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Research Article

Socio-Economic Vulnerability and Empowerment of Women Tea-Garden Workers in Assam: An Analysis of Wages, Living Conditions, Social Security, and Decision-Making Autonomy

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Abstract

Assam has women tea plantation workers, but inadequate basic services and low earnings lead to fragmentation of employment and limit women's voice and choices in both family and work. Women's socio-economic vulnerability in tea estates and the connection to empowerment are at the forefront through the lens of wage levels, the regularity of employment, living conditions, social and financial inclusion, and decision-making power. This study undertakes a critical analysis of authenticated literature in the domain along with official reports for a time period of 2020–2025. In addition, for statistical representation, a transparently declared simulated dataset of 300 women workers is constructed. A seven-dimensional Socio-Economic Vulnerability Index and a seven-dimensional Women Workers' Empowerment Index were developed. Among other things, diverse statistical analyses of the dataset were undertaken. The simulated results demonstrated a clear divide between permanent and temporary workers. Permanent workers earned significantly higher and had greater access to maternity and health benefits, while temporary workers had more irregular paid days and offered weaker paid-day protections. The simulated results showed that the mean vulnerability score was 0.337 and the mean empowerment score was 0.566. Longer hours of unpaid care were negatively associated with empowerment, while empowerment of women workers improved with education, personal income, union membership, social protection, and bank ownership. Social protection reduced vulnerability. The results of the study are hypothetical analyses rather than field estimates, but they demonstrate the value of an integrated empirical approach in identifying intersecting disadvantages. Effective policy includes transparent systems for wage determination, universal and portable social protection, housing and occupational safety standards, functional childcare, women-controlled financial inclusion and institutional mechanisms that enable women's agency and participation so that women transition from having nominal representation in an institution to having substantive power to make decisions.

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KEYWORDS: Women tea-garden workers; Assam; socio-economic vulnerability; women's empowerment; plantation labour; social security; decision-making autonomy.

1. INTRODUCTION

Assam's tea economy exists at the intersections of regional identity, export value, and widespread employment. According to the latest annual reports from Tea Board India, Assam continues to consolidate its position as India's major tea-producing state, and highlights the expansion of organized estates, bought-leaf factories, and small-grower supply chains (Tea Board India, 2023, 2024a, 2024b). In state economic surveys, tea is treated as a key agro-industrial sector, with significant forward and backward linkages (Directorate of Economics and Statistics, Assam, 2022, 2023, 2024a, 2025a). Production statistics, however, say little about the human costs associated with maintenance of labor-intensive tea cultivation. Tasks associated with tea plucking and sorting rely heavily on women. The employment of women is commonly described as culturally appropriate on the basis that it requires dexterity and patience. Gendered occupational segregation may bring about a perception of the tea industry as requiring low-paid work, and, furthermore, may conceal the physical endurance and time precision the production of tea on a plantation entails.

More evidence has emerged showing that the disadvantage women experience extends beyond the wage relation. Rajbangshi et al. (2020) showed how poverty, wage deductions tied to quotas, poor maternity protection, poor sanitation, poor housing, delayed health care, and poor voice have all impacted the health of women plantation workers in Assam. Low monthly incomes and poor working conditions of women workers in Sivasagar reported by Gogoi and Radha (2024) corroborate the previous findings. At the national level, informal work, poor occupational structure, and inadequate social protection have emerged as major sources of concern for Indian women workers (International Labour Organization [ILO] & Institute for Human Development [IHD], 2024; Ministry of Labour and Employment, 2023, 2024a, 2025). The problem thus becomes multidimensional; a wage may be earned, but the empowering effect is determined by the regularity and control of the wage, the provision of social services, the burden of unpaid care, and the ability to participate in decision-making at the household and workplace levels.

Living conditions have a significant role in plantation settings because in so many cases employment, housing and welfare have historically been provided together. Permanent status may give a right to housing, health services or a provident fund, but may increase reliance on the employer in the absence of alternative housing and means of livelihood. Temporary employees may not have even these conditional protections. Reports from the National Family Health Survey and a multidimensional poverty index show that the interrelated aspects of wellbeing include sanitation, clean fuel, nutrition, financial inclusion and joint participation of women in decisions (International Institute for Population Sciences [IIPS] & ICF, 2021a, 2021b; NITI Aayog, 2021, 2023). Although Assam-specific averages should not be applied to tea communities, they show why measuring income is inadequate.

An integrated model is presented to study the socioeconomic vulnerability and empowerment of women tea-garden workers in Assam. The model identifies the employment category and education, income, social security, financial inclusion and degree of participation as determinants of both material deprivation and the extent of decision-making autonomy in the household. Since no primary survey was provided, a respondent level analysis was conducted using a distinctly identified simulated dataset. The aim is not to measure the actual prevalence of Assam, but to exemplify a rigorous model that can ethically be used in the field in the future. This study also combines a multidimensional vulnerability and an empowerment index, and attempts to show the interrelatedness of some structural, institutional and household variables.

1.1 Research Objectives

1. To examine the wage, employment and household economic conditions of women tea-garden workers.
2. To examine housing, sanitation, health care and the conditions of drinking water, childcare and education.
3. Assess effective access to social security programs, welfare benefits, financial services, and labor protections.
4. Measure autonomy in household, financial, health, mobility, and workplace decision-making.
5. Develop and assess multidimensional vulnerability and empowerment indices.
6. Provide evidence-based suggestions for governments, employers, trade unions, financial service providers, and the general public.

1.2. Hypotheses

H01: There is no significant difference between permanent women workers and temporary women workers in terms of monthly income and wage security.

H02: There is no significant relationship between social security access and socio-economic vulnerability.

H03: There is no significant relationship between level of education and decision-making autonomy.

H04: There is no significant relationship between monthly personal income and empowerment.

H05: Having a personal bank account and having a savings account is unrelated to empowerment.

H06: Deprivation in basic living conditions is unrelated to employment status.

H07: Employment status, education, income, social security, and financial inclusion are not significant determinants of empowerment.

2. REVIEW OF LITERATURE

The segmentation of labor markets is a promising place to begin. Workers may have permanent or temporary contracts, but perform similarly productive tasks and may receive different mixes of wages, continuity, housing, provident fund, maternity protection and healthcare. Rajbangshi et al. (2020) found permanent workers were more likely to receive workplace-provided benefits and non-permanent workers

experienced exclusion and the loss of wages due to illness and maternity. Gogoi and Radha (2024) stated low pay resulted in difficulties in carrying out the normal subsistence expenditures of a household. The broader Indian evidence system illustrates that employment status and form of employment strongly influence social protection and bargaining power (ILO & IHD, 2024; MoSPI, 2023, 2024). From the viewpoint of a feminist political-economy analysis, segmentation is used to reduce the cost of labor by transferring the costs of reproduction and care to women, households and communities.

