accounted for in delayed wage payments made by the government. Narayanan, et al. used statistical methods to analyze the impact of return migration during COVID-19 pandemic on MGNREGS demand, the effectiveness of the scheme in meeting demand, and the distribution of work generation compared to the extent of return migration at the district level. The study found a disproportionate distribution of employment generation compared to the expected return migration [44]. Himanshu et al. studied the general trends of MGNREGS demand in the entire country and specifically in Rajasthan using MIS and NSS data to analyze the trends of MGNREGS work demand. The authors used a representative primary survey to find the reasons for declining demand for MGNREGS employment as arising from administrative delays in wage payment and rationing of funds rather than the availability of alternate employment for higher wages, and called it a “discouraged worker” effect [22].

We similarly use statistical methods to assess the extent of inequity in the number of households provided with MGNREGS employment (extensive scheme management), the person days of MGNREGS employment generated (intensive scheme management), and the actual demand in MGNREGS employment (scheme utilization). At the same time, we use our demand prediction model to quantify the demand that is either not recorded or not raised, likely due to the “discouraged worker” effect [22].

3.4 Surveys and ethnographic studies of MGNREGS implementation

Methods like baseline/endline surveys are also used for impact assessment at smaller scales. Ethnographic studies and reports by social sector organizations, often covered in the mass media, also contribute extensively to understanding the impact and shortcomings of welfare schemes. Drèze and Sen, for example, showed that

although MGNREGS implementation falls short of following the processes as laid down in the specifications, it is a powerful instrument for social justice to ensure dignified lives for the poor, empower women, and improve health and education outcomes for children [19]. Veeraraghavan used interviews and ethnographic immersion in two different panchayats in Andhra Pradesh to find that local politics along with workers' attitudes and motivation play a role in influencing MGNREGS outcomes. The author observed better outcomes in tribal-dominated villages emerging from greater community involvement in the commissioning of MGNREGS works. Lower outcomes were however noticed in dalit (lower caste) dominated villages, where urban aspirations caused the communities to undervalue the assets built, and political alignment with the elected representatives made it easier for local middlemen to collude with MGNREGS field assistants to manipulate records. MGNREGS however improved the bargaining power for rural workers, to increase the wages they got otherwise for agricultural labor and other work [56].

Qualitative analysis is able to obtain a nuanced understanding of issues in the implementation of welfare schemes, however, such studies may have limited generalizability due to the narrowed scale of study. Moreover, India is a diverse country with very different socio-economic setups and administrative procedural diversity in different states. Therefore, qualitative analysis from one state may not apply to another state. We leverage the significant number of qualitative analysis studies and field reports that already exist, to complement and validate findings from our quantitative analysis. At the same time, our framework allows us to assess inequity towards marginalized castes at an almost pan-India scale and helps us identify processes that may be causing inequity in a specific state or district. The results from our study may be used to identify specific sites for qualitative studies to understand the underlying processes in more detail.

4 Datasets

4.1 MGNREGS MIS data

The government of India maintains an extensive publicly accessible MIS website for MGNREGS to maintain data at the state, district, and panchayat levels. We wrote web crawlers to automatically download and parse this data. We obtained the data at the panchayat level for 293,451 panchayats, since the genesis of MGNREGS in 2011. We noticed that data specifically for the year 2013 had many missing values, and therefore restricted our analysis to 2014 onward, from the 2014/15 financial year to the 2020/21 financial year. The list of parameters used in this study are given in Table A in the Appendix A. We computed the annual average value of each parameter for our analysis.

4.2 Demographic Data

We obtained demographic data from the 2011 household census in India. The census data is available at the village level, and allows the village units to be identified as "Rural" or "Urban". We filtered 640,949 rural village units, but since the MGNREGS MIS data is available at the panchayat level, we therefore needed to aggregate census data for all villages within a panchayat. We obtained the village-to-panchayat mapping from the Local Government Directory (LGD)

website <https://lgdirectory.gov.in/>. The LGD website unfortunately does not provide census village identifiers, and we therefore had to build an entity resolution method to first resolve the panchayat names used in MGNREGS MIS with the LGD panchayat names, and then to resolve the names of villages in the LGD list with the village names in the census data. Through extensive empirical evaluation, we built a combination of Levenshtein edit-distance based name matching and an ensemble of five phonetic name matching models (Soundex, Caverphone, Metaphone, Double Metaphone, NYSIIS), along with narrowing the search scope within states, districts, and sub-districts, wherever available, to complete this entity resolution exercise. Eventually, we were able to satisfactorily obtain data for 128,038 panchayat from 15 states of India.

4.3 Socio-economic Development Data

The census household data includes several development indicators such as the type of fuel used for cooking by households, bathroom facilities used, sources of drinking water, assets, etc. Bansal et al. introduced a village-level aggregate development index (ADI), built as a linear summation of discrete levels of five such development indicators. Each of the indicators is categorized into three different levels: rudimentary, intermediate, and advanced. Therefore, the village-level ADI can take values between 5 to 15 [6]. We used this indicator and its constituent variables as indicators of the socio-economic development of a village. The village-level indicators were aggregated to panchayat-level values through a population weighted summation.

4.4 Irrigation Data

Since a large number of MGNREGS works are natural resource management (NRM) works that are carried out in areas lacking good irrigation infrastructure, we obtained irrigation data at the sub-district (block) level from the agriculture census website *agcensus.gov.in*. This data provides the percentage of sown area that is irrigated and could be an important driving factor for the demand for MGNREGS work. Since the data is available at the sub-district level, we used the same value for all panchayats in a given sub-district.

4.5 Climate Vulnerability Data

We obtained a district-level climate vulnerability index from a report on climate vulnerability published by the Council on Energy, Environment, and Water [37]. This index internally takes into account exposure, sensitivity, and adaptive capacity using the variable like "frequency of extreme hydro-met events, landscape indicators such as land-use-land-cover, soil moisture, ground water, slope, elevation, and socio-economic indicators such as population density, sex ratio, literacy rate, and availability and accessibility to critical infrastructure" [37]. We applied the same index to all panchayats within a given district.

4.6 Industrialization Data

We used the Annual Survey of Industries data available at data.gov.in to obtain information about the number of industries in a panchayat. We assign a binary value of 1 or 0 to the panchayat based on whether

there is any industry present in the panchayat or not. We use this as a proxy for the availability of alternative employment in the area.

5 Methodology

5.1 Panchayat Categorisation

We follow a two-step approach to categorize panchayats. First, we categorize them based on the population percentage of marginalized castes as *significant SC panchayat population* and *significant ST panchayat population* depending on whether the percentages of SC and ST populations is more than the corresponding average², the average ST population percentage in panchayats across India. The remaining panchayats are classified as *others*. Next, we calculate the average SC population percentage within *significant SC population panchayats*³. We also calculate an uneven distribution indicator to measure unevenness in the distribution of the SC population in different villages within a panchayat⁴. We categorize *significant SC population panchayats* as having *consolidated significant SC population villages* if the SC population percentage in the panchayat is above the category-threshold and the unevenness distribution indicator is lower than the unevenness threshold value; *mixed SC population villages* if the unevenness distribution indicator is lower than its threshold value and the percentage of SC population is below the category-threshold; and *segregated significant SC population villages* if the unevenness distribution indicator is above its threshold value for the given panchayat. Similarly, we subcategorize *significant ST population panchayats* as consisting of *consolidated significant ST population villages*, *mixed ST population villages*, and *segregated significant ST population villages*. The algorithm is presented in Figure 4.

Different sub-categories of *Significant SC population panchayat* are presented in Figure 12 and of *Significant ST population panchayats* in Figure 13, for a sample block.

5.2 Prediction of Demand

5.2.1 Background. MGNREGS is a demand-driven scheme that allows every eligible household in rural areas to demand work. According to MGNREGA 2005, the demand for work should be fulfilled within 15 days of raising the demand, else the government is liable to pay an unemployment compensation. The official MIS data validates that 98–99% demand for work is met and there hardly emerge any cases of unemployment compensation. However, field research shows that discouragement or apprehensions in raising and/or recording employment demand are responsible for the high success rate visible in the MIS [22, 41, 42, 44, 54]. While we do not specifically look into the reason for this disconnect, we attempt to predict the actual demand for work that might go unrecorded or

may not even be raised. To build a model for this actual demand, we leverage the fact that MGNREGS implementation is jointly owned by both federal and state governments and there is a wide variance in the efficiency and utilization of the scheme in different areas; being able to learn a model “good” areas can be used to predict the actual demand in other areas.

5.2.2 Feature Selection. We take a two-step approach for feature selection. Since MGNREGS is a demand-driven scheme, we do a literature survey to identify factors that should influence MGNREGS demand. MGNREGS demand is known to be influenced by factors such as age, gender, land holdings [16], literacy rate, and caste [12, 16], along with the quality of scheme implementation which serves as an encouragement to demand work in the absence of alternative sources of employment [28]. Therefore, demographic variables, socio-economic development indicators, industrialization, climate, and irrigation parameters were selected as features. We also include MIS parameters of the average wage (*average_wage*) and approved amount of compensation for delayed wage payment (*DCapproved_per_payable*) to take into account motivation factors arising from the quality of the scheme implementation. Finally, to avoid collinearity, we computed an $n \times n$ correlation matrix for the n variables and filtered a subset which had a mutual correlation less than a threshold of 0.7. The final set of features used to train the demand model are shown in Table A in Appendix A.

5.2.3 Model. We use a multilayer perceptron with one hidden layer to build a supervised learning based demand prediction model. We identify “good” panchayats that have a high percentage of households demanding work and a corresponding high percentage of this demand being met. Data from this set of panchayats is used to train the demand model. To identify these panchayats for model training, we find the average and standard deviation of the percentage of households demanding work in panchayats across the country, and use the average plus one standard deviation as a threshold. A second threshold is then also applied, to identify panchayats that are able to meet more than the average demand for employment across panchayats in India. The demand model is shown in Figure 5.

We train four different models using a train-set split of 80:20. The first model is trained on panchayats performing better than average from the set of all panchayats (using 0.9 as a threshold for employment demand met and 0.62 as a threshold for the percentage of households demanding employment). The normalized RMSE for the training set is 0.13 and for the test set is 0.15. We also train a demand model on panchayats performing better than average from a set of *Consolidated significant SC population villages* (using thresholds 0.9 and 0.68 respectively, to obtain normalized RMSEs of 0.09 and 0.15 on the train and test sets), *consolidated significant ST population villages* (using thresholds 0.9 and 0.8 respectively, to obtain normalized RMSEs of 0.05 and 0.10 on the train and test sets), and *other* panchayats (using thresholds 0.9 and 0.57 respectively, to obtain normalized RMSEs of 0.13 and 0.19 on the train and test sets) to predict employment demand for scheduled caste, scheduled tribe, and other caste panchayats respectively.

