Geographical Indications and Worker Welfare: Evidence from Darjeeling Tea Gardens

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Abstract

This study investigates the role of Geographical Indications (GIs) in influencing worker welfare. Focusing on Darjeeling tea, the first product in India to receive a GI tag in 2004-05, we examine whether variation in GI adoption across tea gardens affects the well-being of workers. Drawing on primary survey data collected in 2022-23 from 200 workers employed in both GI-certified and non-GI gardens, we adopt multiple econometric techniques, including Instrumental Variable Treatment Regression (IVTR) models and mediation analysis. Our findings reveal that workers in GI gardens spend, on average, about one-third more on consumption than their counterparts, with gains concentrated among poorer workers. These gains occur primarily through access to welfare benefits, the key channel mediating the positive effects of GI legislation on worker well-being. These findings contribute to the ongoing global discourse on GIs as a tool for improving worker welfare. From a policy standpoint, promoting GI adoption among firms that emphasize quality linked to origin can be a viable strategy for empowering low-income workers in India's plantation sector.

Keywords: Geographical Indications, worker welfare, consumption expenditure, Darjeeling Tea, adoption, mediation effect, well-being.

JEL Codes: I31, O34

1. Introduction

Intellectual Property Rights (IPRs) are exclusive legal rights provided to individuals or entities over their creations. These rights grant legal protection and permit commercial use as outlined in the Trade-Related Aspects of Intellectual Property Rights (TRIPS) agreement of the World Trade Organization (WTO). They are instrumental in promoting innovation and fostering economic growth. A recent study by the European Union Intellectual Property Office (EUIPO, 2021) reports that firms in the European Union (EU) with IPRs recorded 23.8 percent higher revenues per employee, paid 22 percent higher wages, and accounted for 29 percent of employment and 45 percent of GDP within the EU compared to firms without such rights.

Among the most commonly used forms of IPRs are patents, copyrights, trademarks, and design rights (Edler et al., 2015), which enable individuals or entities to differentiate their products and obtain greater access to markets for their innovations. Similar to trademarks, Geographical Indications (GIs)[1] are signs, words, or symbols that identify goods as originating from a particular place, where specific environmental and human factors denote distinctive qualities. These attributes are difficult to replicate, thereby permitting product differentiation, premium pricing, and potential economic benefits for producers, farmers, rural communities, and local entrepreneurs (Bramley et al., 2007).

Despite the growing importance of protecting and promoting place-based products, research on their economic implications, especially from a labour perspective, remains limited (Bramley et al., 2007). Empirical evidence[2] on the welfare and well-being effects of GIs is especially

[1] https://www.wto.org/english/tratop_e/trips_e/intel2_e.htm. This makes it virtually impossible for producers elsewhere to reproduce the distinctive qualities that originate from the specific place of production (Addor and Grazioli, 2002). Some products that enjoy a global reputation for their quality and territorial linkages are Darjeeling tea (India), Champagne (France), Tequila (Mexico), and Scotch Whisky (UK).

[2] Much of the literature focuses on legal and economic implications of other forms of IPRs, mainly patents, trademarks, and copyrights (Edler et al, 2015). There is also growing concern about balancing the interests of creators and the public in IPRs legislation.

scarce in Asia, including India. Understanding these relationships is essential for designing IPR policies that adopt a more inclusive approach and are sensitive to regional contexts. Furthermore, little is known about the mechanisms through which GI adoption may impact such outcomes and the magnitude to which mediating or moderating factors influence this relationship. Owing to the scarcity of relevant information in the secondary sources, present study responds to these gaps using primary survey data.

We examine the impact of GI registration on the well-being of workers employed in the Darjeeling tea industry in India. Darjeeling tea was the first product registered under India's GI framework in 2004-05 (GI Registry, GOI)[3]. The tea industry is a major source of employment for a rural and economically disadvantaged workforce (Joseph, 2020; IBEF, 2022), yet it remains characterised by low wages and limited social protection[4] (Besky, 2014; Sarkar, 2016). These longstanding deficits have led to persistent hardship and poor well-being among workers. Addressing their condition is important both for the long-term sustainability of the industry and for achieving broader development goals (Majumder and Chowdhury, 2024). In this context, assessing whether GI protection has improved labour welfare is especially relevant, given that poor living standards persist despite the global reputation and high market value of Darjeeling tea (Besky, 2014).

The study investigates whether GI legislation has improved welfare outcomes for tea garden labourers and, in turn, enhanced their overall well-being. We use consumption expenditure as a proxy for well-being and compare workers in GI-certified (GI) gardens (the treatment group) with those in non-GI (NGI) gardens (the control group) to assess differences in outcomes. Using Instrumental Variable Treatment Regression (IVTR) and mediation analysis (Baron and

[3] https://search.ipindia.gov.in/GIRPublic
[4] https://thewire.in/economy/tea-gardens-in-the-east-are-brewing-starvation-malnutrition

Kenny, 1986), we find that GI protection enhances well-being by improving access to welfare benefits.

A key premise of our analysis is that GI registration does not have a direct effect on wage income, as wages are largely uniform across tea gardens in the region[5]. Drawing on relevant literature (Jena and Grote, 2012; Jena et al., 2015; Belletti and Marescotti, 2021), we argue that GI-certified gardens are more likely to provide better welfare provisions than their NGI counterparts. These benefits may subsequently lead to higher consumption spending, which serves as a proxy for greater economic freedom and increased well-being (Stroup, 2011; Belasen and Hafer, 2013; Graafland, 2020). Thus, we believe that the enhanced well-being of GI workers, as reflected in higher consumption expenditure, is plausibly mediated by gains in welfare provision. By examining this mechanism, our study presents empirical insights on how GI legislation contributes to improving labour well-being by unlocking the value of place-based agricultural products.

Our analysis lends support to the emerging view that GI protection enhances well-being, with gains concentrated among poor workers. These gains occur primarily through access to welfare benefits, which serve as a key channel for mediating the positive effects of GI legislation on workers. The results remain consistent across different specifications and estimation methods. Notably, the study makes a meaningful addition to a literature dominated by conceptual and theoretical arguments about the benefits of GI adoption for rural communities and workers (Bramley et al., 2009; Belletti and Marescotti, 2025). By emphasizing on labour well-being, we introduce a new perspective to the examination of GIs. Our empirical analysis, combined with the application of a mediation framework that is novel in this context, permits us to

[5] The tea garden wage rate is jointly decided by the producer associations, workers' unions, and the State Government representative in the region. The existing daily wage rate across the gardens (Darjeeling, Teari, and Dooars) in the state of West Bengal is Rs 250 (Field Survey, 2022-23; 70th Annual Report, 2023-24, Tea Board of India, Ministry of Labour and Employment, Govt. of India, 2024).

examine not only whether GIs matter, but also the ways in which they influence downstream outcomes. In doing so, we contribute to the sparse body of empirical literature on IPRs and labour welfare, an area of growing relevance for inclusive rural development.

The subsequent section of the paper has been organised in the following manner. Section 2 presents the literature review and the theoretical background. Additionally, an outline of the enactment of GI legislation in India and the Darjeeling Tea industry is provided. Section 3 has discussion on the data sources, selected variables, followed by the empirical strategy. We discuss the main results in Section 4. Section 5 concludes with some policy implications of the findings.

2. Review of Literature

2.1 Theoretical background

GI products are often viewed as a means to support rural communities by adding value to local goods that reflect the region's geography, traditions, and culture. The idea behind GI policy is that such legal recognition can raise incomes, create jobs, and reduce poverty in rural areas (Dupont, 2003; Jena et al., 2015). The value of place-based goods comes from a growing worldwide preference for authentic, safe, and high-quality food products, making GI labels increasingly attractive (Bublitz et al., 2013).