Wage payment and wage adequacy are distinguished from one another. Reports on global wages stress that whilst nominal wages may rise, they may still suffer from the impacts of inflation and rising costs of food, which results in a decline in real wages (ILO 2022a, 2024a). In view of the limitations on permanent contracts, the situation may be further exacerbated by the loss of wages for sickness, penalties related to the quota system, and occupational injuries. The economic surveys of Assam and the published statistics assist in providing a state-level view on social protection, employment, and pricing, but do not resolve inequalities that exist within estates (Directorate of Economics and Statistics, Assam, 2024a, 2024b, 2025a, 2025b). A worker may thereby be recorded as employed and yet be income deficient and in debt.

Housing and other basic services shape the nature of the employment relationship. Rajbangshi et al. (2020) identified housing shortages, the presence of dilapidated buildings, a lack of toilets, contaminated water pathways, and dissatisfaction with plantation health services. Safe water, sanitation, electricity, and clean cooking fuel should be considered basic rights and not discretionary welfare amenities (NITI Aayog, 2023; WHO & UNICEF, 2023). The SDG India Index 2023–24 argues that assessing poverty requires considering social interrelated indicators (NITI Aayog, 2024). In the context of tea estates, service shortages increase women's unpaid labor since collecting water, caring for the sick, and obtaining fuel tend to be women's responsibilities.

In tea plucking, labor poses several health challenges, such as the repetitive nature of plucking, carrying weight, constant standing, exposure to weather, insects, and the risk of contact with agrochemicals. The Occupational Safety, Health and Working Conditions Code, 2020 provides a modern legal framework, however, for women, the risk of losing income if they take a sick leave, and the conflict between health needs of the children and the rigid work requirements, makes the absence of progressive safety standards a serious challenge. NFHS-5 data for Assam raises persistent issues of nutrition, anemia, maternal health, and sanitation (IIPS & ICF, 2021a). The health statistics of the Ministry of Health and Family Welfare show the need for improved healthcare and greater access to health services in rural and remote areas (Central Bureau of Health Intelligence, 2022, 2023).

Social security reduces vulnerability by supporting stabilised consumption and reducing the cost of illness and other shocks related to maternity, old age, and employment. The Code on Social Security, 2020 is intended to consolidate and expand

many of these protective mechanisms. The e-Shram and related programs work on improving the identification of unorganised workers (Government of India, 2020b; Ministry of Labour and Employment, 2024a, 2025). However, registration does not guarantee receipt of benefits. Employment-linked benefits, public schemes with portability, and benefits that are activated by employees' family members fill the gaps of multiple employment options. The focus of analysis has to be on actual coverage and awareness. This is more relevant than the formal eligibility of schemes.

Financial inclusion is another option that can offer empowerment. However, the possession of a bank account is not a sufficient criterion. The reports of the Department of Financial Services and the Reserve Bank of India reflect the continued growth of bank accounts and the spread of digital means of payments (Department of Financial Services, 2024; Reserve Bank of India, 2024). Agency is best represented by savings accounts controlled by women, access to formal credit, and control over income. Agency of women can be reflected by rights and resources with formal access to women's rights and legal means (UN Women & United Nations Department of Economic and Social Affairs [UN DESA], 2024; World Bank, 2024a).

Household norms, education, mobility, care burdens, and the collective voice shape decision-making autonomy. India's Time Use Survey provides evidence of the uneven burden of unpaid domestic and care work on women (MoSPI, 2020). In the ILO's Care at Work report, childcare and care services are considered part of labour market infrastructure as they make it possible for women to enter, stay in, and progress in paid employment (ILO, 2022b). Women in tea communities may bring in income, but may not have a say in how that income is spent, or in their ability to access healthcare, or participate in union activities, or contest workplace issues. Rajbangshi et al. (2020) noted that women often participated in decisions, but did not have the final say, and had poor representation in unions. Economic, household, mobility, health, workplace, and collective empowerment must be considered.

More recent institutional reports expand the policy context. The World Employment and Social Outlook reports highlight the ongoing challenges of informality and poor job quality (ILO, 2024b, 2025). Rural livelihood and women and child development reports highlight self-help groups, childcare, and convergence as critical social infrastructure (Ministry of Rural Development, 2024; Ministry of Women and Child Development, 2024). Tea statistics and trade analysis highlight that in a changing production and market context, labour issues must be addressed outside the welfare debate (Tea Board India, 2024c; World Bank, 2024b).

Three primary gaps can be identified in the literature. First, the existing literature typically explores wages, health, and living standards in isolation and fails to examine their impact in conjunction. Second, the available literature interprets women as welfare recipients rather than rights-holders or decision-makers. Third, there is a dearth of recent research quantitatively comparing women's temporary and permanent employment

using composite indices. The present study uses a reproducible analytical model to address these gaps by distinguishing validated secondary data from simulated data.

3. Conceptual and Theoretical Framework

This framework combines the capability approach, feminist political economy, labour-market segmentation, social exclusion and empowerment theories. The structural aspects of plantation and task segmentation, gendered wage structures, historical and ongoing social marginalization, and a near total absence of alternative employment shape the resources available to women. Also of importance are the organizational structures within the workplace. These include the employment relations, housing and health service provisions, social-security and labour law provisions, union and grievance participation. Individual and household characteristics such as age and education, and income and financial resources, and the presence of dependants and unpaid care work, determine the extent to which the available resources can be converted to capabilities.

Two interrelated outcomes are described. Socio-economic vulnerability refers to being at risk of low income, erratic employment, not having access to basic services, occupational and social protection risks, educational and financial exclusion, and the deprivation of basic services. Empowerment refers to the ability to make informed decisions regarding one's economic situation, and to participate and make decisions regarding one's household, mobility, health, finances, and work. The model predicts that social protection, education, stable jobs, self-managed savings, and union participation will reduce vulnerability and promote empowerment. On the other hand, excessive unpaid caregiving and employment instability will increase vulnerability and reduce empowerment. The model accepts that the relationship is recursive. For example, low empowerment may act as a barrier to women exercising their rights to entitlements whereas increased socio-economic vulnerability may lead women to accept unsafe work and a poor negotiating position.

Figure 1: Integrated conceptual framework

Structural factors	Institutional and household mediators	Outcomes
Plantation labour system Gendered task allocation Employment segmentation Wage-setting Historical marginalisation	Education and income Social-security coverage Housing and healthcare Financial inclusion Unpaid care Union and grievance access	Socio-economic vulnerability Material and health deprivation Decision-making autonomy Financial empowerment Workplace voice
Feedback loop: vulnerability constrains claims-making and bargaining; empowerment improves access, voice and resilience.		

Source: Author's conceptualisation based on the capability, feminist political-economy, labour-segmentation and empowerment frameworks.

4. RESEARCH METHODOLOGY

Combining an analytical cross-sectional design, this research incorporates a structured review of both official sources and peer-reviewed literature published between 2020 and 2025, and a simulated respondent-level dataset. The evidence base incorporates the annual reports of the Tea Board of India, the Assam Economic Surveys and Statistical Handbooks, PLFS and Time Use Survey reports, NFHS-5 reports, NITI Aayog reports on poverty and SDGs, reports of the Ministry of Labour, publications of the ILO, and recent studies on women plantation workers. These sources were used to create range definitions and interpret mechanisms and extrapolate reasonable range estimates. These sources were not integrated as a single micro-dataset.