²The threshold used for identifying *significant SC population panchayats* is 18.1%, the average SC population percentage in panchayats across India, and is referred to as SC_PR. Similarly, the threshold used for identifying *significant ST population panchayats* is 16.3% and is called ST_PR.

³The average SC population percentage within *significant SC population panchayats* is 33%. We call this SC_avg and it is used to identify further subcategories. The corresponding threshold for *significant ST population panchayats* ST_avg is 63%.

⁴We use Gini coefficient to measure unevenness in population distribution. The average value of the indicator for uneven population distribution amongst *significant SC population panchayats* avg(UE) is 16% which is used as a threshold. The corresponding threshold for the uneven population distribution indicator amongst *significant ST population panchayats* is 15%.

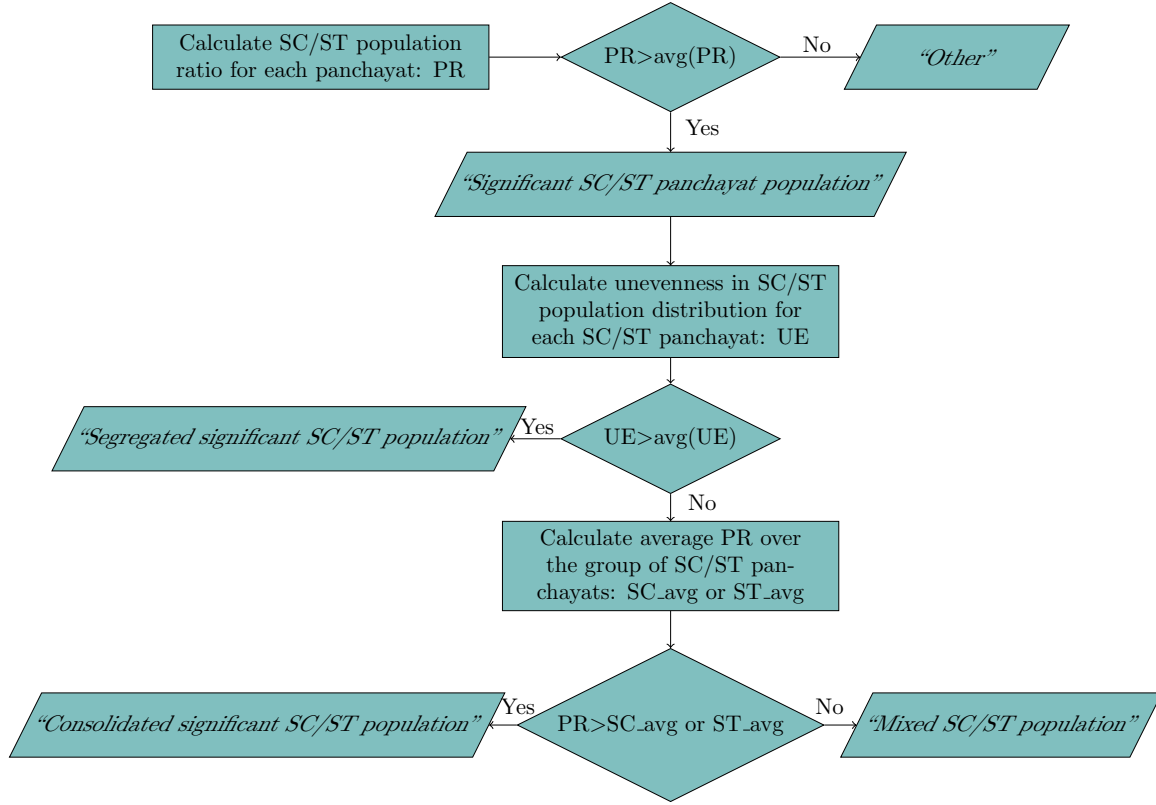


Figure 4: Algorithm for Panchayat Categorization for SC/ST Panchayats

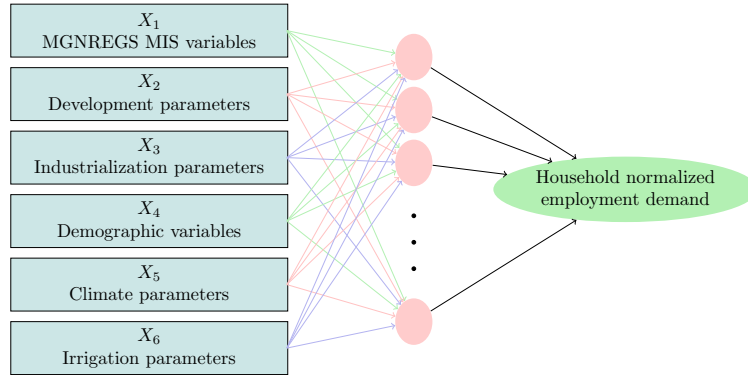


Figure 5: Multi Layer Perceptron based Demand Model

The predicted demand from these three models is then used as a normalizing factor to estimate disparate treatment and disparate impact towards marginalized groups in different types of panchayats.

5.3 Across-Panchayat Equity Assessment

5.3.1 Background. To assess the extent of inequity towards marginalized castes across panchayats, we need to compare the values of outcome variables related to management and utilization in panchayats with significant SC/ST population with the outcome values

in other panchayats. But it is essential to also balance the effect of other confounding variables to isolate the effect of caste (treatment variable) on MGNREGS allocations. Intervention based research studies use randomized controlled trials (RCT) to study the effect of a specific treatment variable; however, in an observational study like the one presented in this paper, a balancing score called the Propensity score is used to pair treated units (panchayats with a significant percentage of marginalized caste population) with counterfactual units (panchayats not with a significant percentage of marginalized castes), such that the treated and counterfactual pair

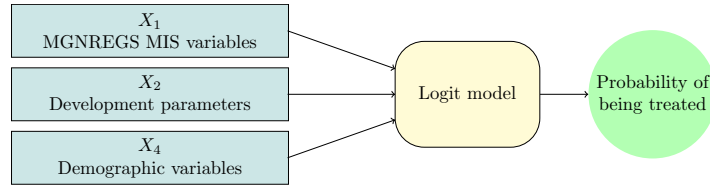


Figure 6: Propensity Model

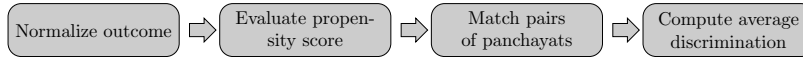


Figure 7: Workflow for equity assessment across panchayats

are similar on other features except for the treatment variable itself [4, 24, 52].

5.3.2 Model. The propensity score is an established technique to find treatment and counterfactual pairs. It works by first training a logistic model to predict the probability of treatment given other covariates including the confounding variables (i.e. a model to predict $P(\text{treated}_i = 1 \mid \text{covariates}_i)$), and then it uses this trained model to identify for each treatment point a matching counterfactual point which is most likely to have been selected for treatment (i.e. for a treated point i , identify a counterfactual point j , such that $P(\text{treated}_j = 1 \mid \text{covariates}_j)$ is closest to $P(\text{treated}_i = 1 \mid \text{covariates}_i)$). In our context, this means that for each panchayat with a significant SC/ST population, a counterfactual panchayat is identified which actually does not have a significant SC/ST population but given the covariates it would have been the best match to fall in the treated set. The propensity score can thus be considered as a method to identify the best matching counterfactual from amongst the untreated panchayats, to estimate the treatment effect for a panchayat having significant SC/ST population. The average of the treatment effects across all such panchayats is then called the average treatment effect and can indicate if these panchayats get more positive treatment than their counterfactuals. To check whether this average treatment effect is statistically significant, a paired t-test is further done on the treated and counterfactual pairs [4, 24].

First, we develop propensity score models as presented in Figure 6 at the state level, i.e. we find counterfactual pairs from within the same state as the treated panchayat. We do this to account for the diversity in socio-cultural and political aspects of different states as is evident from the literature and also confirmed through the statistically significant state fixed effect presented in structural models in Appendix B.3. Next, we match the treated observations with their corresponding counterfactuals using a matching algorithm with calipers. We encountered the need to balance covariates between treated and counterfactual groups on comparing their distributions. Therefore, we next used a technique to partition the impact of unbalanced covariates by regressing the residual outcome variable on the residual treatment variable to get the final treatment effect [59].

5.4 Within-Panchayat Equity Assessment

To assess the extent of inequity towards marginalized castes within a panchayat, we predict the demand for MGNREGS employment for

scheduled caste, scheduled tribe, and general category population groups within each panchayat. Next, we normalize the employment provided per household to each of these caste groups with the respective predicted demand for the group. Finally, we compute the difference in normalized employment provided per household to SC/ST and general category population groups to assess the extent of within-panchayat inequity towards SC/ST groups. This is done for both extensive management and intensive management outcome variables. The workflow for computing this inequity against is shown in Figure 8.

5.5 Computation of an Inequity Index

Our framework allows us to assess the average treatment effect (ATE) between panchayats at the state level, and can also be identically replicated at the district level by identifying counterfactual pairs from within the same district. We limit the scope of our analysis to assess ATE across panchayats at the state and district levels only since the dataset at the sub-district level is too small to get meaningful pairs. Within panchayat, inequity can be handled more simply to produce within panchayat ATE values at the state or district level by aggregating the values from amongst all panchayats at the state or district level. We can therefore compute five different ATE scores corresponding to each of the original research questions.

- Across panchayat ATE scores are measured as the difference in metrics between panchayats with a significant population of marginalized caste (SC/ST) and panchayats with less than significant population of marginalized caste.
 - The ATE score for scheme utilization is measured as a difference in recorded employment demand normalized by predicted employment demand.
 - The ATE score for extensive scheme management across panchayats is measured as the difference in the number of households provided employment normalized by the predicted demand.
 - The ATE score for intensive scheme management across panchayats is measured as the difference in the number of person days of employment provided normalized by predicted demand.
- Within panchayat ATE scores are measured as the difference in metrics for marginalized caste (SC/ST) and for general caste within a given panchayat.