Much of the empirical literature on GIs focuses on the European context (Bowen and Zapata, 2009; De Filippis et al., 2022), where past studies mention that GI-certified products tend to attract premium prices than similar products without such labels (Lecoent et al., 2010; European Commission, 2021). This premium is attributed to the "collective reputation"[6] and

[6] A single firm or producer does not own the GI rights. Infact, producers, mainly organized as producers' associations, who adhere to origin-linked production processes can exercise GI and marketing rights as collective intellectual property rights. This ensures that the reputation is built and maintained collectively (Bramley et al, 2009; Gangjee, 2017).

perceived superior quality associated with GI labels (Menapace and Moschini, 2012; Gangjee, 2017), which influence consumers' willingness to pay more (Landon and Smith, 1997). While many highlight GI as an instrument for securing commercial advantage (Rangnekar, 2003; Pike, 2015), some scholars caution that GI effects are not consistently positive. Bowen and Zapata (2009) note potential income losses, whereas Cardoso et al. (2022) discuss the disproportionate distribution of the value in favour of powerful agents engaged in the supply chain, and De Rosa et al. (2023) find that fewer producers continue with GI products over time.

In India, empirical research on GIs is scarce. Kolady et al. (2011) point out an uneven distribution of GI benefits, while Jena and Grote (2015) find that GI can help improve producer welfare. Other studies focus mainly on pricing and product differentiation (Datta et al., 2021; Ghosh, 2025). Similarly, Bansal and Singh (2024) have documented the positive impacts of GIs on India's agricultural exports. Importantly, attention to the well-being aspects of GIs, mainly on the poor workers, is lacking. So, there exists a clear shortcoming of empirical evidence regarding the well-being implications of GI legislation for economically disadvantaged workers in the country.

Nonetheless, questions persist as to whether the GI benefits reach the actual producers who are often rural or indigenous workers making these products (Bramley et al., 2007; Cardoso et al., 2022). The core intent of GI legislation is to enhance compensation and welfare for these groups. This makes it essential to assess how the benefits of GI registration are distributed across stakeholders, especially labour (Wu, 2024).

Employee well-being[7] is critical to both livelihood and organisational outcomes (Zheng et al., 2015). Poor well-being can lead to absenteeism, reduced productivity, and poor decision-

[7]Studies on well-being measurement are generally based on two perspectives: subjective well-being and objective well-being, depending on the nature of the measurement variable employed (Ma et al., 2025; Zhou and Fei, 2022).

making (Boyd, 1997). Factors such as discrimination, poor compensation, and work-life imbalance can impair these outcomes (Mukherjee, 2022). However, meeting the needs of workers can improve employee welfare and support organisational goals (Bhardwaj et al., 2025). Hence, IPRs, including GIs, are increasingly recognised as tools for enhancing individual and collective well-being. Indeed, previous studies indicate that people associated with GI products experience higher well-being than those without such association (Zhou and Fei, 2022; Wu, 2024). Such evidence validates the significance of providing legal protection to place-based products.

In contrast, literature on plantations reveals widespread deprivation among garden workers. Their socio-economic vulnerability is marked by low wages, poor welfare facilities, inadequate health coverage, and overall lower well-being (Gurung and Mukherjee, 2018; Gogoi and Sumesh, 2023). Although the Plantation Labour Act, 1951[8] mandates management to provide welfare measures such as housing, healthcare, subsidised food, and other social security benefits; implementation varies widely across gardens, leading to disparities in worker well-being. Therefore, this study examines the case of Darjeeling tea garden workers to assess whether GI registration improves their well-being.

2.2 Geographical Indications and the Darjeeling Tea Industry

The hilly region of the Darjeeling district, situated between $26^0$31' and $27^0$30' north latitude and between $87^0$59' and $88^0$53' east longitude in West Bengal, India, is renowned for producing high-quality tea, widely labelled as the "*Champagne of teas*" (Besky, 2014). Despite this reputation, the industry has struggled to consolidate its competitive position. Annual production has declined from about 14 million kilograms in the 1990s to around 6 million

Notable studies by Deaton (1997) and Voukelatou et al. (2021) have used consumption expenditure as a measure of economic or objective well-being.

[8] For details, see https://pib.gov.in/Pressreleaseshare.aspx?PRID=1696814

kilograms in 2023-24. As a result, its share of total tea production has declined from nearly 2 percent of India's output and 10 percent of West Bengal's output in the 1990s to less than 0.5 percent and 2 percent respectively (Tea Board of India, *various issues*). Since the late 1990s, combined direct and indirect employment in the industry has remained at roughly 50,000-60,000 workers (Tea Board of India, *various issues*, Thapa, 2016). Understanding this context requires familiarity with the unique geography of the district and its influence on the legal definition of Darjeeling tea.

The district consists of two distinct topographical zones: the hilly areas (Darjeeling Sadar, Kalimpong[9] and Kurseong subdivisions) and the plains of the Siliguri subdivision (Terai) at the foothills (Figure 1). The Tea Board of India (TBI) has formally designated tea grown and processed in the hilly subdivisions as eligible for the Darjeeling tea label[10], while tea from the Terai plains, even within the district boundaries, is excluded (Tea Board of India, 2001).

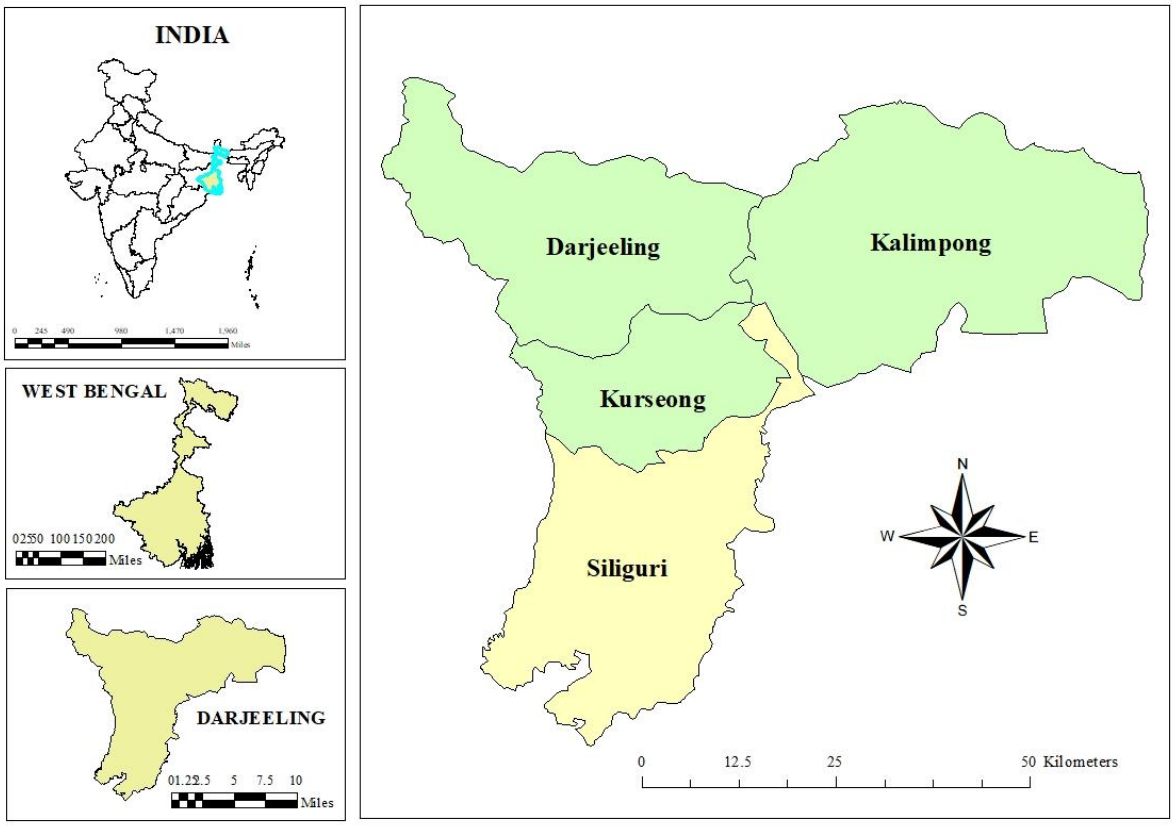
As with many premium products, Darjeeling tea faces widespread counterfeiting. Annual sales are estimated at around 40 million kilograms, while actual production is only about 10 million kilograms (Dasgupta, 1987; Lecoent et al., 2010). This gap is filled largely by teas from Kenya, Sri Lanka, and Nepal falsely branded as Darjeeling tea, leading to an estimated 80% of global sales being counterfeit (Dasgupta, 1987; Lecoent et al., 2010; The Statesman, 2025). Such misrepresentation misleads consumers and also erodes the market and reputation painstakingly built on the historical quality of Darjeeling tea (Landon and Smith, 1997; Portel, 2025; The

[9] Kalimpong has been a separate district since 2017. Only 6 gardens are located in the former Kalimpong subdivision.