The respondent-level dataset used in the analysis is completely simulated and as such, does not actually exist in the context of a real field survey. It was created solely for the purpose of outlining a proper empirical context for the socio-economic vulnerability and empowerment of women tea-garden workers. The analytical sample consisted of 300 individuals, with 60 percent of the sample being permanent employees and the remaining 40 percent temporary/casual employees. The dataset constructed for this purpose included a number of variables such as age, marital status, educational attainment, place of residence, number of years of service, number of paid working days, daily wage, personal income and income of the

household, unpaid caregiving, living conditions, workplace safety, social security, banking, savings, and union membership, as well as seven variables related to decision-making. The existence of a fictitious tea estate, tea estate workers, a tea estate workers interview, a tea estate workers interview consent, or a tea estate workers interview ethics approval is not claimed.

The Socio-Economic Vulnerability Index is created by calculating an equal weighted mean of seven dimensions (more specifically deprivation indicators) which include: personal income (low), paid work (irregular), deprivation of basic services, health and occupational risk, social security (low), education (low), financial exclusion. A higher score means a higher vulnerability, with a score of zero (0) meaning no vulnerability. A score of zero (0) to point two eight five (0.285) is considered low, a score between point two eight six (0.286) and point five seven zero (0.570) is considered moderate, and a score above point five seven zero (0.570) is considered high. The Women Workers' Empowerment Index is constructed of seven dimensions: household purchases, children's education, personal health care, the use of earnings, savings and borrowing, mobility, and working voice. Each dimension is assigned a score of zero for no participation, (joint) participation in a dimension is scored a one (1) and independent participation is scored a two (2), and the total is then divided by

fourteen (14). Empowerment is classified as low (below 0.40), moderate (0.40–0.69), and high (0.70 or above). Means, standard deviations, and descriptive statistics were used for the data. Reliability was tested using Cronbach's alpha. The income variable and the empowerment variable were compared using Welch's t-test and all other categorical variables were tested using Chi-square. Spearman and Pearson's coefficients were used to determine the rank order and to establish correlation. Empowerment was estimated as a function of education, personal income, permanent status, social security score, bank ownership, (independent) savings, union participation, and hours of unpaid care using multiple ordinary least squares regression. A 5% level of significance was used to determine statistical significance, and the significance, amplitude, and direction were considered. The assumptions of regression were verified using the residual plots, normality, tests for heteroscedasticity and the variance-inflation factors. Because the data were simulated, the inferential results were used. The primary constraint is external validity. The values cannot be interpreted as estimated prevalence for Assam or for

any tea estate. Equal weighting also treats each index dimension as having equal normative standing. This assumption can be validated through participatory validation. This, and the undertaking of sensitivity analyses, should be incorporated into future fieldwork. An actual study should incorporate ethical review, non-disclosure of employment-sensitive data, and active participation of women workers in setting contextually relevant indicators, and should embrace a multistage approach stratified by districts and estate types.

5. RESULTS AND STATISTICAL ANALYSIS

The generated sample was 35.2 years old on average, with 10.9 years' average tenure in plantation work. Data was dominated by married women (74.3%) with no formal schooling (23.7%) and secondary schooling (and above) (17.3%) (see Table 1). Most of the participants (65.0%) were permanent workers who were more likely to live in plantation settlements. On average, participants had a care burden of 4.7 hours. This implies that paid work was over significant domestic responsibilities (see Table 2).

Table 1: Demographic profile of the simulated analytical sample (n = 300)

Dimension	Category	n	%
Age group	18–24	37	12.3
Age group	25–34	110	36.7
Age group	35–44	104	34.7
Age group	45–55	49	16.3
Marital status	Married	223	74.3
Marital status	Unmarried	46	15.3
Marital status	Widowed/Separated	31	10.3
Education	No formal schooling	71	23.7
Education	Primary	93	31.0
Education	Middle	84	28.0
Education	Secondary or above	52	17.3
Residence	Plantation resident	205	68.3
Residence	Nearby village/non-resident	95	31.7

Source: Author's calculations using the simulated analytical dataset.

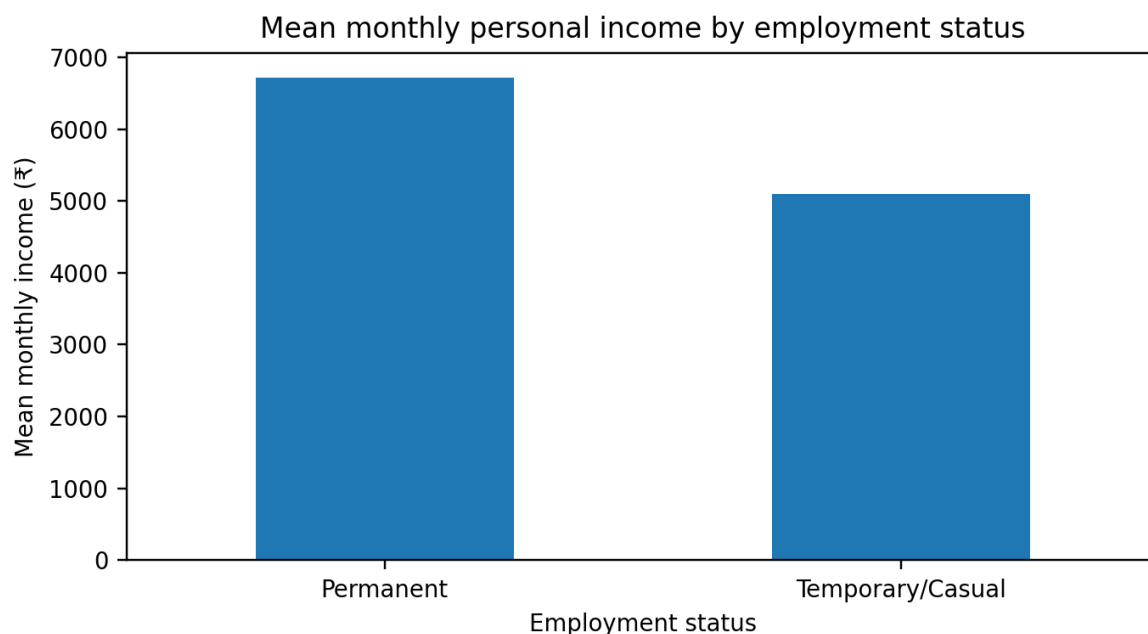
Table 2. Employment and economic indicators (n = 300)

Indicator	Mean/n	SD/%
Permanent workers	195	65.0%
Temporary/casual workers	105	35.0%
Years employed	10.9	6.3
Paid days per month	23.1	3.4
Daily wage (₹)	254	15
Monthly personal income (₹)	6152	1046
Monthly household income (₹)	8835	2142
Unpaid care work (hours/day)	4.7	1.4

Source: Author's calculations using the simulated analytical dataset.