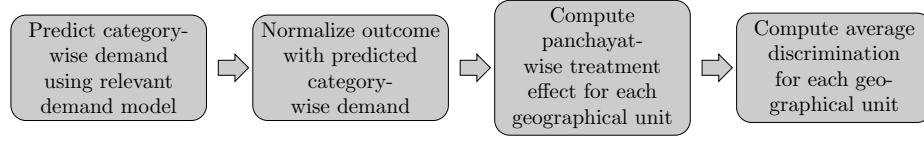


Figure 8: Workflow for equity assessment within panchayats

- The ATE score for extensive scheme management within panchayats is measured as the difference in the number of households provided employment normalized by the predicted demand between the SC/ST caste and general caste in a panchayat.
- The ATE score for intensive scheme management across panchayats is measured as the difference in the number of person days of employment provided normalized by predicted demand between the SC/ST caste and general caste in a panchayat.

The above five indicators are computed for each of the three categories of panchayats: those with *consolidated significant SC/ST population villages*, or *segregated significant SC/ST population villages*, or *mixed SC/ST population villages*. As a result, we get up to fifteen indicators of discrimination for each geographic location (state or district). A sample output of these indicators for the states of Chattisgarh and Jharkhand are shown in Tables 1 and 2 for inequity against the SC population, and in Tables 3 and 4 for inequity against the ST population. We compute an aggregate index of inequity within a given geographical location of a state or district using the following formula:

$$I = (1 + \frac{\sum (1 - \Delta A)_{across}}{N_{across}})(1 + \frac{\sum (1 - \Delta A)_{within}}{N_{within}})$$

$\forall$ metrics lacking evidence of significant equity, where:

$$\Delta A = ATE \text{ score}$$

N_j = Number of observed metrics of type j (across/within)

I = inequity index

The value of the inequity index ranges from 1 to 9. A higher value of the inequity index represents a higher level of discrimination, the inequity index with value 1 indicates perfect equity. We use the term *SC inequity index* to assess the extent of inequity towards scheduled castes, and *ST inequity index* for the extent of inequity towards scheduled tribes. State-level inequity indices are shown in Tables 5, 6, and 7. We also show the *SC inequity index* and *ST inequity index* for the top four districts from each type of state in Tables 8 and 9 respectively. We refer to the states with more than the average number of *significantly SC population panchayats* as *states having significant SC population* and states with more than the average number of *significantly ST population panchayats* as *states having significant ST population*. The states with less than an average number of *significantly SC population panchayats* and *significant ST population panchayats* are referred to as *other states*.

6 Results

We have assessed the extent of inequity along two dimensions: across panchayat and within panchayat. Inequity across panchayats is more likely to happen while allocating budgets. It measures the difference in resource allocation to *Significant SC/ST population* panchayats compared to a general category panchayat. It is likely to arise from the block or district-level administration. Inequity within panchayats is more likely to happen while distributing work allocations to different castes and is likely to be caused by local elite capture.

To measure the statistical significance of the average treatment effect (ATE) over the set of marginalized panchayats within a state, we use a right-tailed t-test to check for evidence of equity in resource allocation by considering unfairness to be a norm and putting the burden of proof of making fair allocations on the administration (Section B.2). Therefore, we consider the difference in resource allocation to be equitable only if it is positive with a p-value less than 0.05. Insignificant positive scores (positive ATE scores and p-value greater than 0.05) and all negative ATE scores (irrespective of their p-value) indicate inequity, or an insufficient proof of equity.

6.1 Inequity towards scheduled castes

We present the extent of inequity toward scheduled castes in Chhattisgarh (Table 1) and Jharkhand (Table 2) for different categories of panchayats. Negative values show inequity in both the across and within dimensions. We can see that the inequity towards scheduled caste groups is higher within-panchayat than across-panchayat since we have larger negative values in columns 4 and 5 as compared to columns 1 and 3 respectively. Therefore, it is more likely that the discrimination is happening at local level rather than being caused through administrative processes.

When we compare across panchayat inequity towards scheduled castes in different categories of panchayats in Chhattisgarh, we find higher inequity in panchayats with *Mixed SC population villages* (row 3 in Table 1) as compared to *Consolidated significant SC population villages* (row 1 in Table 1), showing that the administration is willing to prioritize funds to the panchayats with a higher concentration of scheduled castes yet the lack of overall equity (evident from negative values in Table 1) may be an indicator of a shortage of funds.

The pattern of inequity across panchayats amongst different panchayat categories is reversed in Jharkhand. Here, panchayats with *Consolidate significant SC population villages* (higher negative values in row 1 in Table 2) seem to be the most discriminated panchayat category. It may be an indicator of intentional discrimination toward scheduled caste groups by the administration. Further,

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Consolidated significant SC population	0.0005 (0.2445)	-0.0316 (0.4853)	-0.017 (0.4796)	-0.1999 (1.0)	-0.0616 (1.0)
Segregated significant SC population	-0.0147 (0.3941)	0.0127 (0.1228)	-0.0144 (0.4532)	-0.2212 (1.0)	-0.0514 (1.0)
Mixed SC population	-0.0245 (0.4566)	-0.0676 (0.5)	-0.0286 (0.4978)	-0.1881 (1.0)	-0.0245 (1.0)

Table 1: Difference in resource allocation to SC versus General caste for Chhattisgarh
The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Consolidated significant SC population	-0.101 (0.4493)	-0.039 (0.3392)	-0.0657 (0.4586)	-0.2047 (0.9999)	-0.035 (0.9987)
Segregated significant SC population	-0.0326 (0.4958)	-0.0155 (0.4301)	-0.023 (0.4992)	-0.1531 (1.0)	-0.021 (1.0)
Mixed SC population	-0.0892 (0.4618)	0.0491 (0.0798)	-0.0487 (0.4562)	-0.1171 (0.9964)	-0.0176 (0.9961)

Table 2: Difference in resource allocation to SC versus General caste for Jharkhand
The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Consolidated significant ST population	0.0138 (0.0001)	0.0632 (0.0)	0.0397 (0.0)	-0.3306 (1.0)	-0.4544 (1.0)
Segregated significant ST population	0.0059 (0.0229)	0.0332 (0.0003)	0.0312 (0.0)	-0.263 (1.0)	-0.2636 (1.0)
Mixed ST population	0.0108 (0.0719)	0.0253 (0.003)	0.0169 (0.0019)	-0.2525 (1.0)	-0.0813 (1.0)

Table 3: Difference in resource allocation to ST versus General caste for Chhattisgarh
The values in parenthesis are p-values

the negative score for utilization indicates the possibility of a *discouraged worker* effect. Therefore, the type of policy interventions required in Jharkhand are likely to be different than the interventions required in Chhattisgarh. Chhattisgarh seems to need more funds while Jharkhand seems to need improved administrative processes, training, and audits. There may also be a need for awareness campaigns to improve uptake of MGNREGS.

6.2 Inequity towards scheduled tribes

We similarly show the extent of inequity toward scheduled tribes in Chhattisgarh (Table 3) and Jharkhand (Table 4) for different categories of panchayats.

The negative values in columns 4 and 5 in the results show inequity toward scheduled tribes in Chhattisgarh and Jharkhand in the within-panchayat dimension which indicates the influence of the local elite on the scheme implementation. However, the patterns of inequity across panchayat are different for both states. The results show equitable resource allocation to panchayats with a significant scheduled tribe population in Chhattisgarh (row 1 in Table 3) but inequity in resource allocation to such panchayats in Jharkhand (row 1 in Table 4).

When we compare inequity towards scheduled tribes in different categories of panchayats, we find that panchayats with *Consolidated significant ST population villages* (row 1 in Table 4) are the

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Consolidated significant ST population	-0.1627 (0.4717)	0.0019 (0.2449)	-0.0996 (0.4793)	-0.5545 (1.0)	-0.3071 (1.0)
Segregated significant ST population	0.021 (0.011)	0.0194 (0.0181)	0.0112 (0.0159)	-0.523 (1.0)	-0.2267 (1.0)
Mixed ST population	-0.0051 (0.3992)	-0.0393 (0.4378)	-0.0062 (0.4013)	-0.3693 (1.0)	-0.1012 (1.0)

Table 4: Difference in resource allocation to ST versus General caste for Jharkhand
The values in parenthesis are p-values

State	SC Inequity index	ST Inequity index
Punjab	1.448404	NA
Tamil Nadu	1.664115	NA
Uttar Pradesh	1.668790	3.645876
Telangana	1.684220	3.668145
Haryana	1.782580	NA
Andhra Pradesh	1.794486	2.998418
West Bengal	2.732060	3.094274
Karnataka	3.503498	3.733479

Table 5: Inequity Indices for states with more than the average number of SC panchayats

State	SC Inequity index	ST Inequity index
Maharashtra	3.872583	3.29216
Bihar	3.901622	NA

Table 7: Inequity Index for other states

State	SC Inequity index	ST Inequity index
Gujarat	2.790749	3.879849
Madhya Pradesh	2.969513	3.799395
Odisha	3.871192	4.055006
Jharkhand	4.267735	3.992686
Chhattisgarh	4.292644	2.524199

Table 6: Inequity Index for with more than the average number of ST panchayats

most discriminated category in the across-panchayat dimension in Jharkhand while *Consolidated significant ST population villages* panchayats (row 1 in Table 3 are treated most equitably in Chhattisgarh. Therefore, it seems like the local elite capture is more likely reason for inequity in Chhattisgarh while Jharkhand is facing inequity due to both administrative apathy as well as local elite capture.

Overall, the higher discrimination scores for both scheduled caste and scheduled tribe reflect the need for improved administrative practices in Jharkhand. In addition to that, there is a need for campaigns for sensitization of local elite in both states.

6.3 State level Inequity index

We next show inequity indices for states with more than the average number of *Significant SC population panchayats* in Table 5; for states with more than the average number of *Significant ST population panchayats* in Table 6, and for other states in Table 7. The SC

Inequity index represents inequity towards scheduled castes and the ST inequity index represents inequity towards scheduled tribes. These inequity indexes ranges from 1 to 9. Since the inequity index is a product of the inequity in the across-panchayat and within-panchayat dimensions, it can go up to 3 in either dimension. A value of 3 in either dimension would be an indicator of significant discrimination which is not observed in any state. An inequity index value of 1 represents absolute equity. Any value above 1 indicates the presence of some inequity. A visual representation of SC and ST inequity indices for various states is shown in Figure 9.

The results show lower inequity towards scheduled castes in the states with a higher number of panchayats with significant scheduled caste populations which shows the improved political influence that the scheduled castes are having in these states. However, the situation is different in the states with lower number of panchayats with significant scheduled caste populations and a higher inequity index is observed in these states.