[10] Teas that have been cultivated, grown, or produced, processed, and manufactured within the demarcated geographic region (Schedule III) and listed 87 tea gardens (Schedule III) covering the hilly areas of Sadar Sub-Division, only the hilly areas of Kalimpong Sub-Division, and Kurseong Sub-Division. Precisely, the 87 gardens are spread around 49 in Darjeeling Sadar, 33 in Kurseong, and 5 in Kalimpong. Similarly, the Terai region accounts for 45 tea gardens in Siliguri subdivision. For details, see www.teaboard.gov.in

Statesman, 2025). To address this, the Tea Board of India has pursued legal measures to protect the integrity of the Darjeeling tea label.

Figure 1: Distribution of designated provinces with GIs tea in the district of Darjeeling, West Bengal (India)



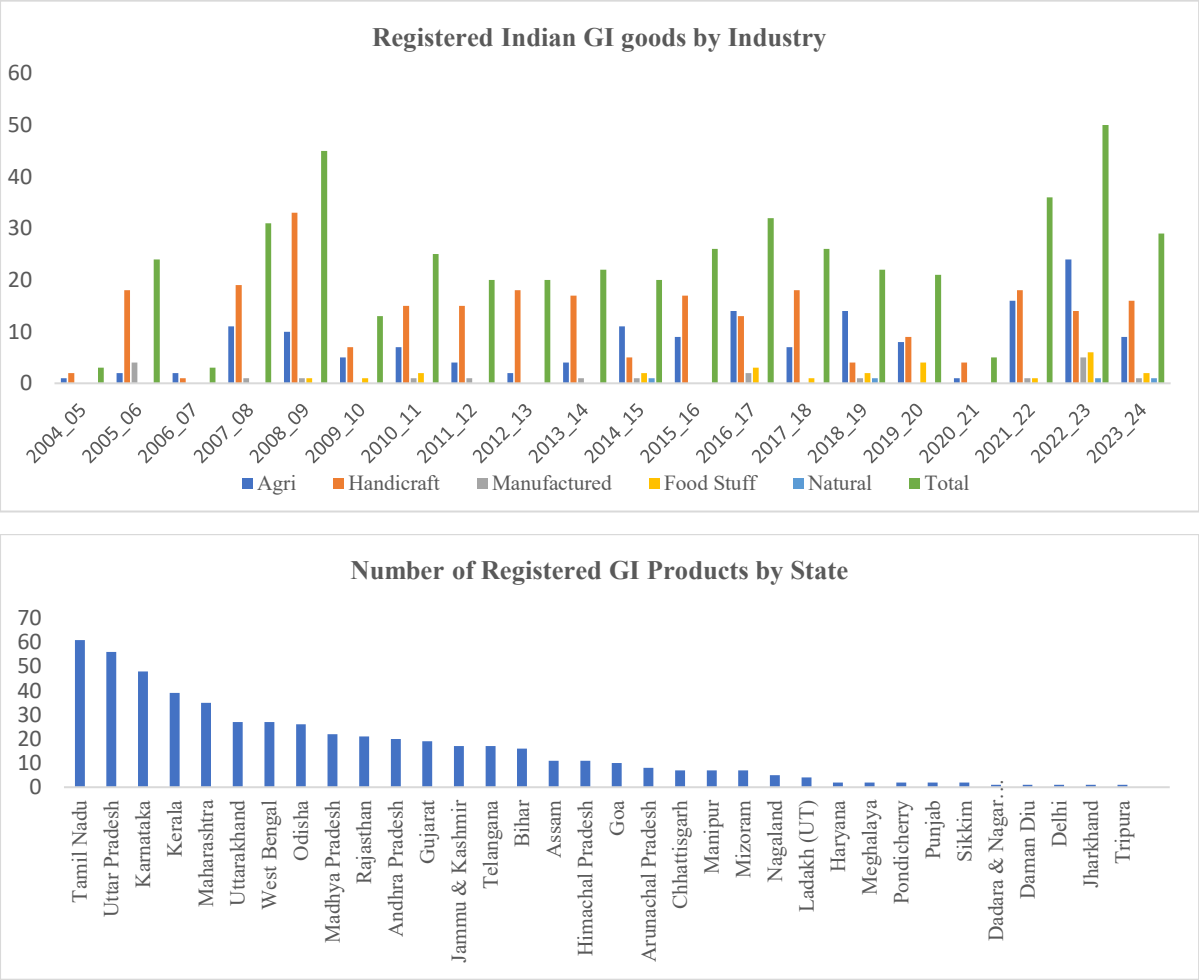
Source: Authors' construction.

2.3 GIs legislation in India

India's entry into the WTO in 1995 paved the way for a significant overhaul in the IPR system of the country. To comply with the requirements of the TRIPS agreement, India created a special law to protect traditional place-based products. The objective was to protect and promote the farmers, artisans, and producers from misuse of their unique products and to help them earn better rewards. To realise this, India enacted the Geographical Indications of Goods (Registration and Protection) Act, 1999, along with the corresponding rules in 2002. Producer groups welcomed this legislation, anticipating better protection and higher economic gains.

Darjeeling tea was the first product to be registered as a GI in India. Since then, many products across states and sectors have been registered as GIs in the country (Figure 2).

Figure 2: Trends of GI registration in India (2004-05 to 2023-2024)



Source: Office of Controller General of Patents, Designs & Trade Marks, Department for Promotion of Industry and Internal Trade, Ministry of Commerce & Industry, Govt. of India.
https://ipindia.gov.in/registered-gls.htm

In India, the Tea Board of India (TBI)[11] holds rights to all Indian GI teas, which include Darjeeling tea, Kangra tea, Assam (orthodox) tea, Nilgiri (orthodox) tea, and Uttarakhand Berinag Tea. These teas derive their quality and reputation from their unique geographical

[11] All tea grown in India is regulated by the Tea Board of India under the Tea Act of 1953. The Board has therefore registered the "DARJEELING Logo" and DARJEELING" (the word mark) as certification marks. India holds a prominent position in global tea production, ranking as the second-largest producer after China and making a significant contribution to global tea exports (Tea Board of India, *various issues*; IBEF, 2022). The tea plantation sector, primarily based in rural areas of India, supports millions of livelihoods in economically disadvantaged regions of Northeast India, Kerala, Karnataka, and Tamil Nadu continue to hold an important industry in India.

attributes, which requires legal protection against potential infringements. Since the GI registration of Indian teas, the TBI has strongly promoted the benefits of legal protection for the industry and its workers. Though there is some evidence pointing to positive outcomes for producers (Nanda, 2018), there is little comprehensive research on the broader socio-economic impacts of GIs on other stakeholders in the country. Our investigation aims to narrow the existing gap by analysing how GI legislation affects labour welfare in the Indian tea industry.

3. Data Sources and Empirical Strategy

3.1 Data

This study is based on primary survey data collected from tea garden workers in the Darjeeling, Kurseong, and Siliguri sub-divisions of Darjeeling district, West Bengal. A pilot survey conducted in 2022, involving 30 workers from one GI and one NGI garden, helped refine the final questionnaire. The full-scale survey was executed in 2023.