Note: Monetary values are simulated analytical values in Indian rupees and are not official wage estimates. Economic differences by employment status were pronounced. Permanent workers earned an average of ₹6718 per month compared with ₹5100 among temporary/casual workers (Figure 1). Welch's test confirmed a statistically significant difference,

$t=16.95$, $p<0.001$. The gap reflected both higher assumed daily wages and greater continuity of paid days. Although mean household income exceeded personal earnings because of other earners, the simulated distribution left many households vulnerable to illness, work interruption and price shocks. H01 was therefore rejected.



Source: Author's calculations using the simulated analytical dataset.

Figure 2: Mean monthly personal income by employment status

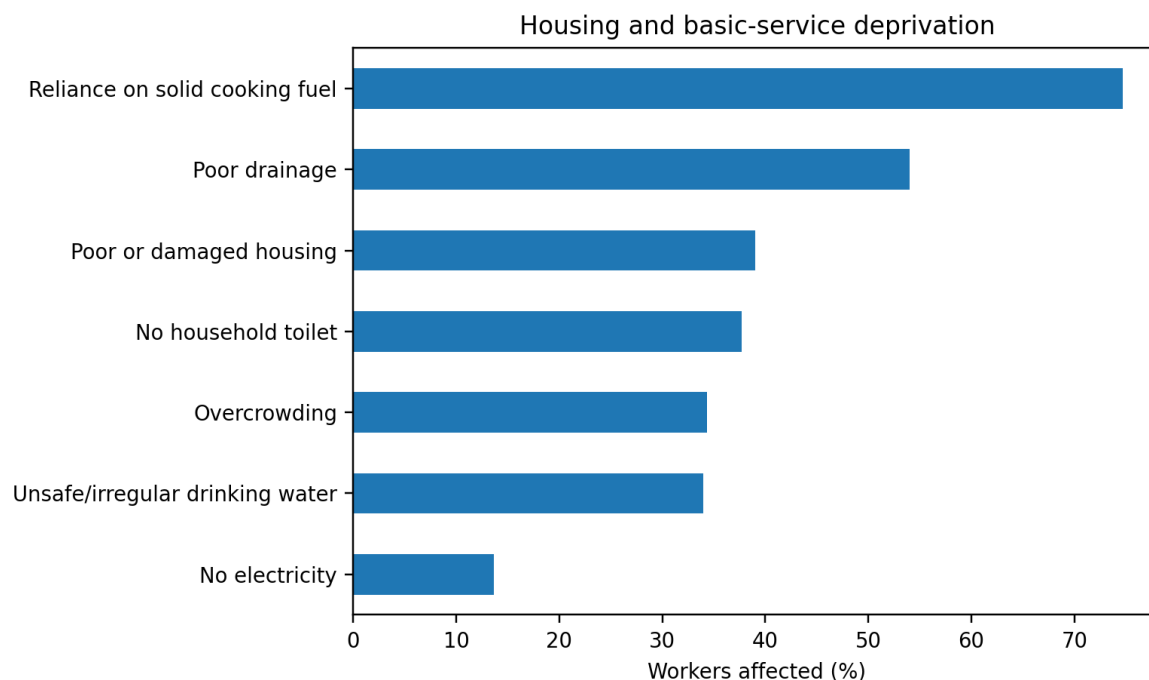
Basic-service deprivation remained substantial across both employment categories (Table 3; Figure 3). Reliance on solid fuel and poor drainage were the most common disadvantages, followed by poor housing, lack of toilets and unsafe or irregular water. Several individual indicators overlapped across categories, showing that permanent status did not guarantee

adequate living conditions. Nevertheless, the composite basic-deprivation measure differed significantly by employment status, $\chi^2=70.54$, $p < 0.001$; H_0 was therefore rejected. The result illustrates how a cumulative index can reveal patterned disadvantage even when selected services are deficient across the workforce.

Table 3. Housing and basic living-condition deprivation by employment status

Indicator	Group	n affected	% affected
Poor or damaged housing	Permanent	76	39.0
Poor or damaged housing	Temporary/Casual	41	39.0
Poor or damaged housing	Total	117	39.0
Unsafe/irregular drinking water	Permanent	68	34.9
Unsafe/irregular drinking water	Temporary/Casual	34	32.4
Unsafe/irregular drinking water	Total	102	34.0
No household toilet	Permanent	79	40.5
No household toilet	Temporary/Casual	34	32.4
No household toilet	Total	113	37.7
No electricity	Permanent	27	13.8
No electricity	Temporary/Casual	14	13.3
No electricity	Total	41	13.7
Reliance on solid cooking fuel	Permanent	150	76.9
Reliance on solid cooking fuel	Temporary/Casual	74	70.5
Reliance on solid cooking fuel	Total	224	74.7
Poor drainage	Permanent	113	57.9
Poor drainage	Temporary/Casual	49	46.7
Poor drainage	Total	162	54.0
Overcrowding	Permanent	65	33.3
Overcrowding	Temporary/Casual	38	36.2
Overcrowding	Total	103	34.3

Source: Author's calculations using the simulated analytical dataset.



Source: Author's calculations using the simulated analytical dataset.

Figure 3: Housing and basic-service deprivation

Health and workplace indicators showed overlapping risks (Tables 4 and 8). Nearly two-thirds of records lacked regular personal protective equipment, more than half lacked a field toilet and about half reported routinely skipping rest breaks. Delayed healthcare was more common among temporary workers because absence was assumed to produce direct wage

loss. Functional crèche access was limited, reinforcing the tension between paid work and childcare. These patterns are consistent with the mechanisms described in qualitative Assam research, although the exact percentages are simulated rather than observed.

Table 4: Health, safety and childcare indicators (n = 300)

Indicator	n	%
Delayed healthcare because of cost/wage loss	133	44.3
No regular PPE	183	61.0
No field toilet	158	52.7
Usually skips rest break	139	46.3
Reports chemical exposure	132	44.0
Occupational injury in previous year	65	21.7
Access to a functional crèche	101	33.7

Source: Author's calculations using the simulated analytical dataset.

Table 8: Workplace conditions and labour-rights awareness (n = 300)

Indicator	n	%
No regular PPE	183	61.0
No field toilet	158	52.7
Skipped rest break	139	46.3
Chemical exposure	132	44.0
Occupational injury	65	21.7
No grievance awareness	141	47.0
Union/committee participation	103	34.3

Source: Author's calculations using the simulated analytical dataset.