The ST inequity indices are high in all the states irrespective of the number of panchayats with significant scheduled tribe populations. There can be several reasons for this. First, the population of scheduled tribes is low and concentrated in certain regions. Therefore, their political influence, if it exists, may be limited to those regions. Second, the tribal areas are generally hard to approach. Therefore, such areas may be missed by awareness campaigns. However, research shows better community support in tribal areas has the potential for better outcomes [56]. Therefore, more MGNREGS funds could be directed towards tribal regions.

6.4 District level Inequity index

We have also evaluated inequity at the district level. We present SC inequity indices in Table 8 and ST inequity indices in Table 9, for some of the most inequitable districts. As mentioned in Section 6.3, we have identified states with more than the average number of *Significant SC population panchayats* as *Significant SC population*

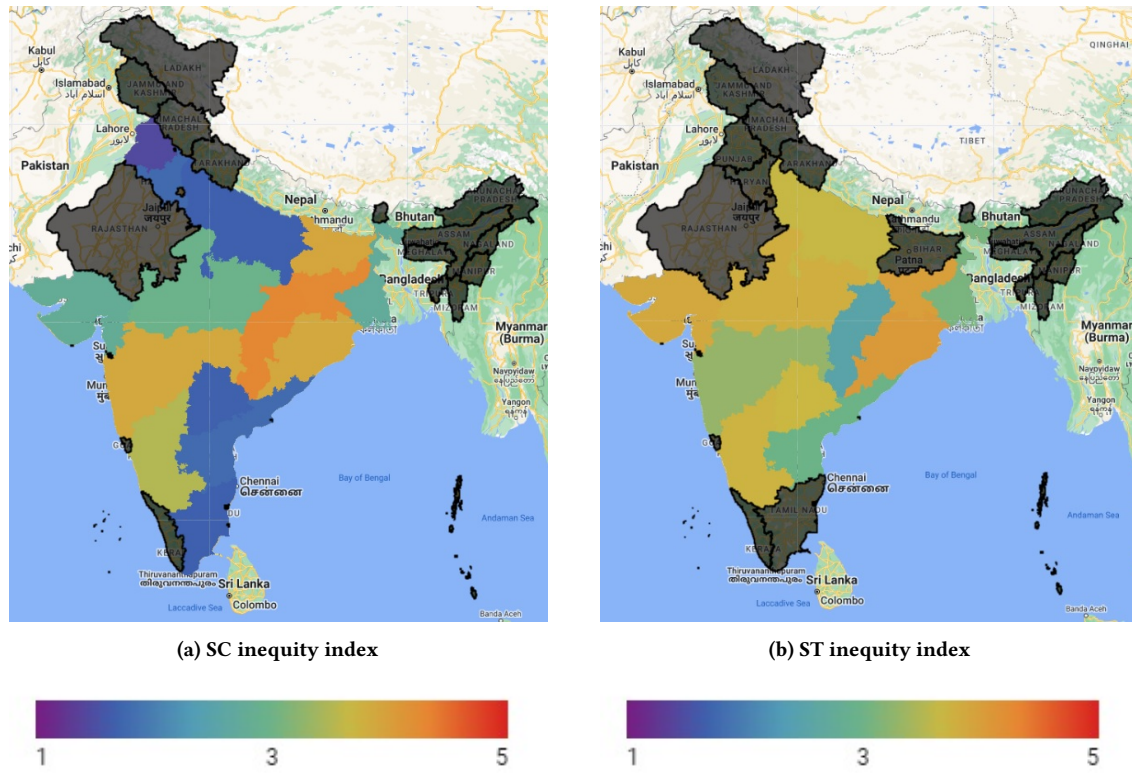


Figure 9: State-level inequity indices

states; the states with more than average number of *Significant ST population panchayats* as *Significant SC population states*, and the states with less than the average number of *Significant SC panchayat population* and *Significant SC panchayat population* as *other states*. We present 4 districts with highest inequity index from each type of states in Tables 8 and 9.

The results show an inequity index of more than 4 in several districts of Bihar and Chhattisgarh, which indicates significant discrimination towards scheduled castes in these districts and highlight the need for improved administrative practices here. Similarly, The ST inequity indices are high for several districts in Andhra Pradesh which shows the need for further research and action in these areas.

6.5 Panchayat level Inequity index

We also evaluated inequity at the panchayat level with above-average scheduled caste or scheduled tribe populations. As an example, we present the inequity towards scheduled castes in *Significant SC population panchayats* in the Maheshwar sub-district from Madhya Pradesh in Figure 11a and towards scheduled tribes in *Significant ST population panchayats* in Figure 11b.

The maps show differences in inequity in different panchayats. While all panchayats exhibit some inequity, we can review the patterns by comparing the maps in Figure 11a with the maps in Figure 12 and the maps in Figure 11b with the maps in Figure 13 to find higher inequity in panchayats with *Segregated significant SC*

population villages and *Segregated significant ST population villages*. It may be an indicator of elite capture since the inequity towards panchayats with *Consolidated significant SC population villages* and *Consolidated significant ST population villages* is lower which indicates that the district administration may be allocating funds to the panchayats but the local elite may be diverting more funds towards villages with lower marginalized populations. These observations may be validated by comparing the extent of inequity across and within the panchayat for a panchayat with a higher inequity index. For example, Bakaner is a panchayat in Maheshwar which we classified as having *Segregated significant ST population villages*. This panchayat has an ST inequity score of 3.509. We find inequity in extensive management within the panchayat to be twice as much as the inequity in extensive management across panchayats. Similarly, the inequity in intensive management within the panchayat is 60% more than the same across panchayats. The SC and ST inequity indices give us an indication of the possible process through which this discrimination may arise. Similar fine grained analysis of the inequity index can help highlight appropriate action that should be taken in a particular panchayat.

7 Discussion

We have used data analytics and machine learning methods to analyze publicly available data to assess the extent of inequity and the processes causing such inequity at various administrative levels. However, we also need to validate our results with the help of

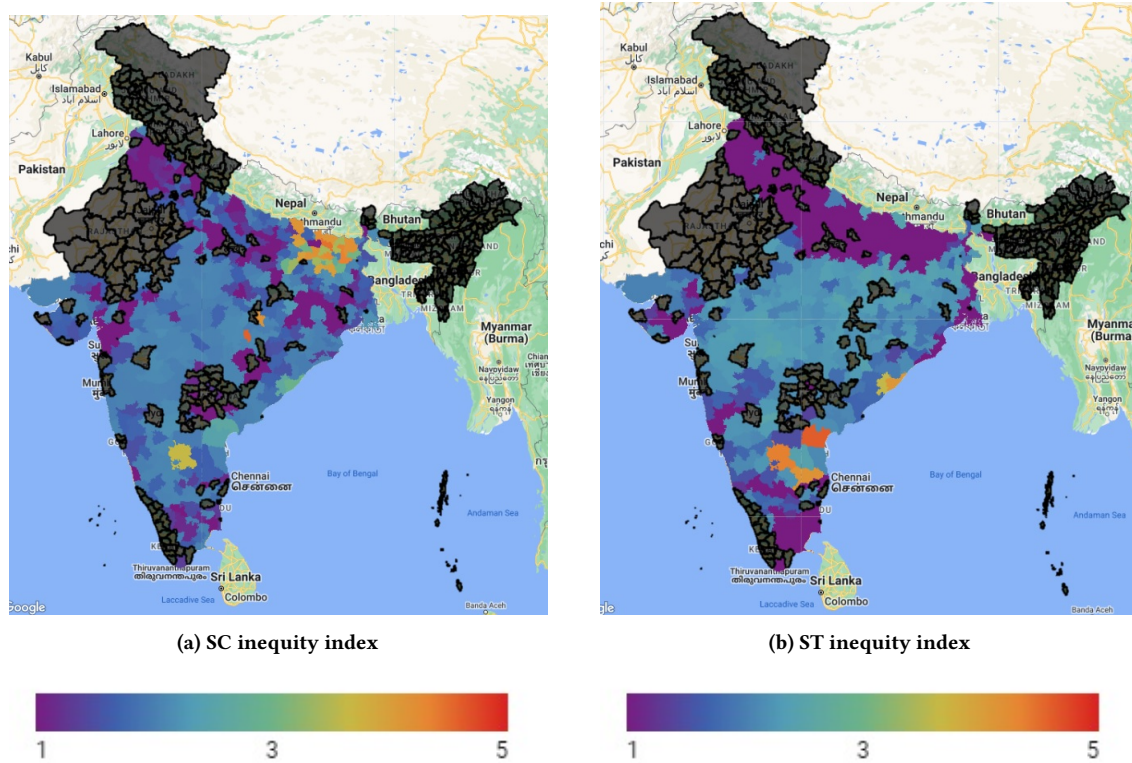


Figure 10: District-level inequity indices

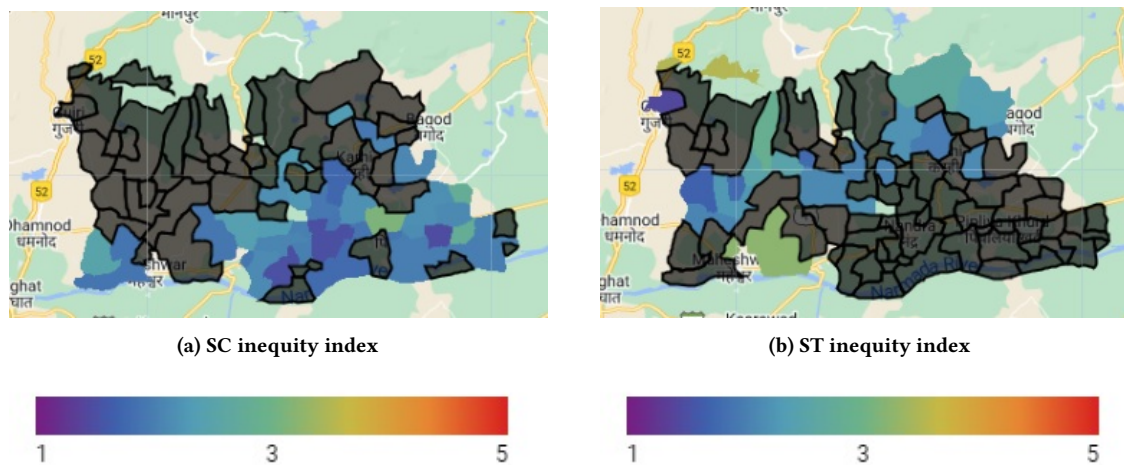


Figure 11: Panchayat-level inequity indices

literature and field reports. In this section, we compare our findings with various field surveys and prior research that may have focused on a specific type of discrimination in a specific region.