West Bengal holds a share of around 25 percent of India's total tea plantation area and 30 percent of its production (Tea Board of India, 2021; 2022). Our sample consists of 200 workers: 100 from gardens with GI registration and 100 from NGI gardens. Gardens were first grouped by location, with the GI group drawn from the hilly Darjeeling sub-divisions and the NGI group from the Terai plains in Siliguri. Within each group, we chose five gardens based on differences in size (plantation area) and age (year of establishment), so as to ensure a mix of large and small, old and new plantations. From each garden, 20 workers were selected and interviewed. Figure A1 presents a flowchart of the sampling procedure.

We used a structured questionnaire to gather both qualitative and quantitative information. Data collected includes demographic attributes, income and wages, additional income sources,

consumption patterns, education, health, fringe benefits[12], and job satisfaction. The survey also captured outcomes before and after GI registration to evaluate welfare changes. Workers in GI gardens form the treatment group, and those in NGI gardens serve as the control group. The design mirrors the approach employed by Jena and Gorte (2015) in their study on rice farmers in India and Thailand and Poetschki et al. (2021) using GI and NGI wine farms.

3.2 Variables

Table 1 presents the variables considered in the analysis. The main outcome variable is per capita household consumption[13], which we use as a proxy for worker well-being. Unlike income, which may be underreported or volatile, consumption provides a more stable and direct measure of living standards (Ma et al., 2020). Hence, researchers have long used consumption data to study welfare outcomes.

Independent variables

Our main variable of interest is GI status, which indicates whether the garden where a worker is employed has GI registration. We construct a binary variable for this: 1 if the worker is employed in a GI garden, and 0 if in a NGI garden. For our mediation analysis, we use welfare components as our mediator[14] to probe the relationship between the GI adoption and workers' well-being.

Several other factors influence workers' well-being, so we include these as control variables in our analysis. These include individual-level characteristics such as gender, age, social group, asset ownership, and the presence of employed household members, along with regional characteristics such as distance to the nearest city (see Table 1).

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[12]Fringe benefits are non-monetary perks provided by the management to workers, typically including items such as tea, firewood, umbrellas, and field equipment.

[13]Also see https://www.worldbank.org/en/programs/lsms/priority-themes/survey-methods/consumption-and-welfare

[14] An intermediary that functions to explain how or why the independent variable influences the dependent variable (Baron and Kenny, 1986; Hermanu et al., 2024)

Table 1: Construction of variables

Variables	Definition
Dependent Variable	
Consumption per capita	Per capita household consumption (in Rs) on food, clothing, education, health, and durable goods.
Independent Variables	
GI	Dummy variable for workers in GI gardens
Female	Dummy variable for female workers.
Age	Age of the workers in years.
Social group	
General	Dummy variable for General category workers.
ST	Dummy variable for ST category workers.
SC	Dummy variable for SC category workers.
OBC	Dummy variable for OBC category workers.
Welfare Index	Index based on four facilities: Fringe benefits, canteen, ambulance, and creche. Equal weight assigned to each. Ranges from 0 to 1.
Asset Index	Index based on ownership of television and mobile phone. Equal weight for each asset. Ranges from 0 to 2.
Employed household members	Dummy variable is coded as 1 if any household member is employed, 0 otherwise.
Distance to city (km)	Distance from the worker's garden residence to the nearest major city.

Source: Own construction.

Gender is a categorical variable, coded as 1 for females and males as 0. Gender role is an important attribute of the tea industry, which influences consumption patterns since women form a lion share of the workforce (Rasaily, 2016). Studies also show clear gender differences in consumption expenditure (Blumberg 1988; O'Donoghue et al., 2024). Age is measured in years as a continuous variable. Consumption patterns vary with age, and among low-income groups, older workers often face greater food insecurity (Bashir et al., 2012). In tea gardens, this is particularly pronounced due to inadequate retirement benefits and sudden closures of gardens (National Commission for Scheduled Tribes, 2009; Besky, 2014). A social group is a four-way categorical variable representing the General, Scheduled Tribes (ST), Scheduled

Castes (SC), and Other Backward Classes (OBC) categories. Historically, the tea industry has relied largely on tribal communities for employment, but these plantation communities suffer from poor socio-economic conditions and low dietary intake (Biswas et al., 2005; Labour Bureau, 2009). Hence, it is important to consider how social background affects consumption.

The asset index represents ownership of assets such as televisions and mobile phones, indicating economic status. Such an index is widely used in studies, showing a variation in ownership of assets across industrial households influencing their consumption (Filmer and Scott, 2012; Naveed et al., 2021). Importantly, the ownership of durables such as televisions and mobile phones is less prone to sudden income shocks (Berger and Vavra, 2015), which the plantation workers often encounter. Therefore, we believe our asset index provides a consistent measure of the socio-economic status of garden workers. The index is constructed by assigning equal weight to each asset, with values ranging from 0 to 2. We also include a welfare index that captures benefits provided to workers, namely, ambulance service, fringe benefits, canteen, and crèche facilities. Greater welfare support is expected to expand workers' economic choices and improve well-being (Stroup, 2011; Graafland, 2020). Specifically, we hypothesize[15] that the level of welfare benefits extended by management contributes to workers' well-being (Anand et al., 2005). This is particularly relevant for our mediation analysis, where we assess whether GI status influences consumption through access to welfare. We include a binary variable to indicate whether the household has at least one employed member. Finally, the distance to the nearest city is measured in kilometres. This variable influence transportation costs, price dispersion, and consumption levels, with closer proximity commonly corresponds to lower prices (John et al., 2021). By including these control variables, we aim to provide a better insight regarding the factors associated with consumption and worker well-being.

[15] Our hypothesis is based on lessons drawn from a wider framework of the well-known Capability Approach proposed by Nussbaum and Sen (1993); welfare empowers workers to achieve what they value the most.

Descriptive statistics

Table 2 presents the summary statistics. GI workers make up about 47% of the sample, while the remaining 53% work in NGI gardens. On average, per capita monthly consumption is around Rs 1,800. The average age of workers is around 45 years, with over 75% being female. The majority of workers belong to the ST category. Around 65% of the workers experience higher welfare benefits, and around 33% of workers own TV sets and mobile phones. Moreover, around 80% of workers have employed family members. The average distance to the main market is around 35 km.

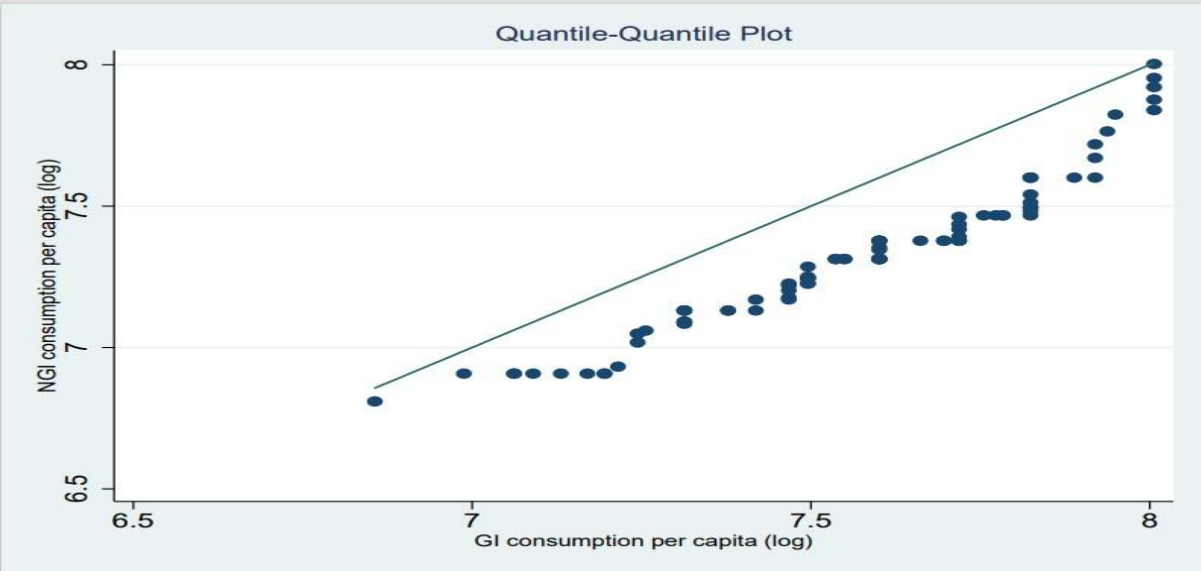
Table 2: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Consumption	177	1779.156	524.406	900	3000
GI	177	0.469	0.500	0	1
Female	177	0.757	0.430	0	1
Age	177	45.356	7.008	27	58
Social group	177	2.372	1.048	1	4
Welfare Index	177	0.652	0.275	0.25	1
Index of Asset	177	0.328	0.538	0	2
Employed household member	177	0.802	0.399	0	1
Distance to the city	177	34.356	24.484	8	72