Social-security coverage displayed the clearest permanent–temporary segmentation (Table 5; Figure 2). Provident fund, maternity protection and health coverage were substantially

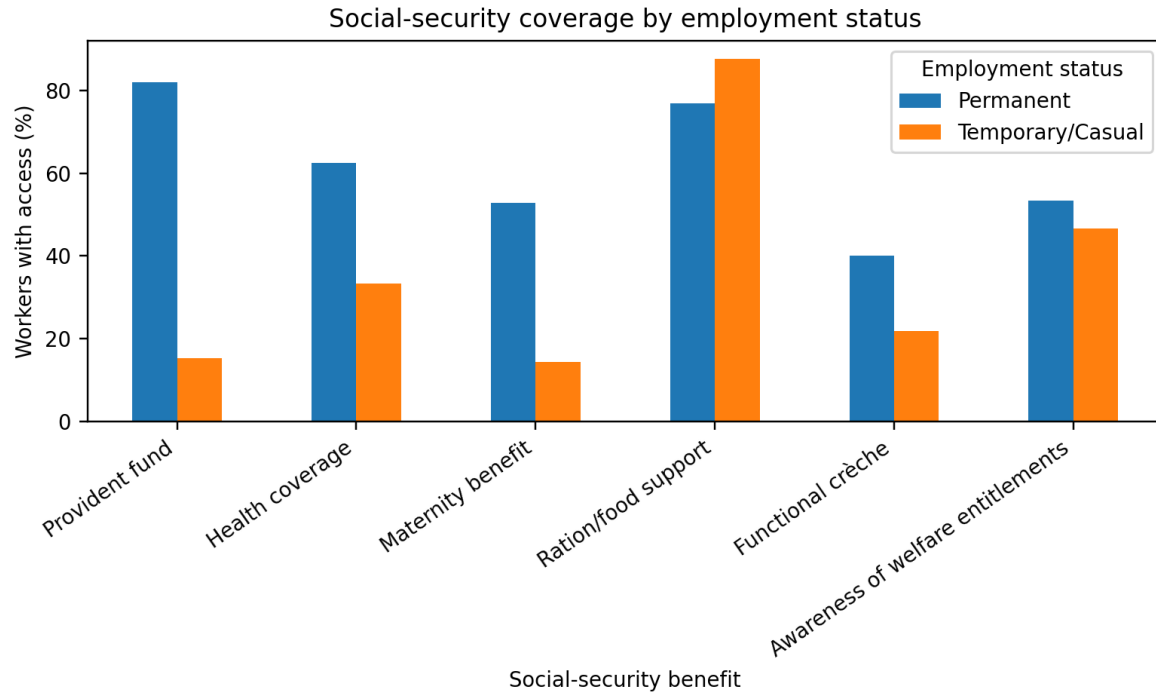
higher among permanent workers. Ration or food support was more widely distributed, but welfare awareness remained incomplete. The social-security score correlated negatively

with vulnerability, $r=-0.496$, $p < 0.001$, leading to rejection of H02. The result demonstrates that cumulative coverage matters more than any single scheme.

Table 5. Social-security coverage by employment status (%)

Benefit/indicator	Permanent	Temporary/casual	Total
Provident fund	82.1	15.2	58.7
Health coverage	62.6	33.3	52.3
Maternity benefit	52.8	14.3	39.3
Ration/food support	76.9	87.6	80.7
Functional crèche	40.0	21.9	33.7
Awareness of welfare entitlements	53.3	46.7	51.0

Source: Author's calculations using the simulated analytical dataset.



Source: Author's calculations using the simulated analytical dataset.

Figure 4. Social-security coverage by employment status

Financial inclusion was broader than substantive financial autonomy (Table 6). 78.0% had a personal bank account, but only 32.7% reported independent savings and 57.7% controlled the use of their earnings. Bank ownership was significantly

associated with empowerment category, $\chi^2=8.64$, $p = 0.013$; H05 was rejected. The gap between account access and control supports the distinction between formal inclusion and effective agency.

Table 6. Financial inclusion and control (n = 300)

Indicator	n	%
Personal bank account	234	78.0
Independent savings	98	32.7
Formal credit access	66	22.0
Controls use of own earnings	173	57.7

Source: Author's calculations using the simulated analytical dataset.

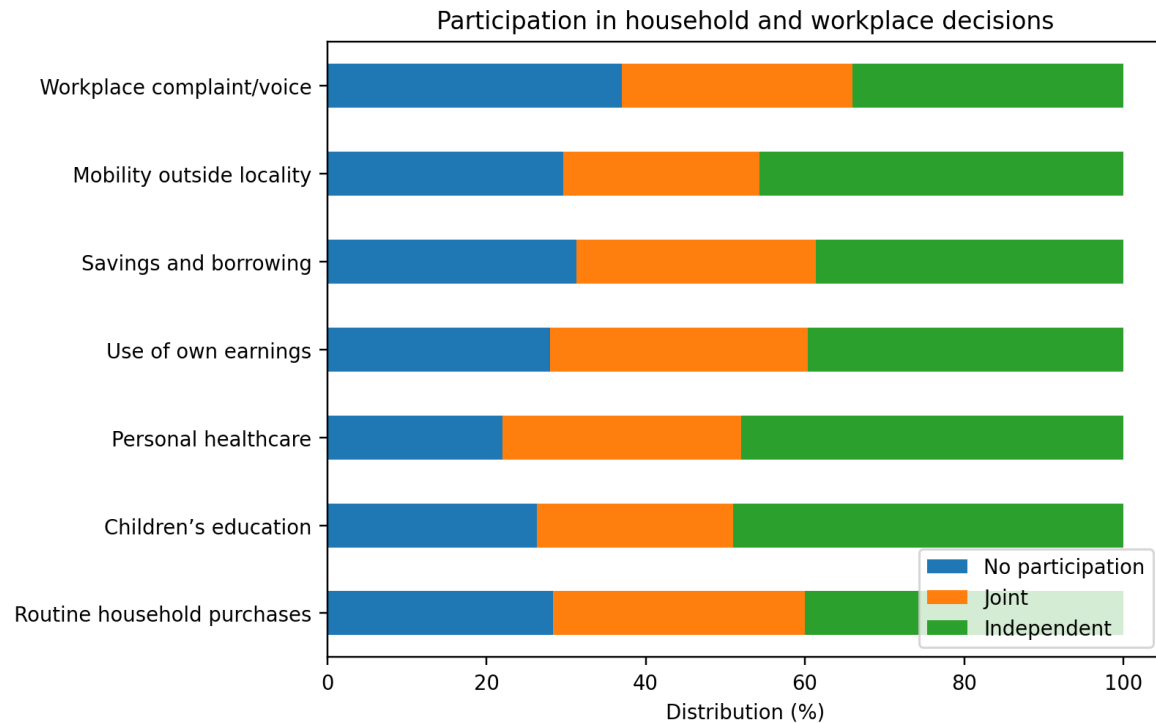
Decision-making varied sharply by domain (Table 7; Figure 4). Joint participation was most common for children's education and personal healthcare, while independent authority was lower for savings, borrowing and workplace complaints. The

empowerment scale showed acceptable internal consistency (Cronbach's $\alpha=0.943$). Education was positively related to empowerment, Spearman $\rho=0.533$, $p < 0.001$, and income was also positively correlated, $r=0.349$, $p < 0.001$. H03 and H04 were rejected.

Table 7. Decision-making participation (percentage distribution)

Decision domain	No participation	Joint	Independent
Routine household purchases	28.3	31.7	40.0
Children's education	26.3	24.7	49.0
Personal healthcare	22.0	30.0	48.0
Use of own earnings	28.0	32.3	39.7
Savings and borrowing	31.3	30.0	38.7
Mobility outside locality	29.7	24.7	45.7
Workplace complaint/voice	37.0	29.0	34.0

Source: Author's calculations using the simulated analytical dataset.



Source: Author's calculations using the simulated analytical dataset.