Camfield and Vennam (2011) found a lack of equity in general and more employment given to upper castes through longitudinal surveys in a few states. The authors found better scheme management and higher wages paid in Andhra Pradesh while poor management

in Jharkhand. They also found evidence of caste-based discriminatory practices with risky work being given to SCs which challenges the “fostering social equity”, and also that “The landless have not benefited as much as expected. The main beneficiaries in the three villages sampled for the qualitative research have been individual farmers, often from higher castes, and to some extent administering officials” [57, p. 1]. Our results of lower SC and ST inequity indices

District	State type	SC Inequity index
Begusarai, Bihar	Other	4.254166
Bhagalpur, Bihar	Other	4.344091
Madhepura, Bihar	Other	4.344824
Darbhanga, Bihar	Other	4.457634
Guntur, Andhra Pradesh	Significant SC population	2.614347
Vizianagaram, Andhra Pradesh	Significant SC population	2.658891
Srikakulam, Andhra Pradesh	Significant SC population	2.951462
Anantapur, Andhra Pradesh	Significant SC population	3.638806
Dumka, Jharkhand	Significant ST population	2.240628
Jashpur, Chhattisgarh	Significant ST population	2.277975
Bilaspur, Chhattisgarh	Significant ST population	4.144880
Durg, Chhattisgarh	Significant ST population	4.565654

Table 8: SC Inequity Index for top 4 districts from each type of state

for Andhra Pradesh as compared to the other states align with the findings from this study. Veeraraghavan’s survey in Andhra Pradesh to compare scheme implementation in the panchayats dominated by scheduled tribes with panchayats dominated by scheduled castes shows better scheme utilization in the tribal panchayats [56]. This may seem contradictory to our results. However, when we analyze the components of these indices, we find higher equity towards scheduled tribes in panchayats with *segregated significant ST population villages* as compared to the equity towards scheduled castes in panchayats with *segregated significant SC population villages* in the scheme utilization dimension. Thus, the essence of our results matches the findings of Veeraraghavan’s work. While our results can be validated with these surveys, the approach shared in this paper broadens the scope of analyzing inequity and allows for a nuanced analysis of different types of inequities. It provides an avenue for identifying the processes causing inequity to bring about precise policy action.

Kumar and Sah analyzed data from 12,044 households from 400 villages of 16 districts in Madhya Pradesh to find evidence of positive action towards the most vulnerable sections of society, in accordance with the spirit of NREGA 2005 [33]. The paper found evidence of 1.5 - 2 times more employment given to the scheduled caste households; however, it raised the question of whether even twice as much employment to the SCs is sufficient considering their marginalization in the past. However, the paper does not offer

District	State type	ST Inequity index
Kaimur, Bihar	Other	2.464669
Paschim Champaran, Bihar	Other	2.467983
Akola, Maharashtra	Other	2.473244
Washim, Maharashtra	Other	2.529184
Srikakulam, Andhra Pradesh	Significant SC population	4.083637
Chittoor, Andhra Pradesh	Significant SC population	4.145543
Anantapur, Andhra Pradesh	Significant SC population	4.360038
Prakasam, Andhra Pradesh	Significant SC population	4.597652
Gumla, Jharkhand	Significant ST population	2.457527
Garhwa, Jharkhand	Significant ST population	2.477151
Dindori, Madhya Pradesh	Significant ST population	2.478103
Pakur, Jharkhand	Significant ST population	2.485485

Table 9: ST Inequity Index for top 4 districts from each type of state

any strategy to compare the expected or ideal demand from SCs with what was provided. Our work provides a method through the demand prediction model of the actual demand that should be expected from SCs. We are therefore able to present data-backed claims of insufficient effort in terms of ensuring equity towards SCs with an *SC Inequity Index* of 2.9695 in Madhya Pradesh, which is an indicator of a significant level of inequity.

Kumar and Sah also suggested the existence of a more democratic process and higher awareness amongst scheduled tribes [33], which matches with our results presented in Table 33 which reflect significant equity in scheme utilization across panchayats with significant ST population. Tribal communities in Madhya Pradesh may have a higher awareness of their right to demand work. However, there is no evidence of equity in providing work which is evident from negative extensive and intensive management scores both across and within panchayat dimensions (columns 1,3,4,5, in Table 33) for all panchayat categories. Overall, the findings match with those in our paper.

Manjula and Rajasekhar looked for evidence of positive action towards scheduled castes and scheduled tribes in Karnataka using official MGNREGS MIS data for a 4-year period from 2009-10 to 2013-14 [35]. The paper found that the per-person expenditure is lower in districts with a higher population of scheduled castes. The paper also found evidence of higher demand for MGNREGS work amongst scheduled castes and scheduled tribes which they attributed to the historically disadvantaged socio-economic conditions of these groups. The paper highlighted the lack of will for positive action towards these groups, also reflected in the fact that useless and noncultivable land was allotted to SCs under the land reform

legislation [58] as cited in [35]. Therefore, the paper attempted to establish the fact that positive action through MGNREGS is insufficient in Karnataka with a qualitative argument in favor of the need for higher demand for MGNREGS work in SC and ST communities. The paper further highlighted the lack of equity towards these marginalized groups because although MGNREGS work is provided to a higher number of SC/ST households, the person days of work are lower than those secured by other castes. Our results shown in Table 19 also reflect a significant level of equity in extensive scheme management across *significant SC population panchayats* but not significant equity in intensive scheme management. Our analysis extends to scheduled tribe communities as well.

Thapar-Biokert, *et al.* presented a dichotomy of empowerment and disempowerment in household, community, and market domains through their comparative study of two districts from each of the states of Uttar Pradesh and Andhra Pradesh [55]. The study used official MIS data along with interviews of civil society activists, politicians, state officials, farmers, and beneficiaries for their analysis to show that MGNREGS work allocation aligned more with the requirements to build NRM assets in Andhra Pradesh as compared to Uttar Pradesh. The paper further found that scheduled castes are more empowered in Andhra Pradesh compared to in Uttar Pradesh. While the social status of scheduled castes is improving in Andhra Pradesh, there is still acute discrimination against SCs in Uttar Pradesh. The paper found that while MGNREGS is helping marginalized communities to come out of a debt trap in Andhra Pradesh, the situation is not the same in Uttar Pradesh. Our work shows similar results for scheduled castes in Andhra Pradesh with an *SC Inequity Index* of 1.7945 showing equitable treatment towards scheduled castes in Andhra Pradesh. Our results for Uttar Pradesh do not match with these findings though. We find an *SC Inequity Index* of 1.6688 showing less inequitable treatment given to SCs in Uttar Pradesh, and will investigate this possible error in more detail in the future. Work done by Pankaj provides possible insights into the reasons for such a low inequity score in UP [47]. His survey-based study presents anecdotal evidence of the misuse of job cards issued to SC households as upper caste Mukhiyas keep job cards issued to SC households with themselves and use them for their own benefit. The paper further highlights the helpless situation of SC Mukhiyas as they are unable to carry on development work. Since we are seeing only the data published on the MIS, it is possible that large scale corruption of this sort may be hiding the actual reality of discrimination against the SCs.

While these papers validate our findings for scheduled castes in several states, they lack strong evidence for proving or disproving equitable treatment given towards scheduled tribes. Discrimination against STs seems to be less studied. We fill this gap through our work based on quantitative analysis, which can be now used to identify specific locations where new patterns of discrimination can be investigated through on-field surveys and discussions.

In general, we find that scheduled tribes are concentrated in certain regions and tend to be treated more unfairly irrespective of whether these regions have higher populations of scheduled tribes or not. Our own field visits to areas like the Chandwa block in the Latehar district of Jharkhand, Adilabad in Telangana, the Pindwara block in the Sirohi district of Jharkhand, and Angul in Odisha, all of which are high ST population areas, indicate similar findings

that ST areas are isolated and get lower budget allocations, while also having low awareness about MGNREGS and other government schemes. Going forward, we plan to undertake more field visits to validate the inferences provided from the quantitative data analysis, especially to ST communities, to uncover discriminatory processes.

8 Applications of This Research

Our analysis framework allows for the assessment of inequity at various administrative levels. The district-level inequity index can provide an opportunity to develop concrete action plans for the district administration to address inequity issues through resource allocation, and the panchayat-level inequity index can help to identify the need for awareness campaigns to improve utilization.

Breakdown of the inequity index into its components can further inform about the extent and nature of disparity by studying the interactions between panchayat categories, different types of disparity, and the dimension (across or within), to identify the underlying processes that might be leading towards inequity. Such analysis is essential to determine precise policy interventions and the administrative level at which the policy action should be undertaken. We are attempting to build such a framework in consultation with experts from the social sector.

As part of future work, the framework proposed in this paper can be extended to also predict the impact of budget allocations on future inequity by building predictive models. The underlying caste dynamics uncovered by this analysis need not be restricted to policy action in MGNREGS only, and is likely to be applicable to other schemes as well.