Source: Own estimates

To see how consumption differs between the groups, we use a quantile-quantile plot (Figure 3). The plot shows that GI workers' consumption spending is higher than that of NGI workers, suggesting a well-being-enhancing effect.

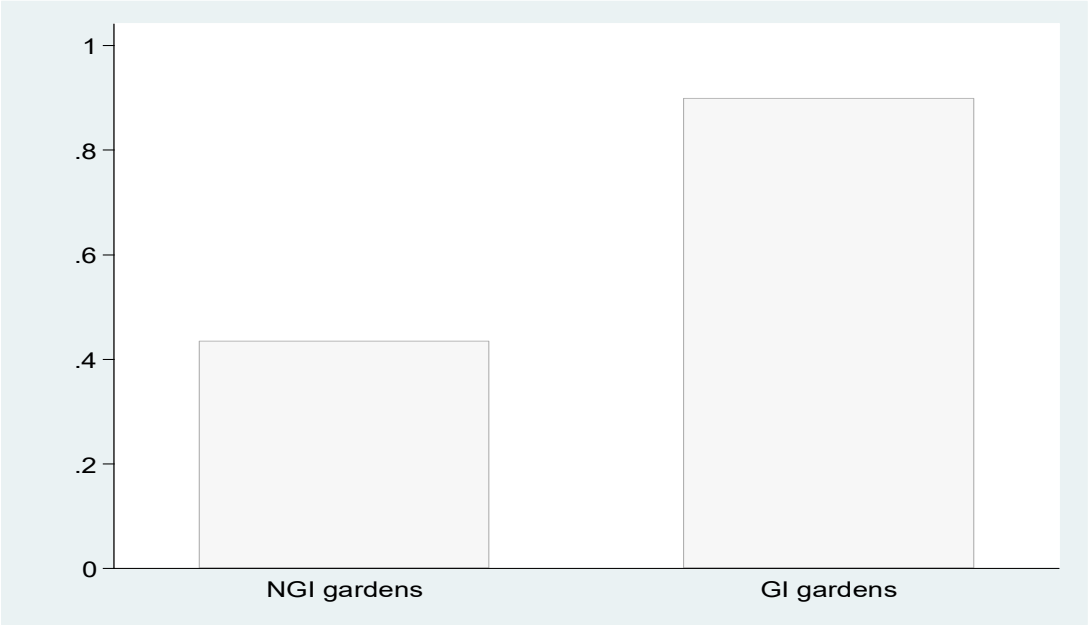
Figure 3: Consumption Differences Across GI and NGI Workers: QQ Plot



Source: Own estimates.

We also compare the welfare differences between worker groups using a bar chart (Figure 4). The averages show that the GI gardens offer higher levels of welfare facilities than NGI gardens. Understanding whether these welfare differences influence the well-being of the workers is an important question we aim to examine, which will help capture the well-being effects of GI adoption through the welfare index. A deeper econometric investigation is required to confirm these patterns, which we discuss in the following section on the empirical strategy, with results discussed thereafter.

Figure 4: Welfare Differences: GI and NGI Gardens



Source: Own estimates.

3.3 Empirical Strategy

We begin our analysis with an OLS model specified as follows:

$$Y_i = \beta_0 + \beta_1 GI_i + \beta_2 X_i + e_i \qquad (1)$$

where Y_i is per capita consumption. Our main variable of interest is GI_i, a binary variable equal to 1 if a worker is employed in a GI garden and 0 otherwise. X_i is a vector of control variables defined in Table 1. e_i is the error term.

While OLS provides a basic framework, it could be affected by potential biases caused by omitted variables, selection, and reverse causality. Consumption decisions could also be affected by unobserved variables, namely, psychological attributes or social and cultural norms. Moreover, the adoption decision regarding GI status is made by the garden itself, thereby introducing potential self-selection bias if gardens characterised by superior attributes, namely, reputation, quality focus, and size, exhibit a higher likelihood of GI adoption (Poetschki et al., 2021). This poses challenges in establishing causal relationship between GI adoption and consumption using OLS estimation alone.

To tackle this issue related to endogeneity, we employ an Instrumental Variable Treatment Regression (IVTR) model, as proposed by Cerulli[16] (2014). This approach treats GI status as endogenous and uses elevation as an instrumental variable. Elevation is measured in meters above sea level at the garden level using Google Earth. Since tea cultivation depends heavily on climate and geography, elevation is a key factor influencing both tea quality and production. This suggests that gardens at higher elevations are more likely to produce high-quality tea and, therefore, more likely to opt for GI adoption. Our choice of elevation as an instrument variable is supported by evidence from prior studies emphasising its role in tea quality and GI adoption (Han et al., 2017; Poetschki et al., 2020; Chen et. al., 2022). We believe elevation influences the well-being of workers only through its impact on the likelihood of GI adoption, thereby satisfying the exclusion restriction.

The IVTR model is ideal in situations where treatment assignment, in our case, garden adopts GI or not, is not random but influenced by factors affecting outcomes, such as consumption. Here, each worker is modelled with two potential outcomes: one if they work in a GI garden (y_i) and the other if they do not work in a GI garden (y_0). We observe a sample of observations (y_i, w_i, x_i) for each worker, where w_i indicates GI status and x_i includes other characteristics.

The potential outcomes are specified as:

$$y_0 = \mu_0 + x\beta_0 + e_0 \qquad (2)$$

$$y_1 = \mu_1 + x\beta_1 + e_1 \qquad (3)$$

$$y = y_0 + \omega(y_1 - y_0) \qquad (4)$$

[16] We employed Instrumental Variable Treatment Regression (IVTR) by using the *direct-2sls* (direct two-stage least squares) model (Cerulli, 2014) to estimate average treatment effects. The Average Treatment Effect (ATE) refers to the mean outcome difference between treated and untreated groups in the population; The Average Treatment Effect on the Treated (ATET) refers to the mean difference between the observed outcomes of adopters and the counterfactual outcomes they would have had without adoption. The Average Treatment Effect on the Untreated (ATENT) refers to the mean difference between the observed outcomes of non-adopters and the counterfactual outcomes they would have had if they had adopted.

Treatment assignment is modelled as:

$$\omega = \theta_0 + x\theta_1 + \alpha \qquad (5)$$

Endogeneity arises if unobserved factors affect both treatment (GI adoption) and outcomes (consumption), which can cause correlation between ω and the error terms e_0 or e_1. Instrumental variables (IVs) help overcome this if they affect treatment but are otherwise uncorrelated with the outcome variable, thereby satisfying the exclusion restriction. Using elevation as our instrument in the IVTR model, we can account for unobserved factors and estimate the true effect of GI adoption on workers' consumption.