Figure 5: Participation in household and workplace decisions

The mean vulnerability index was 0.337 ($\alpha=0.919$). 34.3% of workers fell in the high-vulnerability category and 10.3% in the moderate category (Table 9; Figure 5). The mean empowerment index was 0.566; 33.7% were classified as low,

23.0% as moderate and 43.3% as high empowerment (Table 10; Figure 6). Permanent workers had a higher empowerment distribution (Figure 7), and income showed a positive but dispersed relationship with empowerment (Figure 8).

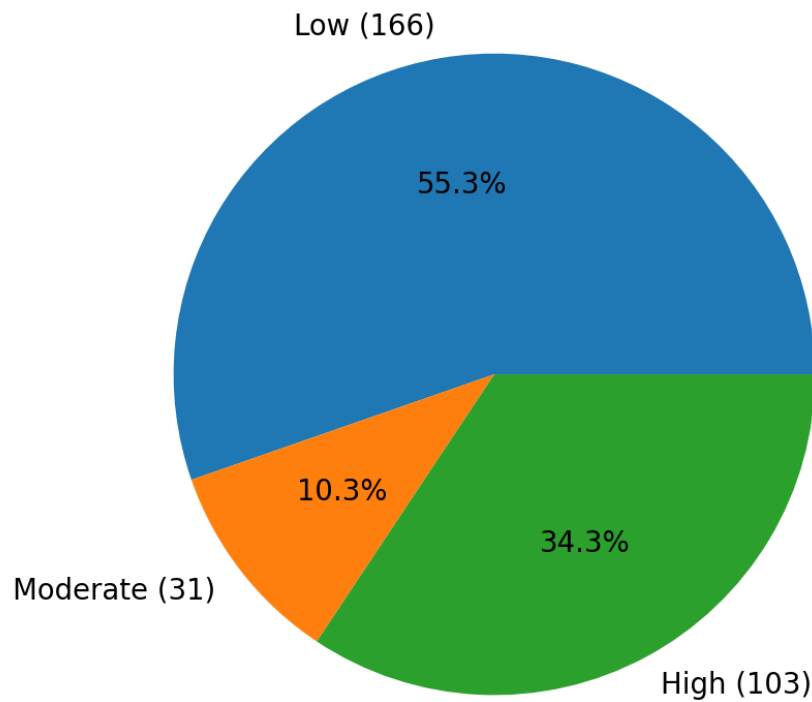
Table 9. Socio-Economic Vulnerability Index distribution

Category	n	%	Mean index
Low	166	55.3	0.030
Moderate	31	10.3	0.341
High	103	34.3	0.829
Overall	300	100.0	0.337

Source: Author's calculations using the simulated analytical dataset.

Note: Cronbach's alpha for the seven-item vulnerability scale = 0.919.

Socio-economic vulnerability categories



Source: Author's calculations using the simulated analytical dataset.

Figure 6: Socio-economic vulnerability categories

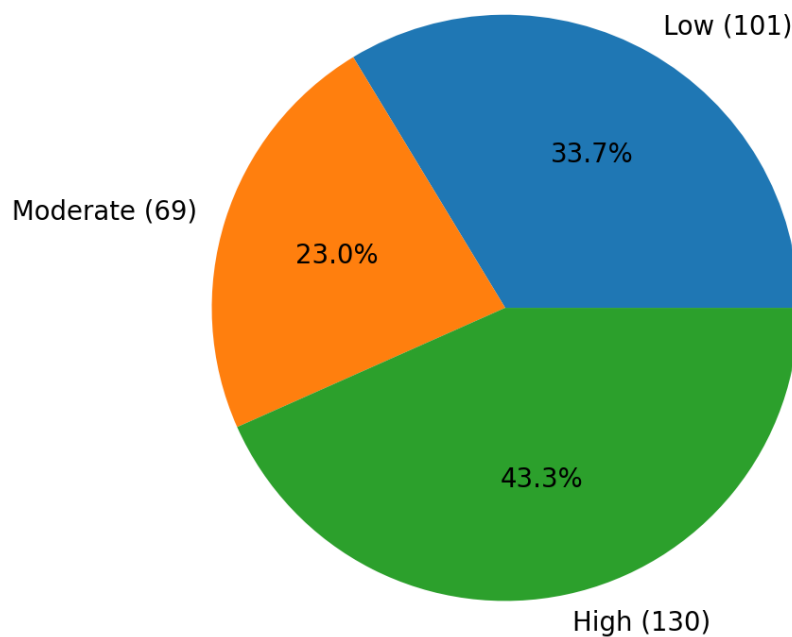
Table 10. Women Workers' Empowerment Index distribution

Category	n	%	Mean index
Low	101	33.7	0.136
Moderate	69	23.0	0.532
High	130	43.3	0.918
Overall	300	100.0	0.566

Source: Author's calculations using the simulated analytical dataset.

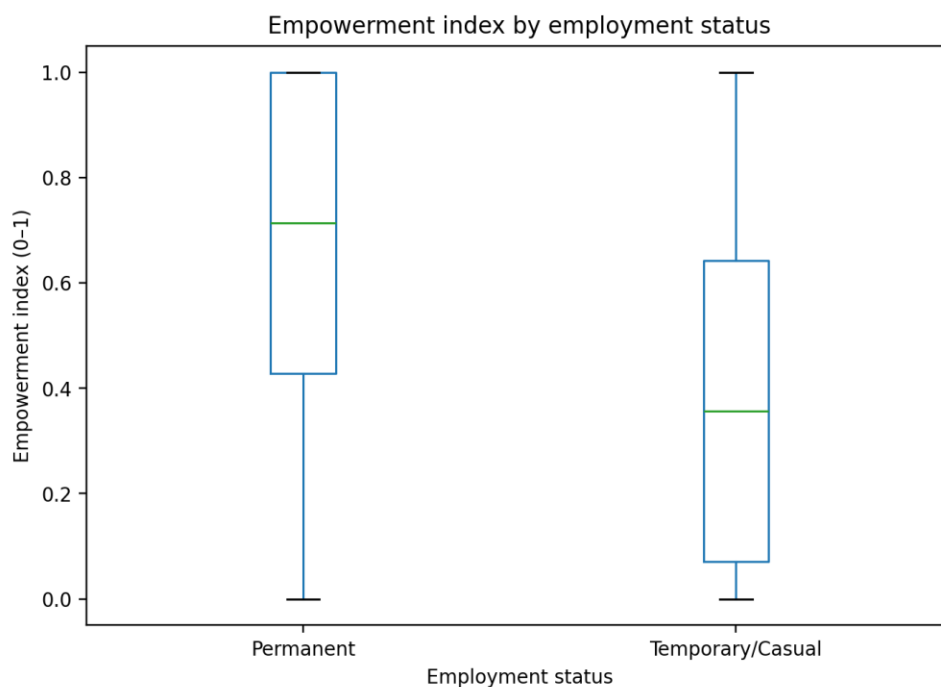
Note: Cronbach's alpha for the seven-domain empowerment scale = 0.943.