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A Variable List

Category	Variable	Description	Min	Max	Mean	Std Dev.
MGNREGS MIS	<i>employment _demanded _household</i>	Number of households demanding work under MGN-REGS in the panchayat.	0	8067	189	295
	<i>employment _provided _household</i>	Number of households provided work in the panchayat.	0	7408	170	275
	<i>employment _provided _total _persondays</i>	Number of person days of work provided in the panchayat.	0	518256	8011	14371
	<i>employment _provided _hh_sc</i>	Number of SC households provided work in the panchayat.	0	3989	41	103
	<i>employment _provided _hh_st</i>	Number of ST households provided work in the panchayat.	0	8803	32	97
	<i>employment _provided _hh_oth</i>	Number of general caste households provided work in the panchayat.	0	6386	117	214
	<i>employment _provided _persondays_sc</i>	Number of person days of work provided to SC persons in the panchayat.	0	214462	1886	5214
	<i>employment _provided _persondays_st</i>	Number of person days of work provided to ST persons in the panchayat.	0	2	0.7751	0.3036
	<i>employment _provided _persondays_oth</i>	Number of person days of work provided to general caste persons in the panchayat.	0	2	0.7751	0.3036
	<i>empDemand_per _household</i>	Number of households demanding work under MGN-REGS relative to total number of household in the panchayat.	0	2	0.345	0.345
	<i>empProvided_per _empDemand</i>	Number of households provided work relative to the number of household demanding work under MGN-REGS in the panchayat.	0	2	0.7751	0.3036
	<i>average_wage</i>	Average wage per person day. The Central and state governments revise the wage rate annually.	0	344	178	40
	<i>DCapproved_per _payable</i>	The delay compensation to be paid by the government needs to be approved. Authorities may not deem all delays as worthy of compensation, and this variable indicates the fraction of compensation payable which was approved by the government.	0	2	0.262	0.416
Demographic	<i>unemployed_female _population</i>	Percentage of unemployed females in the panchayat	0	1	0.636	0.183
	<i>female_literacy_rate</i>	Percentage of literate females in the panchayat	0	1	0.509	0.134
	<i>per_capita_SC_female</i>	Percentage of scheduled caste females in total population of the panchayat	0	0.567	0.082	0.075
	<i>per_capita_ST_female</i>	Percentage of scheduled caste females in total population of the panchayat	0	0.679	0.089	0.152
	<i>mainwork _agricultural _female _population</i>	Percentage of females with agriculture as their main profession	0	0.915	0.102	0.116
	<i>marginal _agricultural _female _population</i>	Percentage of females with agriculture as their marginal profession	0	0.839	0.082	0.104
	<i>ST_population_ratio</i>	Percentage of ST population in a panchayat	0	1	0.179	0.303
	<i>emp_nal</i>	Population employed in non-agricultural profession	0	29261	326	658
Development	<i>adi_2011</i>	A development index created using certain development related parameters from 2011 census at village level which is further aggregated at panchayat level	0	15	7.045	4.625
	<i>BF_RUD</i>	number of households with rudimentary bathroom facility	0	20476	497.07	578.90
	<i>FC_RUD</i>	number of households with rudimentary cooking fuel	0	32653	442.99	505.77
Irrigation	<i>irr_area_ratio</i>	Percentage of irrigated area at sub-district level. This index is applied to all panchayats within sub-district	0	1	0.348	0.336
Climate	<i>vulnerability_index</i>	The vulnerability index is available at district level. This index is applied to all panchayats within district	0	1	0.213	0.254
Industrialization	<i>asi_factories _more_than _zero</i>	A boolean variable indicating presence of factories in a village within panchayat	0	1	0.069	0.253

B Method selection

B.1 Sample Panchayat Categories

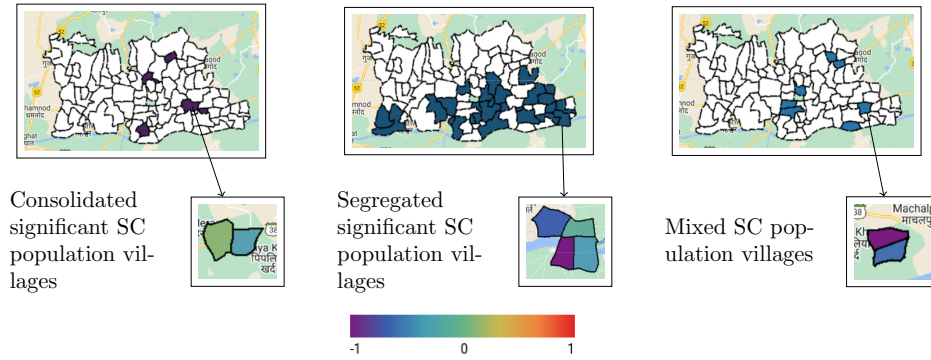


Figure 12: Categorization of SC Panchayats based on the distribution of SC population within panchayat

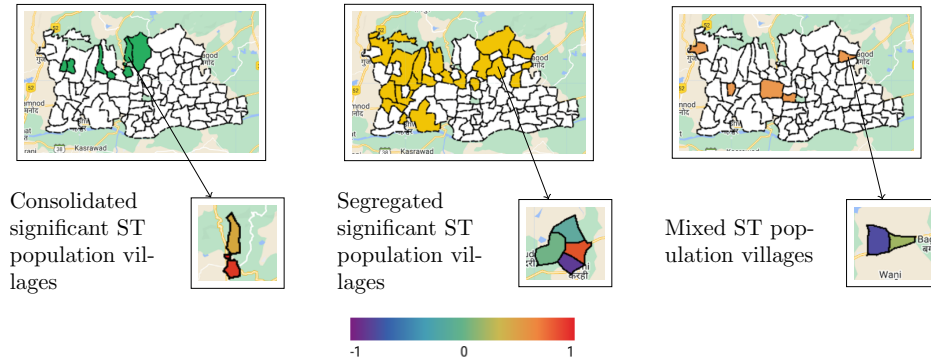


Figure 13: Categorization of ST Panchayats based on the distribution of ST population within panchayat

B.2 Hypothesis Formulation

MGNREGA 2005 has in-built provisions to support equitable treatment towards marginalized groups, as shared in Section 3.2. Caste-based discrimination is often small though, and therefore it may be indistinguishable on a single time slice. As a result, it is difficult to find evidence of discrimination through the standard null hypothesis which considers fairness as a norm and tests for equality. It is important to address even small incidences of discrimination against SC and ST communities to meet the essence of social justice conceptualized in MGNREGA 2005. The philosophical argument for social justice puts the burden of proof to provide fair treatment on the administration, rather than for others to prove discrimination [40]. Therefore, we have designed our framework to measure equity rather than equality, and therefore model the hypothesis differently, as shown in Figure 14.

Here, differential resource allocation towards treated panchayats in “Region1” indicates discriminatory treatment and in “Region3” indicates equitable treatment, irrespective of equity or equality considerations. However, the differential resource allocation to treated panchayats in “Region2” results in different interpretations. We choose to use this region as insufficient evidence of fairness, and therefore use a right-tailed t-test to identify incidents of statistically significant equity and consider everything else as either inequity or insufficient evidence of equity.

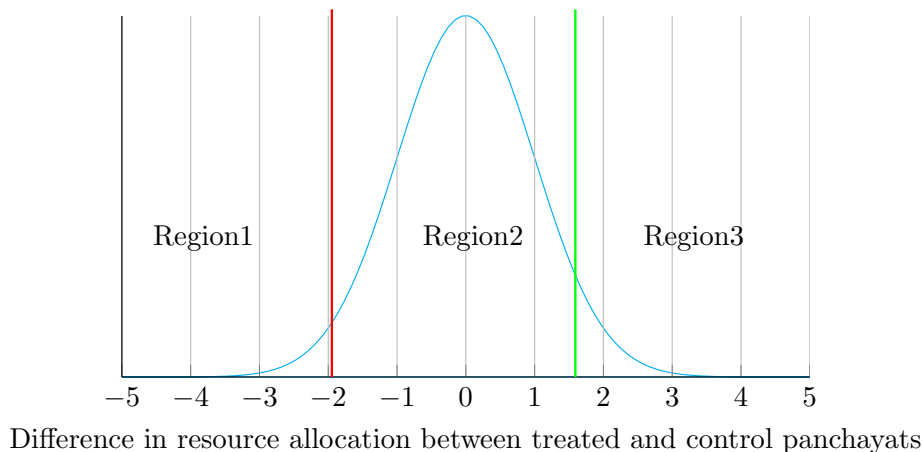


Figure 14: Hypothesis selection for equality vs. equity

B.3 Structural Models

Output Variable: # households provided employment/ # households demanding employment

Number of observations: 72034

Parameter	Andhra Pradesh	Bihar	Chhattisgarh	Gujarat	Haryana
Female population ratio	-0.19***	-0.18***	-0.16***	-0.19***	-0.16***
Marginal female ratio	-0.15***	-0.17***	-0.12***	-0.16***	-0.15***
Mainwork female ratio	-0.24***	-0.24***	-0.20***	-0.29***	-0.21***
Female literacy rate	0.14***	0.11***	0.13***	0.20***	0.14***
ADI 2011	0.02**	0.02***	0.01*	0.04***	0.01
Rudimentary Bathroom facilities	0.15***	0.13***	0.14***	0.15***	0.16***
Rudimentary main source of water	-0.28***	-0.30***	-0.30***	-0.34***	-0.29***
differential Female population ratio	-0.63***	-1.16***	-0.22***	0.06	0.13**
differential Marginal female ratio	0.12***	0.11***	-0.07***	0.07***	0.03**
differential Mainwork female ratio	0.33***	0.15***	-0.08***	0.11***	0.01
differential Female literacy rate	0.66***	0.38***	-0.01	-0.47***	0.06
differential ADI 2011	-0.04**	0.21***	0.10***	-0.00	0.03
differential Rudimentary Bathroom facilities	-0.22***	0.28***	0.17***	-0.31***	-0.14***
differential Rudimentary main source of water	-0.00	0.02**	-0.06***	0.11***	0.03***
Pseudo R-squared	-0.0005925	-0.0039997	-0.0046348	0.0342914	-0.0048247

Table 10: Structural models for Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, and Haryana
Note: differential variables represent the difference in slope/coefficient of the variable for a given state.

Parameter	Jharkhand	Karnataka	Madhya Pradesh	Maharashtra	Odisha
Female population ratio	-0.18***	-0.19***	-0.17***	-0.17***	-0.18***
Marginal female ratio	-0.14***	-0.15***	-0.16***	-0.13***	-0.14***
Mainwork female ratio	-0.22***	-0.23***	-0.21***	-0.09***	-0.21***
Female literacy rate	0.13***	0.15***	0.13***	0.17***	0.12***
ADI 2011	0.02**	0.03***	0.00	0.09***	0.02**
Rudimentary Bathroom facilities	0.13***	0.12***	0.12***	0.03***	0.12***
Rudimentary main source of water	-0.29***	-0.27***	-0.34***	-0.27***	-0.29***
differential Female population ratio	-0.27*	0.73***	-0.57***	-0.71***	-0.24**
differential Marginal female ratio	-0.01	0.05***	0.03*	0.03**	0.01
differential Mainwork female ratio	-0.07***	0.16***	-0.02	0.04*	0.05***
differential Female literacy rate	-0.11**	-0.62***	0.11***	0.19***	0.11**
differential ADI 2011	0.13***	-0.03*	0.39***	-0.11***	0.13**
differential Rudimentary Bathroom facilities	0.24**	-0.15***	0.04	0.25***	-0.00
differential Rudimentary main source of water	0.04**	-0.04***	0.17***	0.07***	0.02
Pseudo R-squared	-0.0069580	-0.0028633	-0.0034638	-0.0043155	-0.0073098

Table 11: Structural models for Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, and Odisha
Note: differential variables represent the difference in slope/coefficient of the variable for a given state.