An additional advantage of the IVTR approach is its ability to account for heterogeneous treatment effects, recognising that differences in observed characteristics among treated units may lead to varying responses to the treatment. Rather than assuming a uniform impact, the model estimates Average Treatment Effect (ATE), the Average Treatment Effect on the Treated (ATET), and the Average Treatment Effect on the Untreated (ATENT) conditional on covariates, thereby capturing how the adoption of the GI effect may not be uniform across worker attributes.

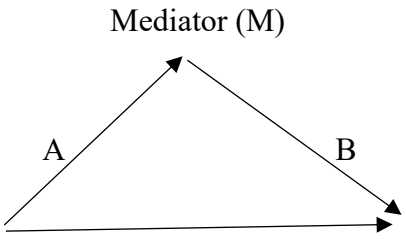
Baron and Kenny's (1986) Model

In our study area, wages are fixed uniformly across gardens in the district. This indicates that direct income differences alone cannot fully capture the effect of GI adoption on per capita consumption, which we use as a measure of well-being. Therefore, it is important to examine whether GI adoption improves well-being through other channels, especially by impacting the welfare benefits provided by gardens. To investigate this, we employ a mediation analysis framework, which helps us understand not just whether GI adoption affects consumption, but whether it does so through enhanced welfare benefits.

To do so, we adopt the widely used mediation framework developed by Baron and Kenny (1986). While existing empirical studies on the impacts of GI primarily rely on regression models to estimate the direct treatment effect, they often overlook potential mediation channels. Following Baron and Kenny (1986) method, we disentangle the direct effect of GI adoption on workers' well-being from the indirect effect that occurs through enhanced welfare benefits. This facilitates us in presenting new insights into the mechanisms through which GI influences worker welfare.

The Baron and Kenny (1986)[17] method is widely used to examine the existence of mediation effects, especially within causal treatment frameworks. This approach aims to decompose the total treatment effect into two components: the direct effect of the treatment and the indirect effect (operating through one or more mediators) (Celli, 2021). The Baron and Kenny framework for analyzing mediation proceeds as follows:

Figure 5: The mediation model



Source: Adopted from Baron and Kenny (1986).

To test the mediation hypothesis, we estimate the following regression equations:

i. Total effect of GI adoption on consumption (Path C):

$$Y_i = c + c'GI_i + X_i\gamma + \varepsilon_{iC} \quad (6)$$

ii. Effect of GI adoption on the mediator, welfare benefits (Path A):

$$M_i = a + a'GI_i + X_i\delta + \varepsilon_{iA} \quad (7)$$

[17] While Baron and Kenny (1986) originally developed their approach in social psychology. Since then, it has been extensively applied in economics, business, management, and health research. For details, see Baron and Kenny (1986).

iii. Direct effect of GI adoption on consumption, controlling for the mediator (Path B):

$$Y_i = b + b_1 GI_i + b_2 M_i + X_i \eta + \varepsilon_{iA} \qquad (8)$$

Y_i is per capita consumption, which is our measure of well-being, GI_i is a binary indicator of GI adoption and M_i is the welfare index. X_i includes other relevant covariates that are likely to affect the relationship between GI adoption, welfare benefits, and consumption.

If the coefficient of b_1 on GI in Equation (8) becomes non-significant compared to the total effect c' in Equation (6), it indicates full mediation. If b_1 remains significant but is smaller than c', it points to partial mediation. We compute the indirect effect as the product $a' \times b_2$ and assess its significance using the bootstrap approach proposed by Preacher and Hayes (2004).

As mentioned earlier, the rationale behind employing mediation analysis is that, since the garden wage rate is the same (jointly fixed) across the gardens in the region (including Darjeeling district), we may not be able to adequately capture the total (or full) GI effect on well-being. In other words, the GI effect may occur through a mediating variable. A mediating variable illustrates the mechanism through which the GI adoption influences well-being. To demonstrate this, we use GI adoption by gardens as the independent variable (GI), welfare benefits offered by the gardens as the mediator (M), and per capita consumption expenditure of workers as the outcome variable (Y). Our framework is straightforward: gardens adopting GI tend to provide better welfare benefits to workers, and these benefits are expected to improve workers' consumption. By combining these two links, we anticipate the welfare benefits to mediate the relationship between GI adoption and worker well-being. Specifically, our aim is to present that improved welfare benefits explain part of the GI impacts on the well-being of workers. Our study offers a meaningful addition to the scant empirical literature on

GI impacts by applying a mediation approach, which has rarely[18] been applied within this setting. Although earlier studies have outlined the benefical effects of GI adoption on producer and worker well-being, they rarely examine how these effects occur. By analysing the potential mediating role of welfare benefits, we present new insights regarding the mechanisms through which GI adoption can improve worker well-being.

4. Empirical results and discussion

4.1 Baseline Results: Role of GI on Consumption Expenditure

Table 3 presents the Ordinary Least Squares (OLS) estimation on GI adoption and consumption expenditure relationship. Results for the combined (pooling data from both GI and NGI gardens) workers are presented in Column 1. Columns 2 and 3 provide separate estimates for GI and NGI workers, respectively.

The coefficient on the GI variable is positive and statistically significant, suggesting that, all else equal, workers employed in GI gardens have significantly higher consumption expenditure than those in NGI gardens. On average, GI workers spend about 45 percent more on consumption than NGI workers. Our result is consistent with previous studies suggesting that GI adoption improves household well-being (Jena and Grote, 2012; Jena et al., 2015; Belletti and Marescotti, 2021).

Among individual and household characteristics, the presence of other employed household members and distance to the nearest city significantly influence consumption expenditure. To put it differently, with more employed household members, consumption increases, which aligns with economic theory that more income leads to higher spending (Friedman, 1957; Tai-Yuen, 2016). In contrast, distance to the city reduces consumption, indicating lower market

[18] Two recent studies (Wu, 2024; Li and Ouyang, 2025) have applied a similar mediation approach for China.

access and higher transportation costs faced by more remote households (Zant, 2018; Chen et al., 2022).

The separate OLS estimates in Columns 2 (GI workers) and 3 (NGI workers) confirm the findings observed in the pooled analysis, although the magnitude of the effects differ somewhat between groups. For example, the positive association between the number of employed household members and consumption holds for both GI and NGI workers, but the coefficient is larger for NGI workers. Likewise, distance from the city has a stronger adverse effect on consumption among NGI workers.

While these results demonstrate a positive association between GI adoption and consumption expenditure, potential endogeneity issues, such as unobserved factors influencing both GI adoption and consumption, must be addressed. Therefore, we extend our analysis using Instrumental Variable Treatment Regression (IVTR) to obtain more reliable estimation illustrating the causal GI impacts on workers' consumption.

Table 3: GI and Consumption: OLS estimates

Independent variables	Dependent variable: Consumption (log)		
	All Workers	GI Workers	NGI Workers
	(1)	(2)	(3)
GI	0.4496***	-	-
	(0.1058)		
Female	-0.0210	0.0769	-0.1061
	(0.0467)	(0.0660)	(0.0658)
Age (log)	-0.0846	-0.0999	-0.0747
	(0.1270)	(0.2184)	(0.1665)
Social group	0.0124	0.024	0.0054
	(0.0186)	(0.0255)	(0.0300)
Asset Index	0.0132	0.0042	0.0435
	(0.0371)	(0.0522)	(0.0551)
Employed Household member	0.1917***	0.2494***	0.1315*
	(0.0493)	(0.0685)	(0.0738)
Distance to city (log)	-0.1273*	0.0667	-0.2497***
	(-0.0661)	(0.1125)	(0.0826)
Constant	7.8049***	7.4036***	8.1967***
	(0.5068)	(0.8567)	(0.6777)
Number of observations	177	83	94
R-squared	0.2633	0.1603	0.1654

Notes: Standard errors are reported in parentheses; *** p<0.01, **p<0.05, *p<0.10
Source: Own estimates.