Women workers' empowerment categories



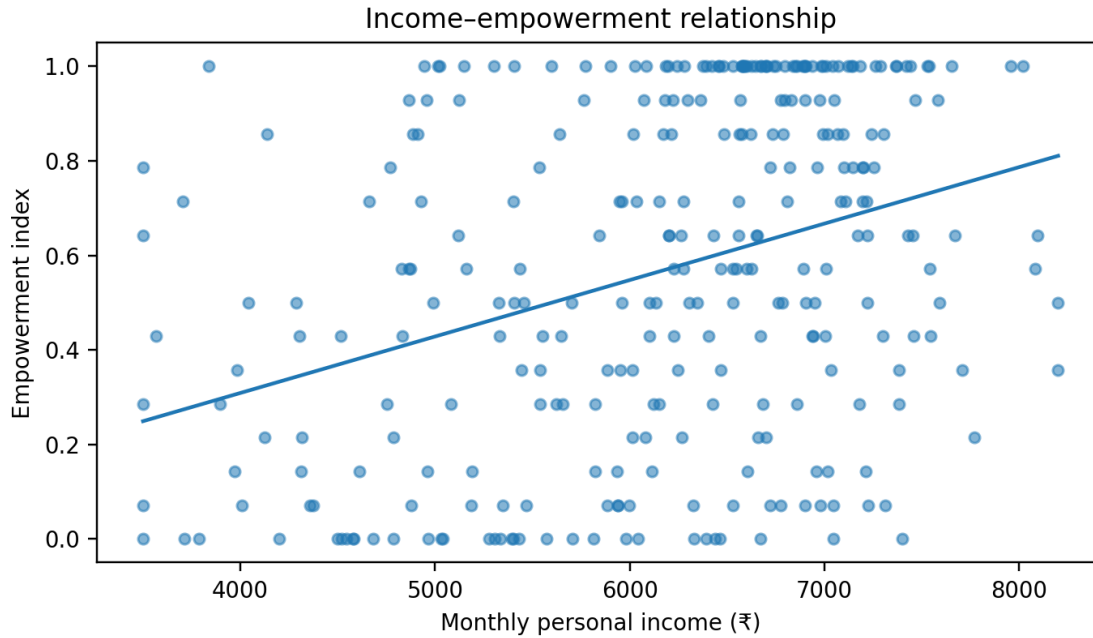
Source: Author's calculations using the simulated analytical dataset

Figure 7. Women workers' empowerment categories



Source: Author's calculations using the simulated analytical dataset.

Figure 8: Empowerment index by employment status



Source: Author's calculations using the simulated analytical dataset.

Figure 9: Income-empowerment relationship.

The multivariable model was statistically significant, $F=36.42$, $p < 0.001$, with $R^2=0.500$ and adjusted $R^2=0.487$ (Table 12). Education, income, social-security score, bank ownership, independent savings and union participation had positive coefficients. Unpaid care hours had a negative coefficient, indicating that time poverty constrained the conversion of paid

employment into autonomy. Permanent status retained an independent positive association after adjustment, though its coefficient was smaller than the combined contribution of social security and financial agency. All VIF values were below 2.57, indicating no serious multicollinearity. H07 was rejected. Table 11 summarises all hypothesis decisions.

Table 11. Hypothesis-test summary

Hypothesis	Relationship	Test	Statistic	p	Decision
H01	Income by employment status	Welch t-test	$t=16.95$	<0.001	Reject
H02	Social security and vulnerability	Pearson correlation	$r=-0.496$	<0.001	Reject
H03	Education and empowerment	Spearman correlation	$\rho=0.533$	<0.001	Reject
H04	Income and empowerment	Pearson correlation	$r=0.349$	<0.001	Reject
H05	Bank account and empowerment category	Chi-square	$\chi^2=8.64$	0.013	Reject
H06	Employment status and basic deprivation	Chi-square	$\chi^2=70.54$	<0.001	Reject
H07	Predictors of empowerment	Multiple OLS	$F=36.42$; $R^2=0.500$	<0.001	Reject

Source: Author's calculations using the simulated analytical dataset.

Note: Decisions use $\alpha = .05$. Results are based on simulated data and illustrate analytical procedures.

Table 12. Multiple OLS regression predicting the empowerment index

Predictor	B	SE	t	p	95% CI	VIF
Constant	-0.208	0.127	-1.64	0.101	-0.458 to 0.041	
Education (years)	0.043	0.004	9.94	<0.001	0.034 to 0.051	1.18
Personal income (₹000/month)	0.069	0.021	3.26	0.001	0.028 to 0.111	2.26
Permanent employment	0.079	0.050	1.58	0.115	-0.019 to 0.177	2.57
Social-security score	0.047	0.014	3.36	<0.001	0.020 to 0.075	1.49
Personal bank account	0.064	0.037	1.74	0.083	-0.008 to 0.136	1.06
Independent savings	0.092	0.033	2.81	0.005	0.028 to 0.157	1.08
Union participation	0.085	0.032	2.63	0.009	0.021 to 0.148	1.06
Unpaid care hours/day	-0.041	0.011	-3.91	<0.001	-0.062 to -0.021	1.01

Source: Author's calculations using the simulated analytical dataset.

Note: $n = 300$; $R^2 = 0.500$; adjusted $R^2 = 0.487$; $F = 36.42$, $p < 0.001$.

6. DISCUSSION

The analysis reveals that female plantation workers' employment should not be automatically perceived as empowering. While plantation employment provides a paid income and a social identity, the positive impacts are dependent on payment permanence and the degree of payment control, as well as the existence of social protection. In the analysis, the distinction between permanent and temporary models reflects a mechanism that was observed in Assam: workers performing similar functions at the plantations may be placed in different systems of entitlements (Rajbangshi et al., 2020). Thus, labor market segmentation is beyond disparities in payment, and extends to disparities in access to housing, provident funds, maternity protection, healthcare, and grievance redress systems. The situation of temporary workers who depend on the permanent status of family members means that rights are derivative; in effect, they are not enforceable.

The findings further reveal that the material situation goes beyond employment status. Permanent workers may be provided housing, but may be positively affected by poor housing conditions, e.g., unsafe, poor quality, and overcrowded housing. A capability approach argues that just housing is not sufficient for the capability to live safely and healthily. Utilizing a multidimensional-poverty and SDG framework, tea plantation communities are poor in many of the same domains: housing, health, education, and financial resources. Poor housing supports poor health, which supports poor income, which supports poor access to the services needed to attain health, which forces women to bear all the added burdens of care work.

Social security acts as an important protective factor as it essentially safeguards against multiple risks. Maternity benefits, provident fund, healthcare, and food supports help reduce different types of risks and exposures. However, the challenges of the policy are not simply adding schemes. Workers demand portable documentation, simplified procedures, help with claim and require recourse when employers or intermediaries evade responsibility. The Code on Social Security, 2020 and the labour-ministry provides the scaffolding for this, but actual inclusion hinges on schemes being operational for all types of employment (India, 2020b; Ministry of Labour and Employment, 2024a, 2025). A plantation worker should not lose important protection because her contract is rendered seasonal, or because she switches employers.