Parameter	Punjab	Tamil Nadu	Telangana	Uttar Pradesh	West Bengal
Female population ratio	-0.17***	-0.21***	-0.19***	-0.16***	-0.19***
Marginal female ratio	-0.12***	-0.14***	-0.15***	-0.13***	-0.14***
Mainwork female ratio	-0.17***	-0.23***	-0.23**	-0.16***	-0.20***
Female literacy rate	0.16***	0.09***	0.15***	0.12***	0.13***
ADI 2011	-0.01	0.07***	0.03***	0.03***	0.02**
Rudimentary Bath-room facilities	0.24***	0.09***	0.15***	0.09***	0.13***
Rudimentary main source of water	-0.29***	-0.25***	-0.28***	-0.27***	-0.28***
differential Female population ratio	2.03***	-0.16	0.10	-0.66***	-0.61***
differential Marginal female ratio	0.07**	0.04**	0.05**	0.09***	-0.05***
differential Mainwork female ratio	0.07**	0.03	0.11**	0.07***	0.03
differential Female literacy rate	-1.45***	0.24***	0.05	0.54***	0.47***
differential ADI 2011	0.14***	-0.01	-0.01	-0.05**	0.10
differential Rudimentary Bathroom facilities	-0.34***	0.18***	-0.16***	0.25***	0.29***
differential Rudimentary main source of water	0.27***	-0.02*	0.02*	0.10***	-0.05***
Pseudo R-squared	0.0151245	0.0033695	-0.0045017	0.0023348	-0.0042424

Table 12: Structural models for Punjab, Tamil Nadu, Telangana, Uttar Pradesh, and West Bengal
Note: differential variables represent the difference in slope/coefficient of the variable for a given state.

C Results: Disparate treatment and impact towards scheduled castes

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	-0.0158 (0.4878)	0.0348 (0.0)	-0.0368 (0.5)	0.1003 (0.0)	0.0132 (0.0)
Consolidated significant SC population	-0.0143 (0.4995)	0.0756 (0.0)	-0.0458 (0.5)	0.2639 (0.0)	0.0327 (0.0)
Segregated significant SC population	-0.018 (0.3964)	0.0292 (0.0524)	-0.0396 (0.4972)	0.1357 (0.0)	0.0214 (0.0)
Mixed SC population	-0.0245 (0.5)	0.0161 (0.038)	-0.0373 (0.5)	0.1714 (0.0)	0.0265 (0.0)

Table 13: Difference in resource allocation to SC versus General caste for Andhra Pradesh The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	-0.0014 (0.3166)	0.0294 (0.0)	-0.0034 (0.4713)	-0.0438 (1.0)	-0.0049 (1.0)
Consolidated significant SC population	-0.0181 (0.3165)	0.0483 (0.12)	-0.0042 (0.2817)	-0.2026 (1.0)	-0.0724 (0.9813)
Segregated significant SC population	-0.0032 (0.3799)	0.03 (0.0)	-0.0041 (0.4822)	-0.044 (1.0)	-0.0045 (1.0)
Mixed SC population	0.0061 (0.1603)	0.0116 (0.121)	-0.0007 (0.2719)	-0.0852 (1.0)	-0.0107 (1.0)

Table 14: Difference in resource allocation to SC versus General caste for Bihar The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	-0.0157 (0.4778)	-0.0239 (0.4975)	-0.021 (0.4999)	-0.3511 (1.0)	-0.1549 (1.0)
Consolidated significant SC population	0.0005 (0.2445)	-0.0316 (0.4853)	-0.017 (0.4796)	-0.1999 (1.0)	-0.0616 (1.0)
Segregated significant SC population	-0.0147 (0.3941)	0.0127 (0.1228)	-0.0144 (0.4532)	-0.2212 (1.0)	-0.0514 (1.0)
Mixed SC population	-0.0245 (0.4566)	-0.0676 (0.5)	-0.0286 (0.4978)	-0.1881 (1.0)	-0.0245 (1.0)

Table 15: Difference in resource allocation to SC versus General caste for Chhattisgarh The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	0.0122 (0.0563)	0.0325 (0.0004)	0.0108 (0.01)	-0.0515 (1.0)	-0.0267 (1.0)
Consolidated significant SC population	-0.0038 (0.3149)	0.1502 (0.0)	0.012 (0.0684)	-0.0317 (0.8451)	-0.0027 (0.7686)
Segregated significant SC population	-0.0538 (0.4629)	0.0434 (0.0504)	-0.0092 (0.3365)	-0.0115 (0.6467)	-0.0003 (0.5322)
Mixed SC population	0.0109 (0.0803)	0.0181 (0.0302)	0.0074 (0.0467)	0.0315 (0.0001)	0.003 (0.0038)

Table 16: Difference in resource allocation to SC versus General caste for Gujarat The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	0.0093 (0.0258)	0.0315 (0.0)	-0.0035 (0.4556)	0.1855 (0.0)	0.0153 (0.0)
Consolidated significant SC population	-0.0036 (0.4653)	0.0632 (0.0)	-0.0126 (0.5)	0.1502 (0.0)	0.0086 (0.0)
Segregated significant SC population	-0.0106 (0.3576)	-0.0078 (0.3268)	-0.0127 (0.468)	0.1688 (0.0)	0.0096 (0.0)
Mixed SC population	0.006 (0.1001)	0.0231 (0.0004)	-0.002 (0.3655)	0.2289 (0.0)	0.0155 (0.0)

Table 17: Difference in resource allocation to SC versus General caste for Haryana The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	-0.0259 (0.4914)	-0.0117 (0.4081)	-0.0201 (0.4989)	-0.2763 (1.0)	-0.0976 (1.0)
Consolidated significant SC population	-0.101 (0.4493)	-0.039 (0.3392)	-0.0657 (0.4586)	-0.2047 (0.9999)	-0.035 (0.9987)
Segregated significant SC population	-0.0326 (0.4958)	-0.0155 (0.4301)	-0.023 (0.4992)	-0.1531 (1.0)	-0.021 (1.0)
Mixed SC population	-0.0892 (0.4618)	0.0491 (0.0798)	-0.0487 (0.4562)	-0.1171 (0.9964)	-0.0176 (0.9961)

Table 18: Difference in resource allocation to SC versus General caste for Jharkhand The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	0.0108 (0.0281)	-0.0141 (0.485)	0.0104 (0.0041)	-0.1455 (1.0)	-0.0272 (1.0)
Consolidated significant SC population	0.0504 (0.0433)	-0.0398 (0.4061)	0.0158 (0.1253)	-0.1731 (1.0)	-0.0508 (0.9996)
Segregated significant SC population	0.0144 (0.016)	-0.0123 (0.4647)	0.0125 (0.003)	-0.1548 (1.0)	-0.0224 (1.0)
Mixed SC population	-0.037 (0.4808)	-0.0363 (0.4707)	-0.0175 (0.4584)	-0.091 (1.0)	-0.0144 (1.0)

Table 19: Difference in resource allocation to SC versus General caste for Karnataka The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	0.0031 (0.0)	-0.0625 (0.5)	0.0114 (0.0)	-0.0851 (1.0)	-0.0407 (1.0)
Consolidated significant SC population	0.0142 (0.0287)	-0.0685 (0.5)	0.0146 (0.0012)	-0.0218 (0.9978)	-0.0074 (1.0)
Segregated significant SC population	0.0042 (0.0)	-0.0683 (0.5)	0.0134 (0.0)	-0.0481 (1.0)	-0.0098 (1.0)
Mixed SC population	0.0038 (0.1329)	-0.0721 (0.5)	0.0118 (0.0002)	-0.0486 (1.0)	-0.0077 (1.0)

Table 20: Difference in resource allocation to SC versus General caste for Madhya Pradesh The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	-0.0028 (0.3648)	0.0117 (0.0037)	-0.0121 (0.4999)	-0.0903 (1.0)	-0.0206 (1.0)
Consolidated significant SC population	0.0133 (0.0674)	0.0125 (0.0852)	-0.0006 (0.2632)	-0.1036 (1.0)	-0.0142 (1.0)
Segregated significant SC population	0.0063 (0.1375)	0.0157 (0.0343)	-0.0031 (0.3283)	-0.0996 (1.0)	-0.0129 (1.0)
Mixed SC population	-0.0014 (0.4905)	0.004 (0.1175)	-0.0117 (0.5)	-0.0757 (1.0)	-0.0091 (1.0)

Table 21: Difference in resource allocation to SC versus General caste for Maharashtra The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	-0.0076 (0.4187)	-0.0358 (0.5)	-0.0044 (0.42)	-0.164 (1.0)	-0.0789 (1.0)
Consolidated significant SC population	0.0517 (0.1272)	-0.0277 (0.3122)	0.0249 (0.1338)	-0.0263 (0.7447)	-0.057 (0.9511)
Segregated significant SC population	0.0028 (0.0064)	-0.0333 (0.5)	-0.0016 (0.407)	-0.0598 (1.0)	-0.0087 (1.0)
Mixed SC population	-0.0357 (0.4587)	-0.163 (0.5)	-0.0144 (0.4259)	0.0056 (0.3876)	-0.0082 (0.9909)

Table 22: Difference in resource allocation to SC versus General caste for Odisha The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	0.0233 (0.0)	0.0781 (0.0)	-0.0056 (0.4969)	0.3946 (0.0)	0.036 (0.0)
Consolidated significant SC population	0.0279 (0.0)	0.1049 (0.0)	-0.0058 (0.4992)	0.4166 (0.0)	0.0268 (0.0)
Segregated significant SC population	0.0136 (0.0048)	-0.0198 (0.4158)	-0.0047 (0.4126)	0.3502 (0.0)	0.0289 (0.0)
Mixed SC population	0.0121 (0.0)	0.0352 (0.0001)	-0.0053 (0.4899)	0.4998 (0.0)	0.0436 (0.0)

Table 23: Difference in resource allocation to SC versus General caste for Punjab The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	0.0137 (0.041)	0.028 (0.0012)	0.0126 (0.0324)	0.0406 (0.0)	0.0141 (0.0)
Consolidated significant SC population	0.0245 (0.0238)	0.0339 (0.0037)	0.0284 (0.0079)	0.129 (0.0)	0.0186 (0.0)
Segregated significant SC population	0.0188 (0.0878)	0.0112 (0.1342)	0.0183 (0.0687)	0.0853 (0.0)	0.0143 (0.0001)
Mixed SC population	-0.0052 (0.3083)	-0.0078 (0.3396)	-0.0123 (0.4071)	0.1013 (0.0)	0.0202 (0.0)