4.2 Heterogeneous GI effect: IVTR estimation

Our IVTR estimation[19] (Table 4, column 1) reaffirms the positive and significant impact of GI registration on workers' consumption expenditure. Specifically, consumption among GI workers is, on average, 33 percent higher than among NGI workers. This result corroborates our OLS findings, emphasizing that GI workers indeed spend more on consumption than their counterparts. Therefore, GI registration emerges as a catalyst for boosting consumption expenditure, consistent with Jena and Grote (2012), and Török et al (2020).

[19] The IVTR model estimated using the direct 2SLS IV approach does not automatically produce the first-stage treatment equation results. Following Cerulli (2014), we estimated the first stage separately and report the results in Appendix A2 along with the first-stage F-statistics, which indicate the relevance of the instruments. The instrument was found to be a strong predictor of GI treatment status, thereby providing support for its relevance.

Moreover, the control variables exhibit a consistent pattern in our IVTR estimation, mirroring the baseline OLS estimates. Importantly, diversified income sources continue to have a positive influence on consumption, indicating that household with higher income from multiple earners enables workers to spend more on both durable goods and consumables. Conversely, a greater distance from the garden to the main city reduces consumption expenditure, suggesting that remoteness limits access to goods and services, thereby lowering overall spending.

When we include the welfare index as one of the control variables, the GI effect becomes insignificant, though it remains positive (Table 4, column 2). The coefficient of the welfare variable (Table 4, column 2) is similar in magnitude to the GI coefficient in the previous specification (Table 4, column 1). Our post-estimation results (Table 5) show that GI adoption, on average, increases consumption by about 34 percent compared to NGI workers (ATE), while the Average Treatment Effect on the Treated (ATET) indicates that GI workers spend roughly 60 percent more than they would have spent without GI registration. However, when the welfare index is included (Table 5, column 4), these treatment effects become statistically insignificant. Taken together, the results underscore three key points: first, GI registration no longer directly influences consumption once welfare is controlled for; second, better welfare benefits influence consumption spending positively; and third, the GI effect appears to operate primarily through its effect on welfare.

Table 4: GI and Consumption: IVTR estimates

Independent variables	Dependent variable: Consumption (log)	
	IVTR	IVTR
	(1)	(2)
GI	0.3389***	0.0662
	(0.1159)	(0.1529)
Female	-0.1068	-0.1177*
	(0.0690)	(.0673)
Age (log)	-0.0687	-0.1440
	(0.1679)	(0.1658)
Social group	0.0062	0.0018
	(0.0302)	(0.0294)
Asset Index	0.0422	0.0509
	(0.0555)	(0.0540)
Employed Household member	0.1305*	0.1392*
	(0.0744)	(0.0723)
Distance to city (log)	-0.2333***	-0.1197*
	(0.0842)	(0.1027)
Welfare Index	-	0.4324**
		(0.1977)
Constant	8.1295***	7.9426***
	(0.6934)	(0.6844)
Number of observations	177	177
R-squared	0.3061	0.3534

Notes: Standard errors are reported in parentheses; *** p<0.01, **p<0.05, *p<0.10
Source: Own estimates.

Table 5: The treatment effects (direct-2sls)

Dependent variable	Treatment type	Coefficient	Coefficient
(1)	(2)	(3)	(4)
Consumption (log)	ATE	0.3389***	0.0662
		(0.1159)	(0.1529)
	ATET	0.5877***	0.2304
		(0.1179)	(0.2206)
	ATENT	0.1191	-0.0788
		(0.1859)	(0.1966)

Note: Standard errors are reported in parentheses; *** p<0.01, **p<0.05, *p<0.10
Source: Own estimates.

4.3 Mediation effects of GI: Baron and Kenny estimates

Drawing from the earlier sections, we now shift our focus to the mediation analysis using the regression framework outlined by Baron and Kenny (1986) to investigate whether welfare mediates the relationship between GI adoption and labour well-being. The detailed estimates are reported in Table 6, which reports the results for total, direct, and mediator relationships. Table 7 summarises the total effect, direct effect, and indirect effect, demonstrating the extent to which welfare mediates the relationship between GI and well-being.

Table 6: Effects of GI adoption on labour well-being (Baron and Kenny model)

Independent variables	Dependent variables		
	Consumption (Path C)	Welfare Index (Path A)	Consumption (Path B)
GI	0.4496***	0.7626***	0.0609
	(0.1058)	(0.0553)	(0.1491)
Welfare Index	-	-	0.5096***
			(0.1423)
Female	-0.0210	0.0162	-0.0292
	(0.0467)	(0.0244)	(0.0452)
Age (log)	-0.0846	0.2339***	-0.2038
	(0.1270)	(0.0664)	(0.1272)
Social group	0.0124	0.0032	0.0108
	(0.0189)	(0.0099)	(0.0183)
Asset Index	0.0132	0.0157	0.0052
	(0.0371)	(0.0194)	(0.0359)
Employed Household member	0.1917***	-0.0374	0.2108***
	(0.0493)	(0.0258)	(0.0479)
Distance to city (log)	-0.1273*	-0.2166***	-0.0169
	(0.0661)	(0.0346)	(0.0710)
Constant	7.7924***	0.1118	7.7355***
	(0.5106)	(0.2668)	(0.4938)
Number of observations	177	177	177
R-squared	0.2633	0.7736	0.3156

Notes: Standard errors are reported in parentheses; *** p<0.01, **p<0.05, *p<0.10.
Consumption is expressed in logs.
Source: Own estimates.

Our Baron and Kenny model (Table 6, Path C column) shows that GI adoption has a positive and significant effect on consumption spending. This indicates that, on average, GI workers have higher consumption levels than NGI workers. The results align with our earlier OLS

estimates (Table 3), thereby reinforcing the positive link between GI adoption and labour well-being.

One key requirement of the Baron and Kenny framework is that the treatment variable must significantly predict the mediator. Our results meet this requirement: GI adoption is a positive and significant predictor of the welfare index (Table 6, Path A column), showing that GI adoption is associated with higher welfare benefits for workers.

Next, the welfare index itself positively and significantly predicts consumption spending when controlling for GI adoption (Table 6, Path B column), indicating that welfare benefits play an important role in explaining consumption differences. However, similar to our IVTR estimation (Table 4), once the welfare index is included, the direct effect of GI on consumption becomes insignificant, even though it remains positive (Table 6, Path B column). This change suggests that the impact of GI on consumption primarily operates through its effects on welfare benefits. In other words, GI adoption does not directly increase well-being but does so indirectly by improving welfare, which then leads to higher consumption spending.

Among household characteristics, the presence of employed family members has a positive effect on consumption, which reinforces the idea that more income leads to higher spending. Meanwhile, the only regional variable, distance to the main city, is negatively related to both consumption and welfare, indicating that remoteness limits access to goods and services.

Table 7: Direct, Indirect, and Total effects of GI adoption on labour well-being

Effects	GI Adoption
Total Effects	0.4496***
	(0.1058)
Direct Effects	0.0609
	(0.1491)
Indirect Effects	0.3886***
	(0.1143)

Note: Total effects represent a sum of Direct and Indirect effects.
Direct effect shows the effect of the treatment variable on the dependent variable after controlling for the effects of mediation.
Indirect effects capture the mediating effects.
Standard errors are reported in parentheses; *** p<0.01, **p<0.05, *p<0.10
Source: Own estimates.