Financial inclusion positively affects empowerment, but bank ownership and independent savings must be differentiated. Accounts that are only used for transfers, are dormant, or are controlled by other household members do not constitute independent savings. Independent savings create a buffer and empower women to negotiate healthcare, education, and mobility. This fits with the evidence that the right of access to streamlined legal and administrative procedures enables agency

(World Bank, 2024a; UN Women & UN DESA, 2024). Therefore, financial literacy programs must address control over budgeting, credit terms and women's rights to transact.

Education has a positive correlation with autonomy. However, the lack of formal education should not be interpreted as an individual deficit. The low educational attainment of women in most low-income countries is the result of historical marginalization, poverty, and an inability to provide support for adolescent women once they entered the labor force. Low-income countries need to integrate efforts for adult literacy and rights education with long-term investments in the children of adult workers. If these efforts are not made, families in low-income countries may make the decision to withdraw their children from school to help provide for the family, thus reproducing a system of occupational segmentation and inequity. Assam's economic and statistical reports provide a data foundation for determining the targets and required infrastructure, but monitoring at the estate level is required for identifying gaps in services (Directorate of Economics and Statistics, Assam, 2024a, 2024b).

The negative relationship between unpaid care work and women's paid work reveals an important gendered aspect. Women's paid work is only a portion of their work. Women are responsible for a majority of the work (cooking, cleaning, and collecting water and fuel) and for the care of dependents. The unequal distribution of unpaid work in India limits women's paid work and their participation in social and economic activities, including trade union activities (MoSPI, 2020; ILO, 2022b). The ability to work and participate in activities that improve one's position is contingent on the elimination of the unequal distribution of resources. The elimination of the unequal distribution of resources is an important complement of a welfare service.

Participating in a union is not enough by itself to be heard when the bargaining process is dominated by male leadership. Women need to serve on the committees that decide the pay, work goals, safety and welfare concerns, as well as the deterrent measures against retaliation. The qualitative studies from Assam show that women are all too often hesitant to challenge pay deductions and management decisions (Rajbangshi et al., 2020). Meaningful empowerment includes access to information in the local language, clear pay slips, the ability to make complaints confidentially, the election of women to positions of authority, and the provision of paid time to participate in committees.

Since the respondent data is of a simulated nature, the resulting numbers should be regarded as an illustrative empirical model. Their chief benefit is in showing how a future research study is able to test the workings of intersecting mechanisms without creating fictional information and passing it off as the truth. It is expected that the fieldwork will show different prevalence and coefficient rates. However, recent official and peer-reviewed work strongly suggests that in order to expand the capabilities of women workers in the plantations, the services, social protections, stable income, financial systems and a

means of expressing collective opinion must be integrated to avoid perpetuating a state of dependency.

7. Policy Suggestions

The Assam government should build an open plantation labor tool that tracks safe and enriching employment along with a plantation labor workforce that provides the following services: water, crèches, health care, and social security. It should include data on wages, days worked, and wage arrears, along with housing repairs and an assessment of safety in the workplace quantified by sex and employment status. Inspections should include a review of documents and confidential interviews with laborers, and be followed by time-bound corrective measures. The departments of state labor, health, public health engineering, women and child development, education, and social welfare should cooperate to create estate-level action plans instead of addressing each deficiency in isolation.

The Central Government and Tea Board India should extend social protection to all workers, including permanent, temporary, casual, and migrant workers. Each worker should receive a personal entitlement statement that clearly defines their employer's obligations to them and public welfare schemes. Social-security registration should be followed by assistance to file a claim and an automated grievance redressal system. Wage policy should distinguish between cash and in-kind pay, prohibit non-transparent quota deductions, and determine wage levels according to household consumption requirements and inflation while adhering to decent-work and wage policy standards (ILO, 2022a, 2024a).

Inequitable Plantation Management Systems require the provision of safe drinking water, safe housing, safe and functional household and field latrines, adequate drainage, personal protective equipment (PPE), and the lifting of weather restrictions and the provision of paid breaks, first aid, and transport referral. Functioning crèches with trained staff, protective housing, and adequate nutrition and water meet the age and care requirements of children. Maternity protection and healthcare should be continuous and not jeopardized by discrimination.

Beyond account opening initiatives, civil society, and financial institutions should provide women with savings and credit services, insurance, digital security training, and self-help group support. Women should retain their entitlements while pursuing diversified income-generating activities through skill development programs. Trade unions and worker committees should create opportunities for women to assume leadership roles, and safe, secret channels for filing complaints on wages, workplace safety, and harassment should be established. Meeting outcomes should be made public. Education interventions should include adult literacy, awareness of labour rights, scholarships, transportation, and support to retain adolescents. Programs should also incorporate tools for monitoring beyond enrollment, such as pathways to secondary school. All of these should be created alongside seasonal and permanent women workers. When creating these programs,

there should be plans to separate sessions in order to avoid better protected groups, or male workers, from creating a voice for the vulnerable women workers.

8. CONCLUSIONS

The tea garden women workers of Assam are positioned where they are productively central and institutionally marginal. The 2020-2025 evidence suggests low and insecure incomes, poor services, and health concerns as well as gendered unpaid work and a restricted voice are all related. Vulnerability and empowerment, used in a simulation, suggest a better way of thinking toward the effects of the intersection: vulnerability rises where income, work, services, protection, and education are lacking. Conversely, empowerment increases where education and income are improved, along with social security, savings, and collective work.

The distinction of permanent and temporary employment is significant, but should not obscure the similarities across the sections. Permanent employment may improve income and formal benefits, but does not ensure safe housing, sanitation, care services, or empowerment in decision-making. Conversely, paid work may exist without control over the income. Policies should measure the extent of real capabilities and benefits received.

The goal is a social contract that integrates assertable rights with honest, adequate wages, portable protections, safe living, working, and caring conditions, and accessible health care, along with childcare, women's finance and voice. Future research should gather representative estate-level data, engage women workers in indicator design, and examine the index weights' sensitivity. In the meantime, simulated results should be clearly marked and can provide design direction, but cannot replace the documented experiences of workers.\

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Appendix A. Coding and Index Construction

The vulnerability index uses seven binary indicators scored 1 when the worker is classified as disadvantaged and 0 otherwise: income vulnerability; irregular work; basic-service deprivation; health and workplace risk; social-protection exclusion; educational disadvantage; and financial exclusion. Each binary domain was generated from a shared disadvantage propensity calibrated by the corresponding observed variables, thereby producing a coherent illustrative scale without claiming observed prevalence. The index is the arithmetic mean of these items. The empowerment index uses seven ordinal items scored 0 (no participation), 1 (joint participation) and 2 (independent participation). The sum is divided by 14. Equal weighting is transparent and replicable but should be tested against alternative weights in primary research.

Appendix B. Reproducibility Summary

The simulation used a fixed random seed (20260726). Employment status was generated at a 60:40 permanent–temporary ratio. Social-security probabilities were higher for permanent workers; empowerment was generated as a function of education, income, employment status, social-security score, bank access, independent savings, union participation and unpaid care, with random variation. All descriptive and inferential outputs in the paper were calculated from the same 300 records, ensuring consistent denominators and hypothesis decisions.

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