Table 24: Difference in resource allocation to SC versus General caste for Tamil Nadu The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	-0.0093 (0.3594)	0.0593 (0.0001)	-0.0256 (0.493)	0.122 (0.0)	0.0226 (0.0)
Consolidated significant SC population	0.0241 (0.0234)	0.1148 (0.0004)	-0.0207 (0.4267)	0.2254 (0.0)	0.0455 (0.0)
Segregated significant SC population	-0.0178 (0.2917)	-0.0648 (0.3911)	-0.0349 (0.3644)	0.1694 (0.0)	0.0397 (0.0)
Mixed SC population	-0.0003 (0.2567)	0.0641 (0.0009)	-0.0195 (0.4907)	0.1953 (0.0)	0.0476 (0.0)

Table 25: Difference in resource allocation to SC versus General caste for Telangana The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	-0.0004 (0.2705)	0.0197 (0.0)	-0.0063 (0.4999)	0.1548 (0.0)	0.0188 (0.0)
Consolidated significant SC population	0.0035 (0.1562)	0.018 (0.0056)	-0.0092 (0.4976)	0.0983 (0.0)	0.0047 (0.0)
Segregated significant SC population	0.0036 (0.1345)	0.0249 (0.0)	-0.0037 (0.4447)	0.1263 (0.0)	0.0083 (0.0)
Mixed SC population	-0.0068 (0.4342)	0.0097 (0.0352)	-0.0065 (0.4915)	0.1507 (0.0)	0.0111 (0.0)

Table 26: Difference in resource allocation to SC versus General caste for Uttar Pradesh The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	0.0254 (0.0042)	0.0874 (0.0)	0.0014 (0.2019)	-0.0128 (0.977)	0.0061 (0.0268)
Consolidated significant SC population	0.0112 (0.0121)	0.1246 (0.0071)	0.0143 (0.1134)	-0.218 (1.0)	-0.0835 (0.9996)
Segregated significant SC population	0.018 (0.0274)	0.0895 (0.0)	-0.0032 (0.3467)	0.0231 (0.0027)	0.0145 (0.0)
Mixed SC population	-0.1148 (0.4653)	-0.1047 (0.4581)	-0.0198 (0.3333)	-0.1035 (0.9278)	0.036 (0.1196)

Table 27: Difference in resource allocation to SC versus General caste for West Bengal The values in parenthesis are p-values

D Results: Disparate treatment and impact towards scheduled tribes

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	0.0169 (0.0982)	0.0105 (0.1727)	-0.0225 (0.4501)	-0.2546 (1.0)	-0.035 (1.0)
Consolidated significant ST population	0.1691 (0.0491)	0.0102 (0.2356)	0.0063 (0.2397)	0.1653 (0.0007)	-0.1369 (0.9961)
Segregated significant ST population	0.0881 (0.0043)	0.038 (0.1203)	0.0221 (0.1251)	-0.055 (0.9922)	-0.1887 (1.0)
Mixed ST population	0.0684 (0.0267)	0.0045 (0.2306)	0.0621 (0.017)	-0.1684 (1.0)	-0.0837 (1.0)

Table 28: Difference in resource allocation to ST versus General caste for Andhra Pradesh The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	0.0057 (0.001)	0.0289 (0.0)	0.025 (0.0)	-0.2702 (1.0)	-0.1504 (1.0)
Consolidated significant ST population	0.0138 (0.0001)	0.0632 (0.0)	0.0397 (0.0)	-0.3306 (1.0)	-0.4544 (1.0)
Segregated significant ST population	0.0059 (0.0229)	0.0332 (0.0003)	0.0312 (0.0)	-0.263 (1.0)	-0.2636 (1.0)
Mixed ST population	0.0108 (0.0719)	0.0253 (0.003)	0.0169 (0.0019)	-0.2525 (1.0)	-0.0813 (1.0)

Table 29: Difference in resource allocation to ST versus General caste for Chhattisgarh The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	-0.0034 (0.3353)	0.0307 (0.0)	-0.0097 (0.498)	-0.1071 (1.0)	-0.0307 (1.0)
Consolidated significant ST population	0.0194 (0.0557)	0.0226 (0.0399)	-0.0043 (0.3588)	-0.3061 (1.0)	-0.2264 (1.0)
Segregated significant ST population	-0.0114 (0.4999)	0.0975 (0.0)	-0.0148 (0.5)	-0.2843 (1.0)	-0.2053 (1.0)
Mixed ST population	-0.0034 (0.4862)	-0.0088 (0.414)	-0.0068 (0.4999)	-0.0344 (1.0)	-0.0133 (1.0)

Table 30: Difference in resource allocation to ST versus General caste for Gujarat The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	0.0053 (0.1471)	0.0134 (0.0465)	0.0027 (0.1529)	-0.3061 (1.0)	-0.0837 (1.0)
Consolidated significant ST population	-0.1627 (0.4717)	0.0019 (0.2449)	-0.0996 (0.4793)	-0.5545 (1.0)	-0.3071 (1.0)
Segregated significant ST population	0.021 (0.011)	0.0194 (0.0181)	0.0112 (0.0159)	-0.523 (1.0)	-0.2267 (1.0)
Mixed ST population	-0.0051 (0.3992)	-0.0393 (0.4378)	-0.0062 (0.4013)	-0.3693 (1.0)	-0.1012 (1.0)

Table 31: Difference in resource allocation to ST versus General caste for Jharkhand The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	-0.0037 (0.4768)	0.0454 (0.0001)	-0.0011 (0.3132)	-0.1419 (1.0)	-0.0168 (1.0)
Consolidated significant ST population				-0.4243 (0.9543)	-0.3696 (0.9225)
Segregated significant ST population	0.005 (0.1903)	0.0494 (0.001)	0.0039 (0.1794)	-0.297 (1.0)	-0.0966 (1.0)
Mixed ST population	0.0526 (0.04)	-0.0048 (0.27)	0.0216 (0.0804)	-0.2142 (1.0)	-0.0735 (1.0)

Table 32: Difference in resource allocation to ST versus General caste for Karnataka The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	-0.0118 (0.5)	0.1034 (0.0)	-0.0301 (0.5)	-0.0812 (1.0)	-0.0259 (1.0)
Consolidated significant ST population	-0.019 (0.5)	0.2474 (0.0)	-0.0509 (0.5)	-0.3753 (1.0)	-0.455 (1.0)
Segregated significant ST population	-0.0113 (0.5)	0.0958 (0.0)	-0.0316 (0.5)	-0.2944 (1.0)	-0.1561 (1.0)
Mixed ST population	-0.0112 (0.5)	0.073 (0.0)	-0.0253 (0.5)	-0.2099 (1.0)	-0.0523 (1.0)

Table 33: Difference in resource allocation to ST versus General caste for Madhya Pradesh The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	0.0024 (0.0)	0.0268 (0.0)	0.0071 (0.0003)	-0.1276 (1.0)	-0.0194 (1.0)
Consolidated significant ST population	0.0031 (0.0265)	-0.0264 (0.4509)	0.016 (0.0078)	-0.5171 (1.0)	-0.3683 (1.0)
Segregated significant ST population	0.0001 (0.231)	0.0586 (0.0)	0.0146 (0.0007)	-0.3203 (1.0)	-0.1194 (1.0)
Mixed ST population	-0.0031 (0.3309)	0.0142 (0.0115)	-0.0002 (0.2573)	-0.276 (1.0)	-0.0431 (1.0)

Table 34: Difference in resource allocation to ST versus General caste for Maharashtra The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	-0.0048 (0.4994)	0.0545 (0.0)	-0.0017 (0.3922)	-0.189 (1.0)	-0.0685 (1.0)
Consolidated significant ST population	-0.0139 (0.2766)	0.0739 (0.0201)	-0.0337 (0.3354)	-0.1956 (0.9893)	-0.4677 (1.0)
Segregated significant ST population	-0.0049 (0.4986)	0.0708 (0.0)	-0.0034 (0.4557)	-0.3794 (1.0)	-0.211 (1.0)
Mixed ST population	0.0179 (0.1545)	0.0346 (0.1058)	0.013 (0.1376)	-0.317 (1.0)	-0.1232 (1.0)

Table 35: Difference in resource allocation to ST versus General caste for Odisha The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	-0.0117 (0.3274)	0.0206 (0.129)	0.0487 (0.0104)	-0.2083 (1.0)	-0.0258 (1.0)
Consolidated significant ST population	0.068 (0.0626)	0.0815 (0.0592)	0.1846 (0.0005)	0.1375 (0.0003)	-0.277 (1.0)
Segregated significant ST population	-0.0904 (0.3821)	-0.1102 (0.3882)	-0.0134 (0.2815)	-0.0651 (0.9085)	-0.0582 (0.9957)
Mixed ST population	-0.0307 (0.3913)	0.0222 (0.148)	0.0297 (0.0791)	-0.1499 (1.0)	-0.072 (1.0)

Table 36: Difference in resource allocation to ST versus General caste for Telangana The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	0.0117 (0.0176)	0.1008 (0.0005)	-0.0289 (0.4994)	-0.2622 (1.0)	-0.0147 (1.0)
Consolidated significant ST population	0.0769 (0.0905)	0.103 (0.0493)	-0.0151 (0.315)	-0.6042 (1.0)	-0.6656 (1.0)
Segregated significant ST population	0.0803 (0.0426)	0.1381 (0.0076)	0.0172 (0.1634)	-0.4987 (1.0)	-0.2344 (0.9996)
Mixed ST population	0.0152 (0.0372)	0.0291 (0.153)	-0.0385 (0.4996)	-0.1169 (0.9673)	-0.0131 (0.9873)

Table 37: Difference in resource allocation to ST versus General caste for Uttar Pradesh The values in parenthesis are p-values

Panchayat category	Across Panchayats			Within Panchayats	
	Extensive Management	Utilization	Intensive Management	Extensive Management	Intensive Management
Overall	0.0077 (0.1701)	0.0319 (0.0191)	0.0157 (0.0346)	-0.1848 (1.0)	-0.0142 (0.9999)
Consolidated significant ST population				-0.4983 (0.75)	-0.7525 (0.899)
Segregated significant ST population	0.024 (0.0904)	0.0297 (0.0587)	0.0304 (0.0113)	-0.3443 (1.0)	-0.1507 (1.0)
Mixed ST population	0.1457 (0.0164)	0.1155 (0.0285)	0.1578 (0.0028)	-0.108 (0.9926)	-0.1646 (0.9999)

Table 38: Difference in resource allocation to ST versus General caste for West Bengal The values in parenthesis are p-values