Following the discussion of detailed regression estimates, we now summarise the effects in Table 7 to understand the extent and nature of the mediation. The total effect estimates show that, on average, GI adoption increases the consumption spending of workers in GI gardens by around 45 percent compared to those in NGI gardens (Table 7). However, once we account for the mediating role of welfare benefits, the direct effect of GI adoption on well-being becomes statistically insignificant, though it is still positive. This indicates that GI adoption improves worker well-being mainly by increasing access to welfare benefits. More specifically, GI adoption raises consumption spending by about 38 percent through the indirect channel of improved welfare provision (Table 7). This highlights that welfare benefits is a key factor in transmitting the positive effects of GI legislation to workers. Accordingly, the indirect effect is both larger and statistically significant relative to the direct effect, showing the importance of the welfare channel in explaining the observed differences in consumption.[20]

A closer look at our results confirms that the direct effect of GI adoption on well-being is not statistically significant, which suggests that the relationship between GI and worker well-being is

[20] When we calculate the percentage share of the direct and indirect effects in the total effect of GI adoption on labour well-being, we find that about 87% of the total effect is mediated through labour welfare, while only 13% is attributable to the direct effect.

fully explained by improvements in welfare benefits (Table 7). The bootstrapped[21] estimate of the indirect effect ($\beta = 0.3886$, $p < 0.05$) further supports the presence of mediation, with a 95% confidence interval that does not include zero ([0.1446, 0.6127]). This provides strong evidence emphasise the critical role of welfare channel in explaining the observed consumption differences between GI and NGI workers.

Our results, imply that GI legislation does not directly increase workers' economic well-being through higher consumption alone. Rather, its impact operates indirectly with improved access to welfare benefits driving higher spending. In other words, the gains from GI status reach workers primarily through the welfare support channel. This signifies that without adequate welfare provision, workers in GI gardens may see little improvement in well-being. These results show the value of not only introducing quality-based certifications or legal protections, but also effectively integrating them with welfare programmes that improve the lives of workers.

5. Conclusion

We examine the impact of Geographical Indications (GI) registration on the well-being of workers in the Darjeeling tea industry, focusing on whether GI legislation improves welfare outcomes and, in turn, enhances overall living standards. Using primary survey data from tea garden workers and employing Instrumental Variable Treatment Regression (IVTR) alongside mediation analysis, we find that GI protection raises well-being primarily by improving access to welfare benefits. On average, workers in GI-certified gardens report about 33 percent higher consumption expenditure than their counterparts. IVTR estimates suggest that GI workers spend roughly 60 percent more than they would have without GI registration. Our analysis shows that these well-being gains occur mainly through enhanced welfare provisions than

[21] It is regarded as a more robust statistical technique of Mediation analysis (Preacher and Hayes, 2004; Hayes, 2018), particularly involving small sample sizes (Hermanu et al., 2024).

direct income increases. This highlights the crucial role of welfare benefits as the key channel linking GI adoption to improved living standards among workers.

Our use of mediation analysis in this context provides novel empirical evidence on how GI effects operate in practice, thereby offering a detailed insights into the indirect channels involved. These findings also highlight the need to combine legal protections such as GI registration with effective welfare measures. Without this, the prospective gains from the GI legislation may fail to reach marginalized workers, as has been documented in the regions such as Latin America and New Zealand (Williams and Penker, 2009; Mancini, 2013).

From a policy perspective, extending the GI certification to more gardens could encourage quality-oriented production while strengthening the enforcement of labour welfare laws, among others, the Plantation Labour Act. Such an approach is especially relevant given the persistently poor living conditions of tea garden workers. In the broader context of India's recent labour reforms (the new Labour Codes aimed at improving compensation, health coverage, and social security), GI legislation offers a complementary route to improve the livelihood of disadvantaged rural industrial workers. Replicating this model in other sectors producing origin-linked goods could further advance inclusive rural development.

A key limitation of this study is its reliance on cross-sectional data and self-reported information from respondents, which may introduce biases and restrict the ability to establish causal relationships. Future research could address some of these limitations by conducting longitudinal studies that track changes over time, or by expanding to other sectors or regions to validate and extend our findings.

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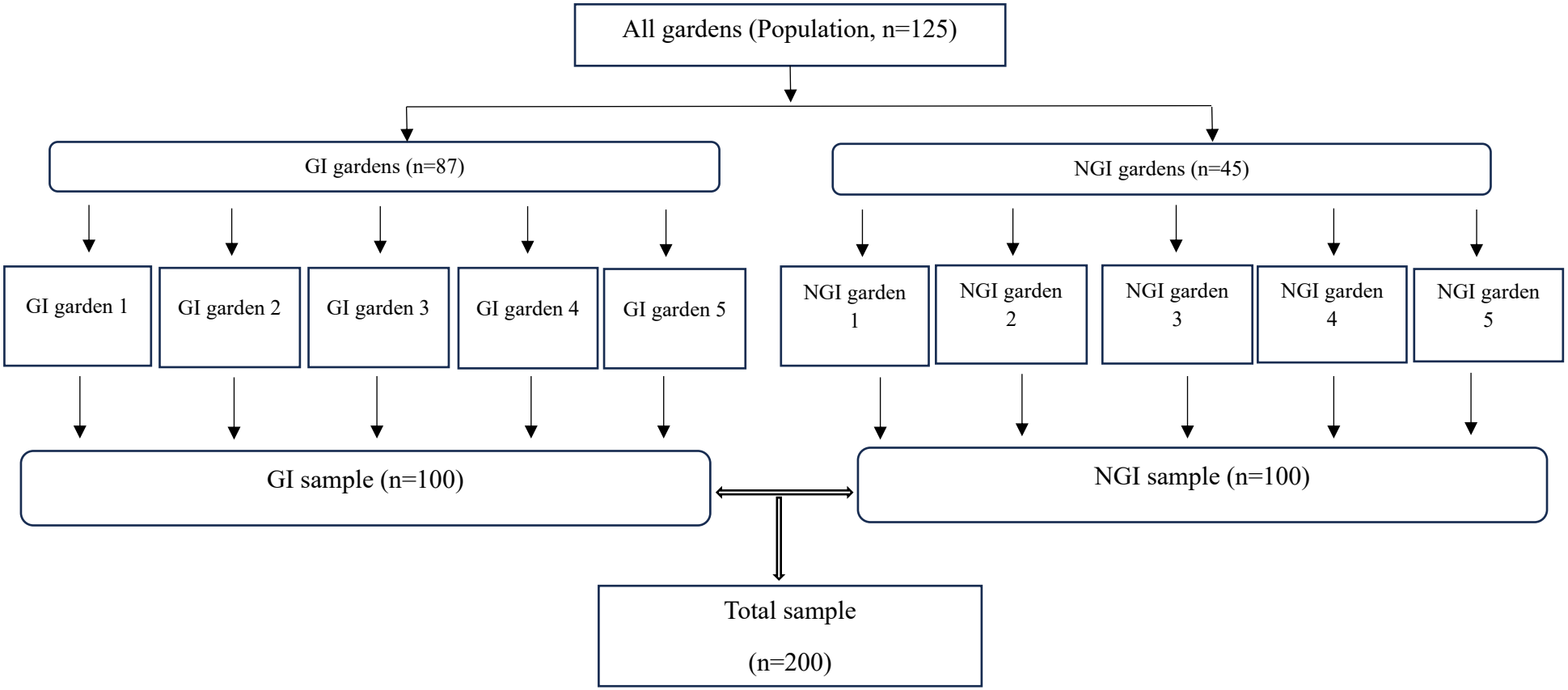
APPENDICES

Figure A1: Flowchart for the primary survey among the target group of tea garden workers



Source: Own construction

Table A2: First-stage estimates (IVTR)

Independent variables	Dependent variable: GI Adoption
	IVTR
	(1)
Elevation (log)	0.3531***
	(0.0107)
Female	-0.0027
	(0.0079)
Age (log)	-0.0244
	(0.0193)
Social group	-0.0047
	(0.0302)
Asset Index	0.0051
	(0.0558)
Employed Household member	-0.0076*
	(0.0082)
Distance to city (log)	0.0876***
	(0.0085)
Welfare Index	0.1851***
	(0.0258)
Constant	-1.9859***
	(0.0843)
Number of observations	177
R-squared	0.9934
F-test	4836.8290***

Notes: Standard errors are reported in parentheses; *** p<0.01, **p<0.05, *p<0.10
Source: Own estimates.